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Revision of the Nearctic species of the caddisfly genus *Wormaldia* McLachlan (Trichoptera: Philopotamidae)

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Table of contents

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Abstract

The genus *Wormaldia* McLachlan 1865 (Trichoptera: Philopotamidae: Philopotaminae) is one of eight Philopotamidae genera found in the New World. In the Nearctic Region five genera are reported: *Chimarra, Dolophilodes, Fumonta, Sisko,* and *Wormaldia*. This last genus is diverse and widely distributed from Canada to South America; for the Nearctic Region the following species are reported: *W. anilla* (Ross, 1941), Canada, USA; *W. arizonensis* (Ling, 1938), Mexico, USA; *W. gabriella* (Banks, 1930), Canada, USA; *W. gesugta* Schmid, 1968, USA; *W. hamata* Denning, 1951, USA; *W. lacerna* Denning, 1958, USA; *W. laona* Denning, 1989, USA; *W. moesta* (Banks, 1914), Canada, USA; *W. mohri* (Ross, 1948), USA; *W. occidea* (Ross, 1938), Canada, USA; *W. oconee* Morse, 1989, USA; *W. pachita* Denning, 1956, USA; *W. planae* Ross and King, 1956, USA, *W. shawnee* (Ross, 1938), USA; *W. strota* (Ross, 1938), USA; and *W. thyria* Denning, 1950, USA. Diagnoses, redescriptions, and illustrations of the forewing, the hind wing, and the male genitalia of the 16 species are provided. New state distribution records are given for *W. anilla, W. gabriella, W. occidea, W. planae,* and *W. shawnee*. Two undescribed Nearctic species are diagnosed, described, and illustrated: *Wormaldia birneyi*, new species, from USA (California) and *W. clauseni*, new species, from Canada (British Columbia). A key for identification of males of these 18 species of *Wormaldia* is provided, as well as maps of their Nearctic distributions.

Key words: aquatic insects, new species, descriptions, identification key, distribution

Resumen

El género *Wormaldia* McLachlan 1865 (Trichoptera: Philopotamidae: Philopotaminae) es uno de los ocho géneros conocidos de la familia Philopotamidae en el Nuevo Mundo. En la región Neártica están presentes cinco géneros de esta familia de tricópteros: *Chimarra, Dolophilodes, Fumonta, Sisko* y *Wormaldia.* El género *Wormaldia* es diverso y ampliamente distribuido desde Canadá hasta América del Sur, para la región Neártica son conocidas las siguientes especies: *W. anilla* (Ross, 1941), Canadá, EUA; *W. arizonensis* (Ling, 1938), México, EUA; *W. gabriella* (Banks, 1930), Canadá, EUA; *W. gesugta* Schmid, 1968, EUA; *W. hamata* Denning, 1951, EUA; *W. lacerna* Denning, 1958, EUA; *W. laona* Denning, 1989, EUA; *W. moesta* (Banks, 1914), Canadá, EUA; *W. mohri* (Ross, 1948), EUA; *W. occidea* (Ross, 1938), Canadá, EUA; *W. oconee* Morse, 1989, EUA; *W. pachita* Denning, 1956, EUA; *W. planae* Ross y King, 1956, EUA; *W. shawnee* (Ross, 1938), EUA; *W. strota* (Ross, 1938), EUA; y *W. thyria* Denning, 1950, EUA. Se proveen diagnosis, redescripciones e ilustraciones de alas anterior y posterior, y de estructuras del aparato genital de los machos de las 16 especies conocidas especies de *Wormaldia.* Además, nuevos registros de distribución estatal en la región Neártica son dados para las siguientes especies: *W. anilla, W. gabriella, W. occidea, W. planae* y *W. shawnee*. Dos especies no descritas de la región Neártica son diagnosticadas, descritas e ilustradas: *Wormaldia birneyi* presente en EUA (California) y *W. clauseni* en Canadá (British Columbia). Una clave para la identificación de los machos de las especies es sumnistrada, así como también mapas que ilustran la distribución conocida de las 18 especies conocidas de *Wormaldia* en la región Néartica.

Palabras clave: insectos acuáticos, especies nuevas, descripciones, clave de identificación, distribución

Introduction

At present, the caddisfly family Philopotamidae contains five genera in the Nearctic Region, *Chimarra* Stephens, 1829, *Dolophilodes* Ulmer, 1909, *Fumonta* Ross, 1956, *Sisko* Ross, 1956, and *Wormaldia* McLachlan, 1865 (Blahnik 2005). After *Chimarra*, *Wormaldia* is the second largest genus in the family for the New World and Nearctic region. In 1949, Ross published a taxonomic study of the known Nearctic species of the genus *Wormaldia*. In this work, he described a new species of *Wormaldia*, and also established various species groups. In the same work, Ross considered *Dolophilus* McLachlan, 1868 a synonym of *Wormaldia*. Later, Ross (1956) provided an exhaustive taxonomic review of the World fauna, where he also considered phylogenetic relationships and biogeographic aspects of *Wormaldia* and the family Philopotamidae.

Numerous recent authors, including Flint (1991, 1995), Malicky (1993a, b, 1994, 1995), Malicky and Chantaramongkol (1993a, b, 1996), Mey (1993, 1996), Morse (2008), Morse *et al.* (1989), Neboiss (1999), Schmid (1968, 1989, 1991, 1998), and others (see Morse 2008) considered *Wormaldia* and *Doloclanes* Banks

1937 as two distinct philopotamid genera when they described new species of these genera from different biogeographic regions. Subsequently, Armitage (1996), in his diagnostic atlas of North American species of the family Philopotamidae, considered *Doloclanes* and *Wormaldia* (*sensu stricto*) as subgenera of *Wormaldia* (*sensu lato*) following Ross (1956). In his treatment, Neboiss (1999) treated *Doloclanes* and *Wormaldia* as distinct genera when he described two Indonesian new species of *Doloclanes*. He also transferred to *Wormaldia* four species listed and placed previously in *Doloclanes* in the Trichoptera World Checklist (Morse 2008).

Until 2002, the genus *Doloclanes* contained 36 extant species, all known from the East Palearctic and Oriental Regions, except for a single eastern North American species, *Doloclanes mohri* Ross 1948 (Morse 2008). In their recent study, Sun and Malicky (2002) described 22 new Philopotamidae species from China, 6 of them in the genus *Wormaldia*. In that publication, they considered *Doloclanes* a synonym of the genus *Wormaldia* based on observed variation in the wing venation characters used by Ross (1956) to separate the two genera.

In this work, we recognize the synonymy proposed by Sun and Malicky (2002) in which all the species of *Doloclanes* are placed in the genus *Wormaldia*. We follow and incorporate the species group arrangement within *Wormaldia* as presented by Ross (1956) and partially modified by Armitage (1996) (Table 1). The taxonomic classification presented by Ross (1956) and Armitage (1996) will require a phylogenetic analysis of the genus *Wormaldia* worldwide to determine if these species groups are monophyletic, as well as the subgeneric or generic status of *Doloclanes*. Those cladistic analyses are outside of the scope of the present taxonomic paper. At present, the genus *Wormaldia* contains 146 species in the World and 16 species for the Nearctic region (Morse 2008). The species of *Wormaldia* are found in all faunistic regions except the Australasian.

The present paper provides descriptions, diagnoses and illustrations of two undescribed species of *Wormaldia*, as well as redescriptions, diagnoses, and illustrations of the 16 known species of *Wormaldia* from the Nearctic region. New state distribution records for *W. anilla, W. gabriella, W. occidea, W. planae,* and *W. shawnee* are provided. An identification key for males of all the Nearctic species of *Wormaldia* is included. The identification key and species diagnoses are based on male genitalia. A Spanish version of this paper is provided at the University of Minnesota Insect Collection website (http://www.entomology.umn.edu/museum/projects/index.html).

Taxonomic review

McLachlan established the genus *Wormaldia* in 1865. Its oldest named Nearctic species, *W. breviatus* and *W. moesta*, were described by Banks (1914) as *Dolophilus breviatus* and *Paragapetus moestus*, respectively. Banks (1930) described *W. gabriella* (as *Dolophiliella gabriella*) from California. Betten (1934) mentioned *D. breviatus* and *P. moestus*, but treated the latter species as *Dolophilus moestus*. Milne (1934–1936) also listed the species as *D. moestus* and considered *D. breviatus* a synonym of *D. moestus*.

Later, Banks (1937) erected the genus *Doloclanes* for two species from the Philippines, and designated *Doloclanes montana* the type species. In 1938, Ross described *Dolophilus occidea*, *Dolophilus shawnee*, and *Dolophilus strota* (Ross 1938a, b), and in the same year, Ling described *Dolophilus arizonensis* and *Dolophilus cruzensis*, all from the Nearctic region. Ross (1941a) described *W. anilla* (as *Dolophilus anillus*) from British Columbia, Canada, and Tsuda (1942) established the genus *Nanagapetus* and designated the species *N. kisoensis*, from Japan, as the type species.

In 1944, Ross synonymized the genera *Paragapetus* Banks, 1914, and *Dolophiliella* Banks, 1930, under the genus *Dolophilus* McLachlan, 1868. He also listed the nine Nearctic species of *Dolophilus*. Included within these nine species was the Nearctic species described previously by Banks (1914) and named originally as *Dolophilus major*. In 1948, Ross erected the genus *Gatlinia* and designated the new species *G. mohri* from North Carolina, USA, as the type species.

In 1949, Ross concluded that the genus *Dolophilus* McLachlan, 1868, was a synonym of *Wormaldia*. Therefore, all species listed by Ross in 1944 under *Dolophilus* were transferred to *Wormaldia*. At the same time, he designated *Hydropsyche occipitalis* Pictet, 1834, as the type species of the genus *Wormaldia*, and also described a new Nearctic species, *W. sisko* [currently in the genus *Sisko* (Blahnik 2005)]. Ross (1949) also established three species groups to accommodate the ten Nearctic species recognized within the genus *Wormaldia*. These species groups were: the *Wormaldia major* Group, which included one species, *W. major* (Banks, 1914) [originally *Dolophilus major* and currently in the genus *Fumonta* (Blahnik 2005)]; the *Wormaldia arizonensis* Group, with only *W. arizonensis*; and the *Wormaldia moesta* Group, which was segregated into three subgroups containing the following species: (1) *W. anilla* and *W. cruzensis*; (2) *W. gabriella* and *W. moesta*; and (3) *W. occidea*, *W. shawnee*, *W. sisko*, and *W. strota*. Subsequently, two Nearctic species *W. thyria* and *W. hamata* were described by Denning (1950, 1951, respectively). Denning placed both species in the *W. moesta* Group of Ross (1949).

Kimmins (1955a, b) described two new species of *Doloclanes* from southeastern Asia. Kimmins (1955b) also pointed out his disagreement with Ross's placing (1949) of *Dolophilus major* Banks (1914) within *Wormaldia* and suggested placing *Dolophilus major* within *Dolophilodes* Ulmer (1909).

In his complete review of the World fauna of the genus *Wormaldia*, Ross (1956) established *Doloclanes* Banks (1937) and *Wormaldia* McLachlan (1865), as subgenera within the genus *Wormaldia* (*sensu lato*). At the same time, Ross synonymized *Nanagapetus* Tsuda (1942) and *Gatlinia* Ross (1948) with the subgenus *Doloclanes*. He also placed *W. major* (Banks) (as *Dolophilus major*), within the new subgenus *Fumonta* and *W. sisko* Ross within the new subgenus *Sisko*, both species in the genus *Sortosa* Navás (1918), which was subsequently recognized as a junior synonym of the genus *Dolophilodes* Ulmer (1909), and recognized as a subgenus of *Dolophilodes* by Flint *et al.* (1999). Blahnik (2005) elevated the New World taxa *Fumonta*, *Sisko*, and *Sortosa* to generic status, and described a new Neotropical genus, *Alterosa*.

Additionally, in Ross's (1956) study, the taxonomic arrangement of his earlier (1949) work was reconsidered and the Nearctic *Wormaldia* species were rearranged into three species groups: *W. anilla* Group, *W. arizonensis* Group, and *W. moesta* Group. Ross recognized two species complexes within the *W. anilla* Group: the *W. strota-shawnee* Complex and *W. thyria-hamata* Complex. Ross (1956) described 11 new species (4 *Doloclanes* and 7 *Wormaldia*) and recognized 42 extant species, three subspecies, and three fossil species for the World fauna of *Doloclanes* and *Wormaldia*. He placed 39 of these species (three species were unplaced) in 10 species groups (one for *Doloclanes* and nine for *Wormaldia*), to accommodate 36 species of *Wormaldia* and nine species of *Doloclanes*. Of the 45 described species, 18 species were from the New World and among these, 11 occured in the Nearctic region. The 11 Nearctic species were placed in four species groups (ten species in the subgenus *Wormaldia* and one species in the subgenus *Doloclanes*).

Since Ross's 1956 work, 26 new species have been described in *Doloclanes*, all from Asia (Malicky 1993a, b, 1994, 1995; Malicky & Chantaramongkol 1993a, b, 1996; Mey 1993, 1996; Neboiss 1999; Schmid 1991). In *Wormaldia*, five additional species from the Nearctic Region have been described and one species has been synonymized. Denning described *W. pachita*, *W. lacerna*, and *W. laona* (1956a, 1958, and 1989, respectively). He placed *W. pachita* in the former *W. moesta* Group of Ross (1949), *W. lacerna* in the more recent *W. moesta* Group of Ross (1956), and *W. laona* in the *W. anilla* Group of Ross (1956). In 1958, Denning determined that *W. cruzensis* (Ling 1938) was a synonym of *W. occidea* (Ross 1938a). In 1968, *W. gesugta* was described by Schmid. Finally, *W. oconee* was described and placed in the *W. anilla* Group of Ross (1956) by Morse (in Morse *et al.* 1989).

Armitage (1996) in his diagnostic atlas of North American species of the family Philopotamidae followed Ross's (1956) convention and recognized *Doloclanes* and *Wormaldia* as subgenera. However, he considered four species groups instead of Ross's three for the Nearctic species of the subgenus *Wormaldia*: *W. anilla* Group, *W. arizonensis* Group, *W. moesta* Group, and *W. thyria* Group (Table 1).

TABLE 1. List of the species groups [as defined by Ross (1956) & Armitage (1996)] and known species in the genus *Wormaldia* recorded or the Nearctic Region by state or province. (* = new distribution record)

Species & Species Groups	Characters & Distribution	References
***anilla* species Group**	**Sterna VII & VIII** with or without projection or process posteromesally **Tergum X** triangular, rounded apically; **Superior appendage** digitate	Armitage 1996; Ross 1949, 1956
W. anilla (Ross), 1941	**CAN**: BC; **USA**: CA, ID*, OR, WA	Armitage 1996; Ross 1941a, 1949, 1956; Schmid 1982
W. birneyi, **new species**	**USA**: CA	
W. clauseni, **new species**	**CAN**: BC	
W. occidea (Ross), 1938	**CAN**: BC; **USA**: AK*, CA, MT, OR, WA	Armitage 1996; Ross 1938a, 1949, 1956; Schmid 1982
W. pachita Denning, 1956	**USA**: CA	Armitage 1996; Denning 1956a
W. shawnee (Ross), 1938	**USA**: AL, CT*, IL, KY, MO, NC, NH, OH, PA, SC, TN, VA, WV*	Armitage 1996; Moulton & Stewart 1996; Ross 1938a, 1949, 1956; Wiggins et al. 2001
W. strota (Ross), 1938	**USA**: AR, MO, OK	Armitage 1996; Moulton & Stewart 1996; Ross 1938b, 1949, 1956
***arizonensis* species Group**	**Tergum X** lengthened, widening medially	Armitage 1996; Ross 1949, 1956
W. arizonensis (Ling), 1938	**MEX**: DU; USA: AZ, TX*, UT	Armitage 1996; Ling 1938; Ross 1949, 1956
W. planae Ross & King, 1956	**USA**: AZ. * new Nearctic distribution record	Ross 1956
***moesta* species Group**	**Sternum VII** with digitate posteromesal process **Sternum VIII** sometimes with posteromesal process	Armitage 1996; Ross 1949, 1956; Schmid 1991
W. gabriella (Banks), 1930	**CAN**: AB, BC, MB*, NT, PQ, YT; **USA**: CA, CO, ID, MT, NV, OR, SD*, UT, WA, WY*	Armitage 1996; Banks 1930; Nimmo 1974;
W. lacerna Denning, 1958	**USA**: WA	Armitage 1996; Denning 1958
W. moesta (Banks), 1914	**CAN**: MB, NB, NF, NS, ON, PQ; **USA**: AL, AR, CT,DE, FL, GA, IL, IN, KY, MA, MD, ME, MN, MO, MS, NC, NH, NJ, NY, OH, OK, PA, SC, TN, VA, VT, WV	Armitage 1996; Banks 1914; Moulton & Stewart 1996; Ross 1949, 1956; Schmid 1982, 1991
***thyria* species Group**	**Tergum VIII** strongly projected posteriorly, hood-shaped	Armitage 1996; Ross 1956
W. gesugta Schmid, 1968	**USA**: CA	Armitage 1996; Schmid 1968
W. hamata Denning, 1951	**USA**: CA	Armitage 1996; Denning 1951; Ross 1956
W. laona Denning, 1989	**USA**: CA	Armitage 1996; Denning 1989
W. mohri (Ross), 1948	**USA**: NC, SC, TN, VA	Armitage 1996; Ross 1948, 1956
W. oconee Morse, 1989	**USA**: SC	Armitage 1996; Morse et al. 1989
W. thyria Denning, 1950	**USA**: AL, NC, SC, TN, VA	Armitage 1996; Denning 1950; Ross 1956

Material and methods

Collecting and preserving specimens

Methods used for collecting, preserving, and curating specimens of *Wormaldia* examined in this work were those commonly used for entomological studies on Trichoptera and other aquatic insect groups (Blahnik 1998; Blahnik & Holzenthal 2004; Martin 1977; Merritt *et al.* 2008b; Ross 1941b; Schauff 2001). For collecting *Wormaldia* adults, specimens were attracted using white, ultraviolet, and mercury vapor lights placed in front of a white bed sheet erected adjacent to water courses. Individuals landing on the sheet were collected in potassium cyanide (KCN) kill jars and subsequently pinned. An alternative collecting method used was alcohol traps with white or ultraviolet light.

Preparing and storing genitalia

For genitalia preparation, the male abdomen was cut from the body, as close to the basal region of the abdomen as possible. The separated abdomen containing the terminal genitalia was cleared using a solution of 10–12% potassium hydroxide (KOH) at room temperature. After 6–12 hours of clearing, the internal contents of the abdomen were flushed using a small tuberculine syringe (1 cc) with distilled water; this also removed residual KOH. The cleared and cleaned abdomen with genital structures was transferred to a watch glass containing 10–15 ml of a solution of 10% acid alcohol [= 1 part glacial acetic acid in 9 parts of 80% ethyl alcohol (EtOH)] for about one minute to neutralize any remaining KOH. Later, it was transferred to a microvial with 80% ethyl alcohol for permanent storage with the remainder of the specimen in a vial of alcohol. For examination of pinned specimens, the same procedure was used, except the cleaned genitalia were placed in a microvial with glycerin and pinned beneath the remainder of the dry specimen.

Because of the membranous nature of segment X (X in figures) in *Wormaldia* species, and because segment X sometimes becomes very transparent in the clearing process and difficult to distinguish in shape, it is recommended to stain the male genitalia. Male genitalia were placed in a Chlorazole black E (from Sigma Chemical Company) and glycerin solution for several hours.

Morphological considerations

In general, terminology used for structures of the male genitalia of *Wormaldia* species follows that presented by Armitage (1996), Kimmins (1955a, b), Nielsen (1957), Morse *et al.* (1989), Neboiss (1999), and Schmid (1968, 1982, 1998); however, some previous authors used different names for the same structures. Because of this varied terminology and to help users unfamiliar with Trichoptera morphological terminology, listed below are the names used in this study (**in bold**) for structures of the male genitalia, together with other names used:

Superior appendages: cerci (singular = cercus) (Ross 1956); preanal appendages (Armitage 1996; Schmid 1998), "*appendices préanaux*" (Schmid 1968, 1982, 1991); "*cerco*, plural = *cercos*" (Bueno-Soria & Holzenthal 1986).

Inferior appendages: claspers (Armitage 1996, Ross 1956); "*appendices inférieurs*" (Schmid 1968, 1982, 1991); "*apéndice inferior*" (Bueno-Soria & Holzenthal 1986).

Basal segment of the inferior appendage: coxopodite (Nielsen 1957); basal article (Armitage 1996); "*premier article*" (Schmid 1968, 1982, 1991); "*segmento basal*" (Bueno-Soria & Holzenthal 1986).

Apical segment of the inferior appendage: harpago (Nielsen 1957); apical article (Armitage 1996); "*second article*" (Schmid 1968, 1982, 1991); "*segmento apical*" (Bueno-Soria & Holzenthal 1986).

Phallus: aedeagus (Ross 1956); "*appareil phallique*" (Schmid 1968, 1982, 1991); "*edeago*" (Bueno-Soria & Holzenthal 1986).

Illustrations of the hypothetical genitalia of a male *Wormaldia* are presented in Figs. 1–5. Other general and morphological features follow the terminology of Neboiss (1991) and the Torre-Bueno Glossary of Ento-

mology (Nichols *et al.* 1989). The posterior margins of sterna (S) VII, VIII, and IX often bear conspicuous and elongate *processes*, usually convexly subtriangular (Fig. 124), triangular (Fig. 110), or digitate (Figs. 36, 78), or these processes are much shorter and usually convex (Figs. 8, 29). Morphological variation on the posterior margin of tergum VIII (T VIII) occurs in specimens of *W. anilla, W. lacerna, W. moesta, W. occidea,* and *W. planae.* Some specimens also contained morphological variation of the posterior margin of sterna VII and VIII (S VII, S VIII). This observed morphological variation apparently occurs naturally, but can sometimes originate by distortions of the cuticle during the clearing and cleaning processes of the genitalia. For these reasons, especially for someone unfamiliar with Trichoptera identification, it is necessary to use a combination of several diagnostic morphological characters and to read carefully the diagnoses, descriptions, illustrations, and maps for accurate identification of *Wormaldia* species. The fore- and hind wings of 15 species were illustrated and their major longitudinal veins, apical forks, crossveins and cells were labeled (Figs. 12–13). Wing venation terminology follows the Comstock-Needham system as applied to Trichoptera (Holzenthal *et al.* 2007).

Illustrations and maps

Illustrations of the male genitalia were made using an Olympus BH-2 compound microscope equipped with a camera lucida. Male genitalia were examined and illustrated at 400X. For each species, left lateral, dorsal, and ventral views of the male genitalia were illustrated. A dorsal view of the apical segment of the inferior appendage and the phallic sclerites is provided for most species. Sternum VII was illustrated only when its posterior margin had processes. Wing illustrations were made using an Olympus SZX12 stereomicroscope with a camera lucida. Forewing length was measured under the stereomicroscope to the nearest 0.5 mm using a small hand held ruler. For illustrative purposes, the hind wings appear almost at the same size of the forewings in the illustrations, however the hind wings are shorter than the forewings in nature.

Maps present the distribution of the recognized species of the genus *Wormaldia* in the Nearctic Region. Morse & Holzenthal (2008) provided information on regional distributions of North American Trichoptera genera, including *Wormaldia*.

Miscellaneous considerations

In the text, the species of *Wormaldia* are presented in alphabetical order. The diagnoses of the species and the identification key are based entirely on morphological characters of the male genitalia. Since the male genitalia are similar among the species, to aid the non-specialist in identifying specimens in hand, the diagnoses and descriptions are presented in detail and comparatively structured. In this study, the Nearctic Region is considered to include the northern territory of Mexico, the United States, and Canada as defined by Morse (2008). Abbreviations for US states and Canadian provinces follow standard 2-letter abbreviations (CBE 1999). All specimens examined are pinned unless otherwise noted. Abbreviations used in this paper correspond to the following depository institutions:

BYU	Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, USA
CAS	California Academy of Sciences, San Francisco, California, USA
CNC	Canadian National Collection, Ottawa, Ontario, Canada.
INHS	Illinois Natural History Survey, Champaign, Illinois, USA
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA
NMNH	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
OSAC	Oregon State Arthropod Collection, Oregon State University, Corvallis, Oregon, USA
UMSP	University of Minnesota Insect Collection, St. Paul, Minnesota, USA

Generic diagnosis

Wormaldia McLachlan 1865

Type species: *Hydropsyche occipitalis* Pictet, 1834, subsequent selection of Ross (1949: 154).

Wormaldia McLachlan, 1865: 140; Ross 1949: 154 (subsequent designation of type species: *Hydropsyche occipitalis* Pictet, 1834); Kimmins 1955b: 68–70; Ross 1956: 38–46, 60–67; Fischer 1961: 31–55, 58–60, 70, 71; Fischer 1971: 187–201; Schmid 1982: 26, 31–34; Schmid 1991: 89, 92, 93, 97, 98; Schmid 1998: 10, 43–45; Armitage 1996: [work not paginated]; Sun and Malicky 2002: 521–522.

Dolophilus McLachlan, 1868: 301 (Type species: *Dolophilus copiosus* McLachlan, 1868); Betten 1934: 170 (*Dolophiliella* Banks, 1930, as subgenus of *Dolophilus* McLachlan 1868); Ross 1944: 292 (*Dolophiliella* Banks, 1930, and *Paragapetus* Banks, 1914, synonyms of *Dolophilus* McLachlan, 1868); Ross 1949: 154 (as synonym of *Wormaldia* McLachlan, 1865); Ross 1956: 61; Fischer 1961: 45–55; Fischer 1971: 187.

Dolophiliella Banks, 1930: 230 (Type species: *Dolophiliella gabriella* Banks, 1930); Betten 1934: 170 (as subgenus of *Dolophilus* McLachlan, 1868); Ross 1944: 292 (as synonym of *Dolophilus* McLachlan, 1868); Ross 1956: 61; Fischer 1961: 45; Fischer 1971: 187.

Paragapetus Banks, 1914: 202 (Type species: *Paragapetus moestus* Banks, 1914); Ross 1944: 292 (as synonym of *Dolophilus* McLachlan, 1868); Ross 1956: 61; Fischer 1960: 33; Fischer 1971: 29, 188.

Doloclanes Banks, 1937: 168, 169 (Type species: *Doloclanes montana* Banks, 1937); Kimmins 1955b: 68, 70 (as genus); Ross 1956: 43, 60, 61, 65, 66, 67 (as subgenus of *Wormaldia* McLachlan, 1865); Fischer 1961: 51; Fischer 1971: 201–203; Schmid 1989: 110, fig. 252; Schmid 1991: 89, 97, 98; Schmid 1998: 10 (as genus); Armitage 1996: [work not paginated] (as subgenus); Neboiss 1999: 285, 286, 289 (as genus); Sun and Malicky 2002: 521–522 (as synonym of *Wormaldia* McLachlan, 1865).

Gatlinia Ross, 1948: 22 (Type species: *Gatlinia mohri* Ross, 1948); Ross 1956: 65, 66 (as synonym of subgenus *Doloclanes* Banks, 1937, in genus *Wormaldia* McLachlan, 1865); Fischer 1971: 201.

Nanagapetus Tsuda, 1942: 249 (Type species: *Nanagapetus kisoensis* Tsuda, 1942); Ross 1956: 65 (as synonym of subgenus *Doloclanes*, in genus *Wormaldia* McLachlan, 1865); Fischer 1971: 201.

Adult (Fig. 133). Forewing length 3–8 mm. Body sclerites, including dorsum of head and thorax fuscous or brown, with small fuscous or brunneous setae. Head and palpi setose; antennae with lighter setae, annulated, shorter than forewings; each with scape stout, flagellum slender; ocelli present; maxillary palps each with segment V the longest, segment I the shortest, segment III longer than II and IV, II and IV subequal; labial palps shorter than maxillary palps, each with 3 segments, segment III longest, slender. Leg segments with small, fuscous or brownish setae; tibial spur formula 2-4-4. Forewings (Figs. 12, 51, 58, 82) fuscous or brunneous, covered with small, fine, fuscous or brown setae, sometimes with small, scattered patches of lighter setae, each with discoidal cell short (dc absent in *W. gabriella*, Fig. 39); medial cell (mc) present in all Nearctic species; R_2 and R_3 veins sometimes fused (consisting of R_{2+3}, such that apical fork I absent in *W. gabriella*, *W. lacerna*, *W. shawnee*, and *W. strota*, Figs. 39, 58, 113, 120); M vein 3-branched [M_1, M_2, and M_{3+4}, with apical fork IV absent in *W. hamata*, *W. laona*, *W. oconee*, and *W. thyria*; 4 of the 6 species of the *W. thyria* species Group (Table 1), Figs. 51, 65, 127, and fig. 3E of Morse *et al*. (1989)], or M vein 4-branched (M_1, M_2, M_3, and M_4, remaining Nearctic species, Figs. 12, 19, 25, 32, 39, 58, 74, 82, 90, 106, 113, 120). Hind wings (Figs. 13, 59, 83): shorter than forewings, each with discoidal cell (dc) short, present in all Nearctic species; all R veins (R_1, R_2, R_3, R_4, and R_5) present in almost all Nearctic species, except for R_1 and R_2 veins sometimes fused (R_{1+2} in *W. mohri*, Fig. 83), R_2 and R_3 veins sometimes fused (R_{2+3} and apical fork I absent in *W. gabriella*, *W. lacerna*, *W. shawnee*, and *W. strota*, Figs. 40, 59, 114, 121); M vein 3-branched (M_1, M_2, and M_{3+4}, with apical fork IV absent) in all Nearctic species; apical forks II, III, and V present in all Nearctic species; anal vein 2A fused to 1A, resulting in 2A being atrophied beyond crossvein a_2 in all *Wormaldia* species (Figs. 13, 83).

Male genitalia (Figs. 1–5). Sternum VII with or without process posteromesally. Tergum VIII usually straight anteriorly, diversely developed posteriorly. Sternum VIII with or without process posteromesally. Segment IX, when viewed dorsally, reduced to narrow, lightly sclerotized transverse band, with anterior margin straight or concave; when viewed ventrally, straight or concave anteriorly, diversely developed posteriorly.

Segment X membranous, unilobate, usually triangularly elongate for Nearctic species (nearly subtriangular in *W. arizonensis* and *W. planae*) projected posterad, parallel with superior appendages; varying in shape and structure from simple segment to complex segment grouping various lobate processes (in *W. arizonensis* and *W. planae*). Superior appendages elongate, usually digitate. Inferior appendages each 2-segmented, when viewed laterally basal segment generally elongate, rectangular, wider and stouter than apical segment; when viewed ventrally, pair of basal segments united anteriorly, separated posteromesally by a V-shaped or U-shaped emargination; apical segment generally elongate, with apicolateral or apical patch of short, black, spines. Phallus, when viewed laterally, usually pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with visible, internal sclerites (Figs. 5, 10).

Female genitalia. Abdomen rounded, tapering from segments VII to segment XI. Abdominal segment VII longer than segments VIII–XI combined. Abdominal segments VII and VIII each with distinct sternum and tergum. Abdominal segment IX membranous, simple, shorter than tubular segment X. Abdominal segment XI small, tubular (Armitage 1996; Schmid 1982: figs. 156–161; Schmid 1991: fig. 27; Schmid 1998: figs. 109–115).

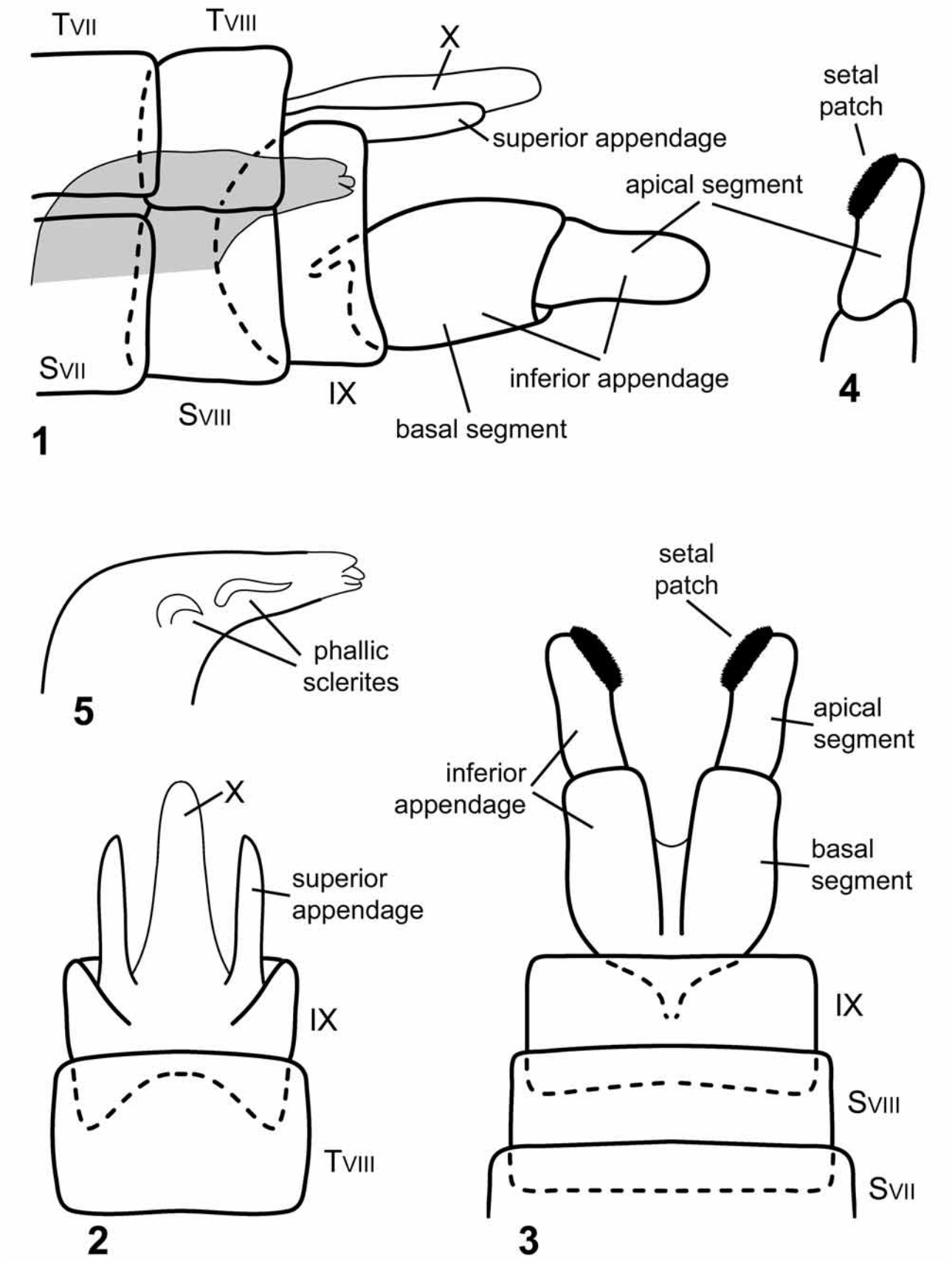
Pupa. Length 5–12 mm. Mandible with at least one conspicuous tooth subapically in addition to apical tooth (Ross 1944: figs. 160–161). Abdominal segment III with one or two pairs of dorsal hook plates. Abdominal segment IV with one pair of dorsal hook plates. Abdominal segment V with two pairs of dorsal hook plates (e.g., Wiggins & Currie 2008: 17.120). Abdominal gills absent (Ross 1944; Wiggins & Currie 2008).

Larva. Length 10–15 mm. Body: stout, subtubular, elongate; head, thorax, and abdomen well developed and differentiated, with occasional setae. Head: sclerotized, elongate, subrectangular or suboval; antennae very small; eyes small; anterior margin of frontoclypeal apotome usually symmetrical, but may be slightly concave or convex; labrum wider apically, anterior margin straight, setose; setae no. 18 conspicuous, placed ventromedially. Thorax: pronotum sclerotized; meso- and metanota membranous, mesothorax larger than metathorax; legs long, subequal, slender, tarsal claws stout, curved, bifurcated subapically; fore trochantins sclerotized, projected freely, each forming short process; coxae elongate, tubular, simple, without projections. Abdomen: elongate, about 2 times as long as head and thorax together, stout, without gills, but anal papillae present; segment IX without dorsal sclerite (Morse & Holzenthal 2008; Ross 1944; Wiggins 1996).

Retreats. The larvae of *Wormaldia* construct tubular retreats of silk, which have a small opening facing into the current (Wiggins 1996: fig. 8.2F). The tubular retreat has several layers of meshes. The mesh opening is elongate and rectangular and its size is about 0.4 x 3.7 µm (microns). The layers of mesh are overlapped diagonally, thereby reducing the size of the mesh openings and resulting in a very fine meshed net (Wallace & Malas 1976b: figs. 18–19; Merritt *et al.* 2008a; Nielsen 1942; Philipson 1953; Ross 1944; Wallace & Malas 1976a; Wiggins 1996). In general, the pupal retreat or cocoon consists of a modification of the larval retreat.

Biology. Adults of the Nearctic species of *Wormaldia* are small (forewing length 3–8 mm; Fig. 133) with blackish or brown coloration. They are usually associated with vegetation around small streams in forested, mountainous areas. They are primarily nocturnal in habit. The larvae of *Wormaldia* are usually encountered on rocks or sticks in running waters. They build silken tubular retreats in which they freely move and in this way feed by cleaning fine organic particles from the tube's inner surface (Wiggins 1996).

Remarks. Adults of the genus *Wormaldia* are distinguished from the other genera of Philopotaminae by the particular arrangement and shape of the anal cells of the hind wing. This consists of the hind wing with anal vein 2A fused to 1A, resulting in 2A being atrophied beyond crossvein a_2 (Figs. 13, 83; Ross 1956: fig. 20). Larvae of Nearctic *Chimarra*, *Wormaldia*, *Dolophilodes*, and *Fumonta* can be distinguished based on the key provided by Morse & Holzenthal (2008); the larva of *Sisko* is unknown. Larval descriptions of European species can be found in the work of Lepneva (1970). Ross (1944) provided a key to Nearctic *Chimarra*, *Dolophilodes* (as *Trentonius*), and *Wormaldia* (as *Dolophilus*) pupae. Weaver *et al.* (1981) described the pupa of *Fumonta major* (as *Dolophilodes*); the pupa of *Sisko* is unknown.



FIGURES 1–5. Hypothetical male genitalia of *Wormaldia*: 1—left lateral view; 2—dorsal view; 3—ventral view; 4—apical segment of left inferior appendage, dorsal view; 5—phallus with sclerites, left lateral view. Abbreviations as in text.

Species descriptions

***Wormaldia anilla* (Ross)**
Figures 6–13, 129

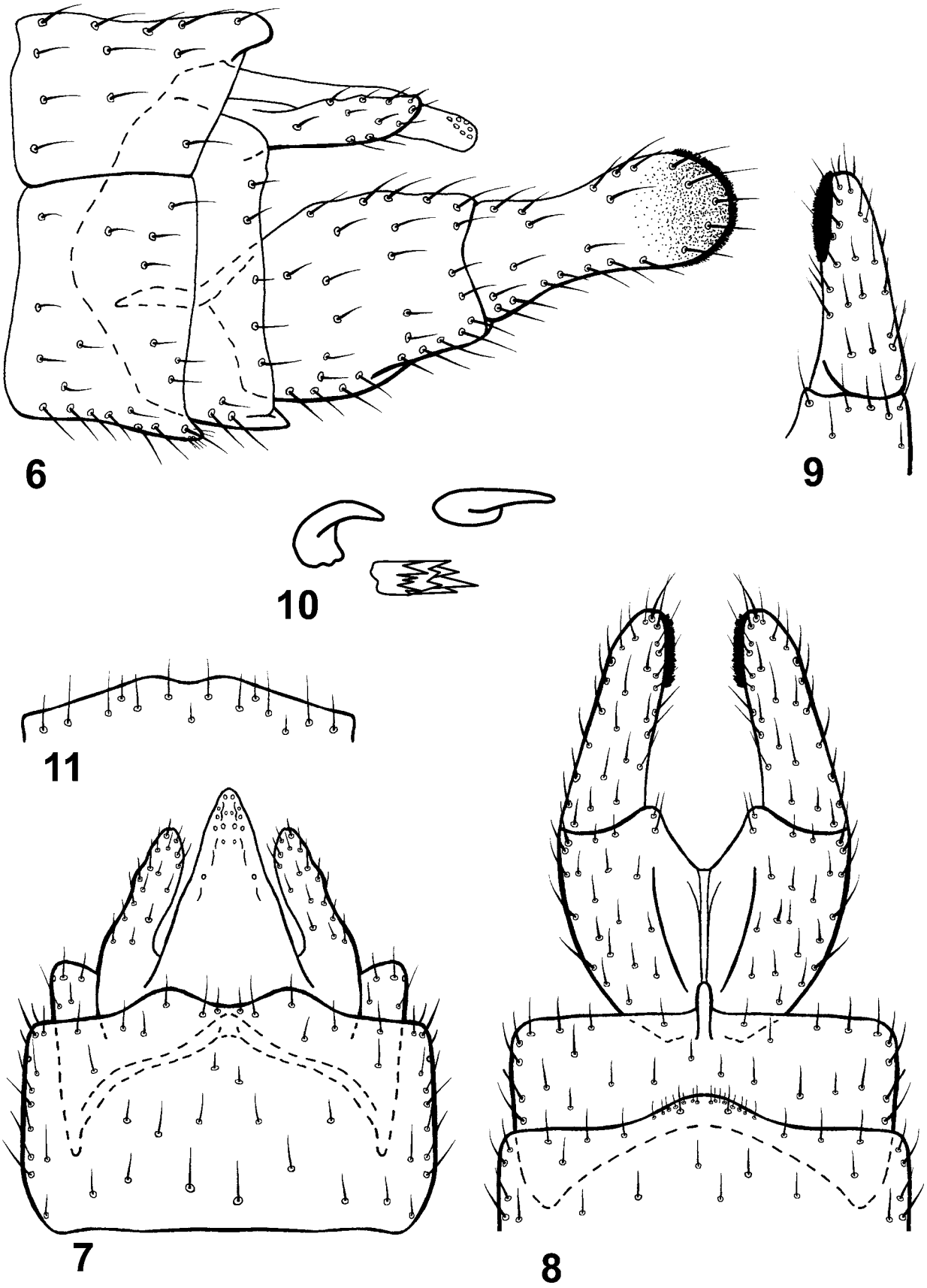
Wormaldia anilla (Ross, 1941a: 55, pl. III, fig. 18), male, British Columbia, Canada (INHS) (as *Dolophilus anillus*); Ross 1944: 292; Ross 1949: 154–157 (transferred to *Wormaldia* McLachlan 1865); Ross 1956: 38, 40, 42, 62, fig. 64 A; Denning 1956a: 79; Denning 1956b: 248, fig. 10: 16A; Fischer 1971: 188; Schmid 1982: 31, 32, 71 (map 14), figs. 152, 153, 158, 159; Armitage 1996: [work not paginated].

In 1949, Ross placed this species within subgroup 1 of the *W. moesta* Group. Later, Ross (1956) reconsidered his former *W. moesta* Group proposal for this genus and transferred *W. anilla* to the *W. anilla* Group, which was maintained by Armitage (1996) (Table 1).

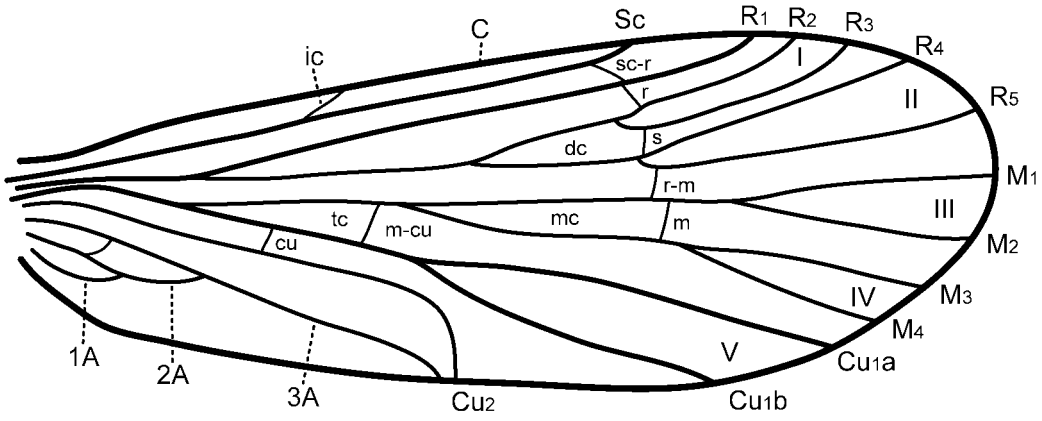
This species is similar to *Wormaldia occidea* (Ross, 1938a), but differs in the shapes of sterna VII and IX, and the inferior appendage. Sternum VII in *W. anilla* is without a process posteromesally. On sternum VII in *W. occidea*, there is a prominent and subtriangular process posteromesally. Sternum IX in *W. anilla* has an elongate, slender, and pointed process posteromesally that arises preapically. Sternum IX in *W. occidea* has a smaller and truncate process posteromesally that arises subapically. When viewed laterally, the apical segment of the inferior appendage in *W. anilla* is slightly concave medially and widely rounded apically. The apical segment of the inferior appendage in *W. occidea* is straight medially, and very slightly truncately rounded apically. *Wormaldia anilla* can be distinguished from *W. clauseni*, new species, as discussed in the diagnosis of that new species. *Wormaldia anilla* specimens from Mt. Hood (Oregon), presented morphological variation in the shape of the posterior margin of tergum VIII from that of the holotype. The posterior margin of tergum VIII of the Mt. Hood specimens is very slightly sinuous or relatively straight mesally (Fig. 11).

Adult (in alcohol). Length of forewing 5–7 mm (holotype: 6 mm). Head brown, with yellowish setae. Antennae long, slender, brown, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs brown, with small, yellowish setae. Forewings yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 12). Hind wings translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 13).

Male genitalia (Figs. 6–11). Sternum VII straight posteriorly without process mesally. Tergum VIII straight or sinuous posteromesally; when viewed laterally, posterodorsal corner slightly roundly projected. Sternum VIII straight or slightly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, long, nearly subrectangular in appearance, convex anteriorly, straight posteriorly; when viewed ventrally, concave anteriorly, straight posteriorly with elongate, slender, pointed, mesal process arising preapically. Segment X, when viewed dorsally, triangularly elongate, narrowly rounded apically; when viewed laterally, stout, rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, shorter than segment X. Inferior appendages 2-segmented; when viewed laterally, each with basal segment stout, subrectangular, elongate, broadest and convex medially, apical segment stout, subrectangular, elongate, relatively equal in length, narrower than basal segment, concave and narrowest medially, rounded and widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments of the 2 inferior appendages united for about their anterior 2/3rds, separated posteromesally by broad, moderately deep, U-shaped emargination, each basal segment stout, widest posteromedially, with outer margin convexly curved, apical segment tubularly elongate, narrowest and rounded posteriorly, with elongate and apicolateral patch of short, thin, black, spines on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, small, internal sclerites (Fig. 10).



FIGURES 6–11. *Wormaldia anilla* (Ross). Male genitalia: 6—left lateral view (phallus not shown in this and preceding species); 7—dorsal view (terga IX and X only in this and preceding species); 8—ventral view; 9—apical segment of left inferior appendage, dorsal view; 10—phallic sclerites, left lateral view; 11—posterior margin of tergum VIII from Mt. Hood (OR), USA, dorsal view.



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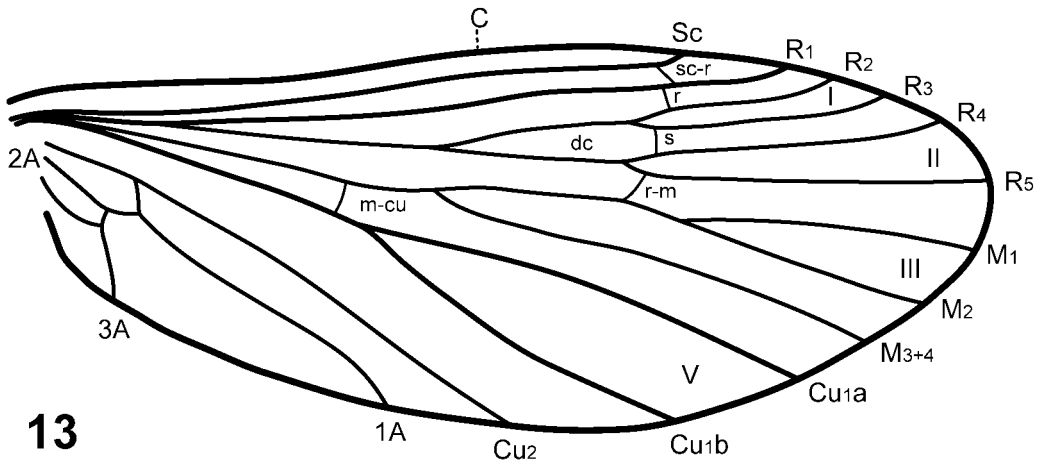

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FIGURES 12–13. *Wormaldia anilla* (Ross). Wings: 12—right forewing; 13—right hind wing. Wing terminology: *Veins*: A = anal vein, C = costa, Cu = cubitus, M = medius, R = radius, Sc = subcosta. *Crossveins*: cu, ic, m, m-cu, r, r-m, s, sc-r. *Cells*: dc = discoidal cell, mc = medial cell, tc = thyridial cell. *Forks*: I, II, III, IV, V.

Material examined. CANADA: British Colombia: *Holotype* & *Paratype*: 2 males, Stave Falls, along very small brook, 6.vii.1940, H.H. & J.A. Ross (in alcohol, INHS); same except, Steelhead Creek, 6.vii.1940, H.H. & J.A. Ross, 7 males (in alcohol, INHS); Cultus Lake, 20.v.1934, W.E. Ricker, 1 male (INHS); same except, 10.v.1935, 1 male (INHS); 30.v.1935, 1 male (INHS); 27.iii.1937, 1 male (INHS); 24.v.1965, F. Schmid, 6 males (CNC); *Paratype*: 1 Male, Vancouver, Marine Drive, 6.vii.1940, H.H. & J.A. Ross (in alcohol, INHS); N Vancouver, trib. Seymour Creek, 19.vii.1946, H.H. Ross, 1 male (in alcohol, INHS); same except, Tidalis Creek, 15.i.1939, W.E. Ricker, 1 male (in alcohol, INHS); S. Vancouver Is., 10.vii.1950, R. Guppy, 1 male (CNC); E of Chilliwack, Cheam View, 10.viii.1950, H.H. Ross, 1 male (in alcohol, INHS); 5 mi [= 8 km] E of Hope, 28.vi.1973, H.J. Teskey, 1 male (CNC). **USA: Idaho:** Idaho Co.: Powell District, Low, New Elk Summit Rd., 27.v.1972, R.A. Haick, 1 male (in alcohol, INHS); **Oregon:** Baker Co.: Spring Creek, 22.viii.1952, K.M. Fender, 1 male (in alcohol, INHS); *Paratypes*: 3 Males, Clackamas Co.: along Beaver Creek, tributary of Sandy River, 3.ii.1939, S.G. Jewett, Jr. (in alcohol, INHS); same except, Beaver Creek, 19.iv.1947, 7 males, 2 females (in alcohol, INHS); Mt. Hood, Still Creek, for Campground, 17.vii.1949, K.M. Fender, 6 males, 1 female (in alcohol, INHS); same except, 17.vi.1967, S.G. Jewett, Jr., 3 males (in alcohol, INHS); Forest Camp, 31.vii.1948, K.M. Fender, 1 male (in alcohol, INHS); Midden Lake outlet, Mt Hood, Nat. Forest, 4800 ft [= 1463 m], 23.vii.1953, W.E Ricker, 1 male (in alcohol, INHS); Bear Creek, 1.viii.1948, K.M. Fender, 14 males, 3 females (in alcohol, INHS); Wildcat Creek, trib. Sandy River, 15.vi.1947, S.G. Jew-

ett, Jr., 1 male (in alcohol, INHS); Bear Creek, near Rhododendron, 16.vii.1947, K.M. Fender, 4 males, 2 females (in alcohol, INHS); same except, 16.xii.1947, 23 males, 16 females (in alcohol, INHS); Douglas Co.: Foster Creek, 8.vi.1965, F. Schmid, 1 male (CNC); Hood River Co.: Oxbow Springs, 18.iv.1940, S.G. Jewett, Jr., 1 male (in alcohol, INHS); Jackson Co.: Prospect, 6.vi.1965, F. Schmid, 1 male (CNC); Josephine Co.: O'Brien, 5.vi.1965, 1 male (CNC); Lincoln Co.: Saddleback Mt., 26.ix.1959, J.C. Dirks-Edmunds, 1 male (INHS); Linn Co.: Cascadia, 19.v.1935, H.A. Scullen, 1 male (in alcohol, INHS); Yamhill Co.: McMinnville, High Heaven, 4.v.1947, K.M. Fender, 5 males (in alcohol, INHS); same except, Peavine Ridge, nr. McMinnville, Sta. 3A, 18.ix.1948, 1 male, 1 female (in alcohol, INHS); Gunaldo Falls, 18.vii.1952, K.M. Fender, 5 males (in alcohol, INHS); **Washington:** [Clark Co.(?)]: Ellsworth, 1.xii.1941, S.G. Jewett, Jr., 1 male, 1 female (in alcohol, INHS); King Co.: Barclay Creek, Hwy 2 W of Stevens Pass, 28.vi.1987, Armitage & Smith, 4 males (in alcohol, INHS); Issakwa, River, E. Fk., 14.v.1972, R.A. Haick, 1 male, 1 female (in alcohol, INHS); Lewis Co.: Lewis & Clark State Park, 28.vii.1952, K.M. Fender, 3 males, 1 female (in alcohol, INHS); Mason Co.: Hoodsport, 20.vii.1968, B.V. Peterson, 1 male (CNC); Skagit Co.: Marblemount, 31.v.1965. F. Schmid, 1 male (CNC); Whatcom Co.: N Branch Hutchinson Creek, E of Acme, 28.viii.1971, Ross, 1 male (in alcohol, INHS).

Distribution. Canada: BC. USA: CA, ID (new record), OR, WA.

***Wormaldia arizonensis* (Ling)**
Figures 14–20, 129

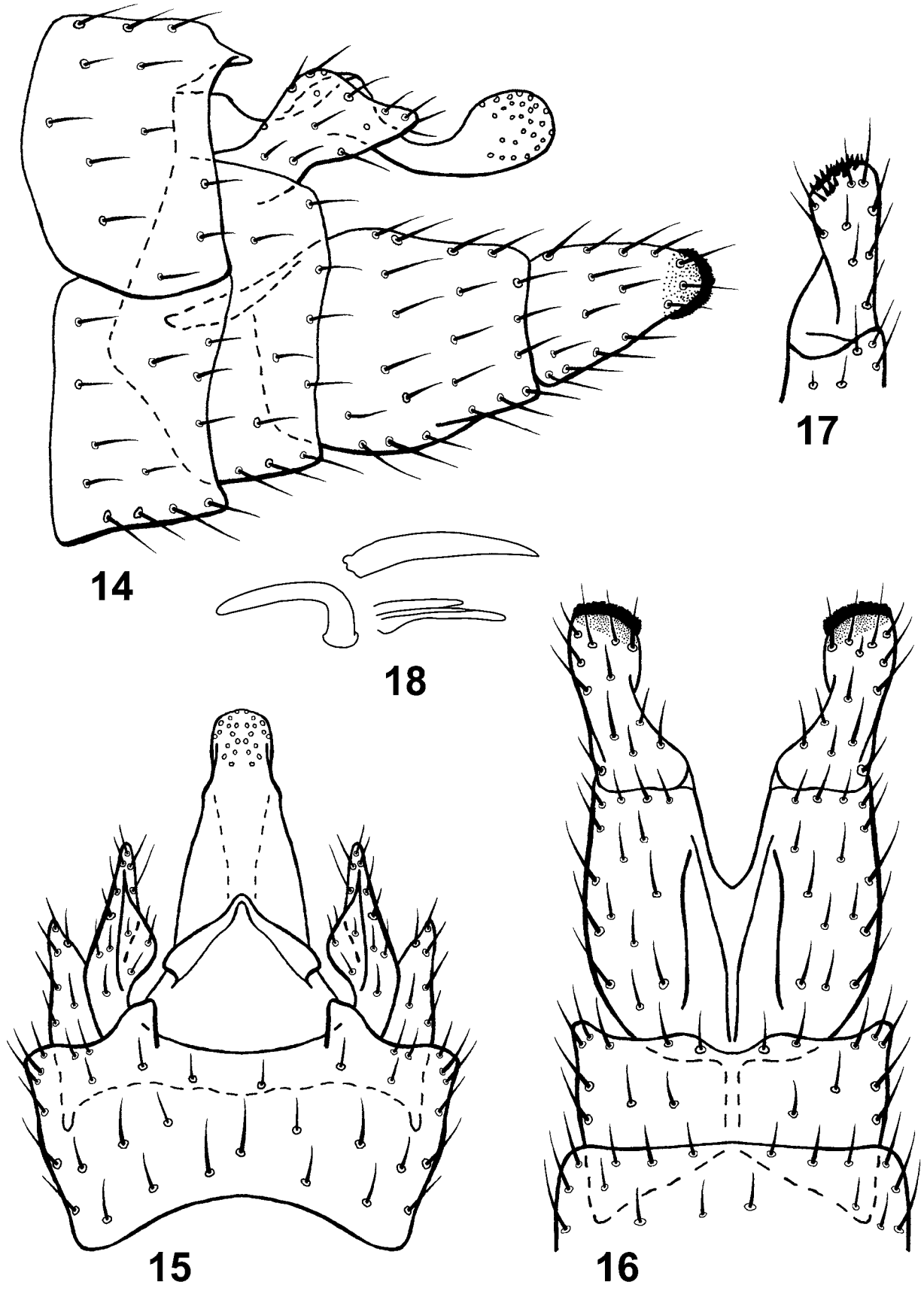
Wormaldia arizonensis (Ling) 1938: 63, male, Arizona, USA (CAS) (as *Dolophilus arizonensis*); Ross 1941a: 51; Ross 1944: 292; Ross 1949: 154–156, pl. 13, figs. 2, 2A (transferred to *Wormaldia*); Ross 1956: 38, 40, 61, 62, figs. 20, 74 A, B; Denning 1956a: 79; Fischer 1961: 46; Fischer 1971: 189; Bueno-Soria & Flint 1978: 194 (distribution); Armitage 1996: [work not paginated].

In 1949, Ross established the *W. arizonensis* species Group for a single species, *W. arizonensis* (Ling). Ross (1956) and Armitage (1996) in their species group proposals followed the previous work and retained *W. arizonensis* in the *W. arizonensis* Group (Table 1).

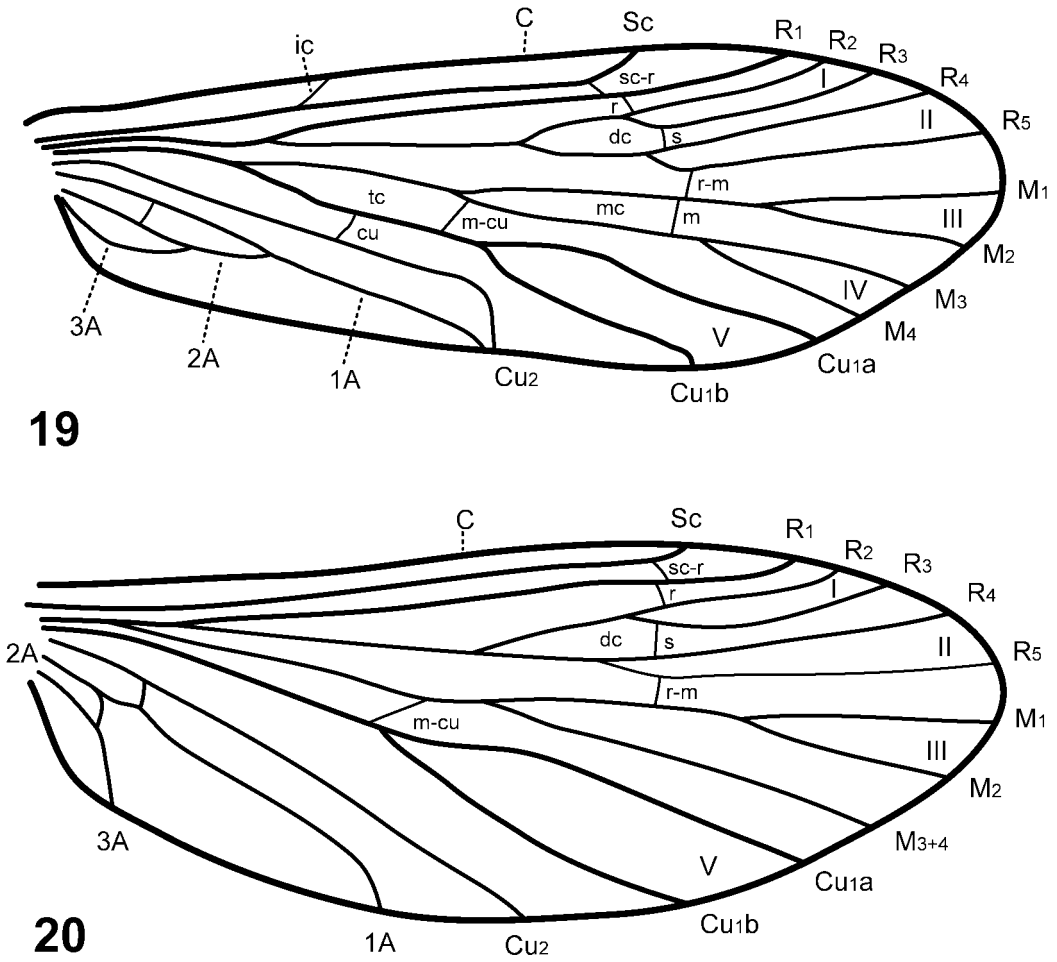
This species can be easily distinguished from the other Nearctic *Wormaldia* by the distinctive shapes of segment X and the superior and inferior appendages. Tergum X has a prominent and inverted "V"-shaped process basally, which is not present in the other Nearctic species; when viewed laterally, the apex of the tergum has a distinctive and prominent ballon-shape. When viewed laterally, the superior appendage is uniquely and strongly convexly extended dorsomedially, the apex reaches the middle of segment X. Finally, when viewed laterally, the apical segment of the inferior appendage is triangular, narrowly rounded apically, and smaller (about 0.7 times) and narrower than the basal segment.

Adult (in alcohol). Length of male forewing 6–7 mm (holotype: 7 mm). Head yellowish, with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, light brown setae, with apical forks I, II, III, IV, and V present (Fig. 19; Ross 1956: fig. 20). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 20; Ross 1956: fig. 20).

Male genitalia (Figs. 14–18). Sternum VII straight posteriorly without process mesally. Tergum VIII slightly concave anteriorly, slightly sinuous posterolaterally, with two stout, triangular, mesolateral projections followed by a wide, concave, mesal emargintion; when viewed laterally, posterodorsal corner with pointed apex of posterolateral process. Sternum VIII straight posteriorly without process mesally. Segment IX, when viewed dorsally, shallowly concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anteriorly, relatively straight posteriorly; when viewed ventrally, concave



FIGURES 14–18. *Wormaldia arizonensis* (Ling). Male genitalia: 14—left lateral view; 15—dorsal view; 16—ventral view; 17—apical segment of left inferior appendage, dorsal view; 18—phallic sclerites, left lateral view.



FIGURES 19–20. *Wormaldia arizonensis* (Ling). Wings: 19—right forewing, dorsal view; 20—right hind wing, dorsal view.

anteriorly, weakly sinuous posteriorly with shallow mesal concavity. Segment X, when viewed dorsally, stout, subtriangularly elongate, with conspicuous, inverted V-shaped anteromedial process, strongly wide basally, elongate, nearly reaching lower middle of tergum, apex of tergum conspicuous and broadly rounded; when viewed laterally, convexly extended dorsomedially, narrow and upcurved preapically, prominently balloon-shaped apically. Superior appendages, when viewed dorsally parallel with segment X, convexly enlarged medially, slightly pointed apically; when viewed laterally, thick, clearly short, reaching middle of segment X, strongly extended convexly dorsomedially, apically slightly pointed. Inferior appendages two segmented; when viewed laterally, basal segment thick, rectangular, elongate, widest and convex medially, apical segment stout, triangular, narrowest and rounded posteriorly, shorter (about 0.7 times) and narrower than basal segment; when viewed dorsally, apical segment subrectangularly elongate, widened and rounded posteriorly, with apical patch of short, black, spine-shaped and peg-shaped setae; when viewed ventrally, basal segments paired, united for about their anterior two-thirds, separated posteromesally by a narrow, deep, U-shaped emargination, each basal segment robust, widest medially, with outer margin convexly curved anteromedially, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 18).

Material examined. MEXICO: **Durango**: 3 mi [= 4.8 km] W of El Salto, 8500 ft [= 2591 m], 19.vi.1964, J.E.H. Martin, 1 male (CNC); 10 mi [= 16 km] W of El Salto, 9000 ft [= 2744 m], 1.vii.1964,

J.E.H. Martin, 1 male (CNC). **USA**: **Arizona**: *Holotype*: Male, type locality Arizona, (in alcohol, in CAS, Type # 4629); Cochise Co.: Chiricahua Mts., SW Research Sta., 5400 ft [= 1646 m], swimming pool, 22.vi.1980, V. Roth, 1 male (in alcohol, INHS); same except, 19.viii.1980, L.L. Lampert, 3 males (in alcohol, 2 vials, INHS); Cave Creek, nr. Portal, 9.vi.1961, J. Kingsolver, 3 males, 1 female (in alcohol, INHS); SW Research Station, 7.vii.1965, V. Roth, 37 males, 6 females (in alcohol, CAS); same except, 5–6.viii.1965, 6 males (in alcohol, CAS); 25.viii.1965, 13 males, 1 female (in alcohol, CAS); 1–4.xi.1965, 9 males, 3 females (in alcohol, CAS); 15.xi.1965, 1 male (in alcohol, CAS); 3.5 mi [= 5.6 km] SW of Portal, 5000 ft [= 1524 m], 13.viii.1952, H.B. Leech & J.W. Green, 5 males, 1 female (in alcohol, CAS); 5 mi [= 8 km] W of Portal, 27.viii.1965, V. Roth, 1 male (in alcohol, CAS); same except, 10.ix.1965, 5 males (in alcohol, CAS); 16.ix.1965, 8 males (in alcohol, CAS); Sierra Vista, 1–31.x.1967, R.F. Sternitzky, 2 males, 1 female (CNC); Coconino Co.: Indian Garden, Oak Creek, 21.vi.1978, M.W. Sanderson, 13 males, 1 female (in alcohol, INHS); Gila Co.: Tonto National Forest, Rd. 708, 2 mi [= 3.2 km] E of Fossil Creek, 27–28.viii.1984, M.W. Sanderson, 2 males (in alcohol, INHS); Gila Co. - Yavapai Co.: Line, Fossil Creek, 30.viii.1986, A.R. Brigham & M.W. Sanderson, 5 males, 7 females (in alcohol, INHS); Yavapai Co.: Beaver Creek at Montezuma Well, 24–25.v.1985, M.W. & W.M. Sanderson, 2 males, 2 females (in alcohol, INHS); same except, below Montezuma Well, 3–4.iv.1985, M.W. Sanderson, 2 males (in alcohol, INHS); below outlet Montezuma Well, 25–26.vii.1985, S. King & M.W. Sanderson, 1 male (in alcohol, INHS); same except, 4–5.xi.1985, M.W. Sanderson, 2 males (in alcohol, INHS); nr. Montezuma Well, 2–3.v.1985, M.W. Sanderson, 2 males, 1 female (in alcohol, INHS); outlet Montezuma Well, 3–4.vi. 1984, M.W. Sanderson, 1 male, 2 females (in alcohol, INHS); Beaver Creek Ejct. [17-179], Rd. 121-618G, M.W. Sanderson, 2 males, 5 females (in alcohol, INHS); Oak Creek, 76-C-9 (IX), 1 male (in alcohol, INHS); Page Springs, nr. Oak Creek, 14–15.vi.1985, M.W. Sanderson, 1 male (in alcohol, INHS); stream ex. Chas. Ward Ranch, Rd. 618, 19–20.v.1984, M.W. Sanderson, 1 male, 3 females (in alcohol, INHS); West Clear Creek @ Bull Pen Ranch, 9 mi [= 14.4 km] ESE Campe Verde, 3680 ft [= 1122 m], T13N R6E NW/4 NW/4 NW/4 Sec. 11, 27–28.viii.1986, A.R. Brigham, 1 male (in alcohol, INHS); Deception Gulch, SW Jerome, 19.viii.1980, M.W. Sanderson, 1 male (in alcohol, INHS); same except, 23–24.viii.1980, 1 male (in alcohol, INHS); **Texas:** Culberson Co.: stream in McKittrick Canyon, about 2 mi [= 3.2 km] W of of Information Center in Guadalupe Mts. National Park, nr. Pine Springs, 18.vi.1985, A.R. Brigham & J.L. Brower, 1 male (in alcohol, INHS); same except, McKittrick Creek, McKittrick Canyon, 26.iv.1939, J.A. & H.H. Ross, 1 male (in alcohol, INHS); Frijole Ranch Canyon, nr. Pine Springs, 7.vi.1961, J. Kingsolver, 3 males (in alcohol, INHS); Manzaneta Springs, Frijole, 26.iv.1939, J.A. & H.H. Ross, 1 male (in alcohol, INHS); **Utah:** Washington Co.: Zion National Park, stream at Weeping Rock, 25–26.vi.1985, M.W. Sanderson, 2 males (in alcohol, INHS).

Distribution. Mexico: Durango. USA: AZ, TX, UT.

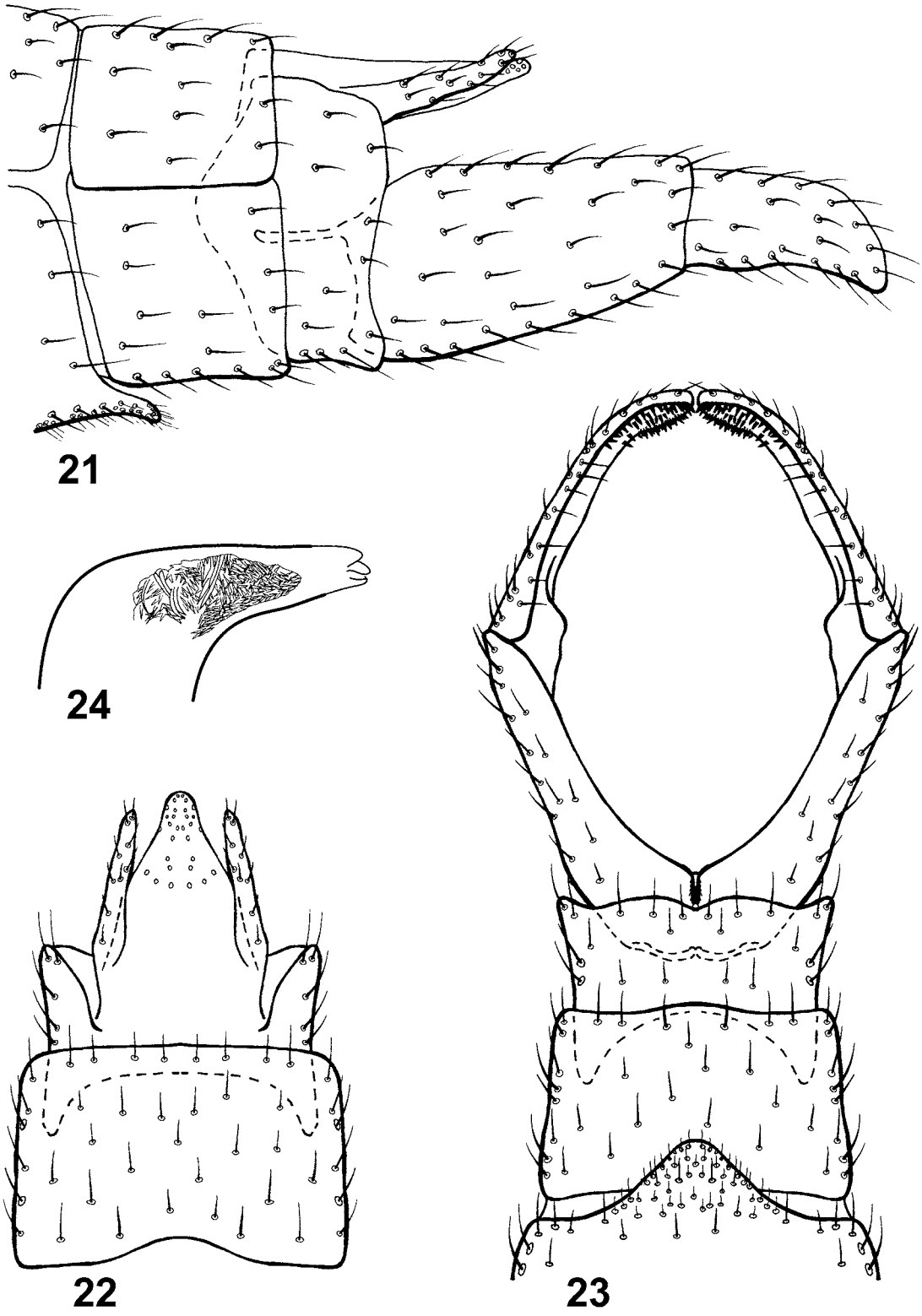
Wormaldia birneyi Muñoz-Quesada and Holzenthal, new species

Figures 21–26, 132

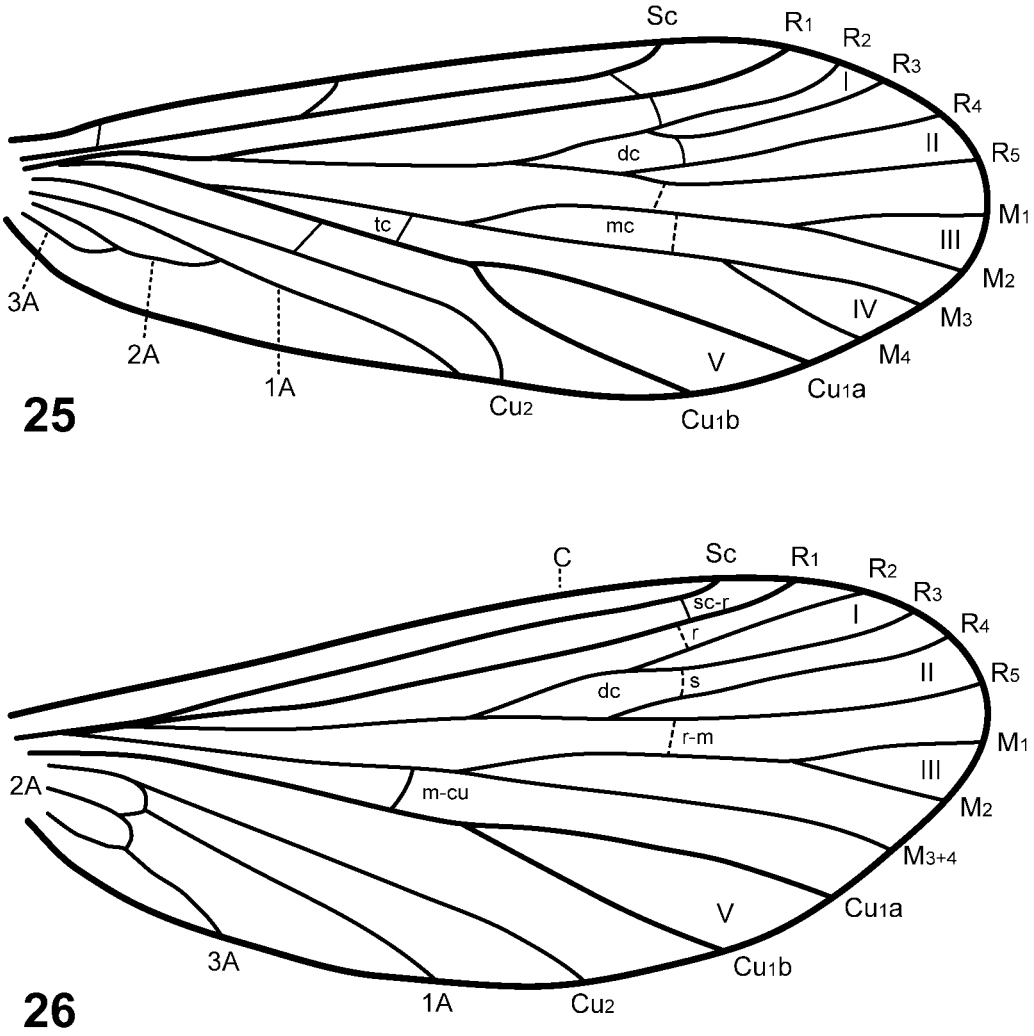
According to the species group proposals of Ross (1956) and Armitage (1996), this new species would belong within the *W. anilla* Group (Table 1).

This new species and *Wormaldia pachita* Denning (1956a) are similar to *W. shawnee* (Ross 1938a) and *W. strota* (Ross 1938b), but are distinguishable from those two species and the other Nearctic *Wormaldia* by the wider, deeper, V-shaped posteromesal emargination of the paired basal segments of the inferior appendages. These paired basal segments are clearly incurved and considerably narrower and more elongate in the new species. In addition, *W. birneyi* differs from *W. pachita* by the shapes of sterna VII and IX, and the inferior appendages. Sternum VII in *W. birneyi* has a conspicuous and convexly subtriangular process posteromesally. Sternum VII in *W. pachita* is straight posteriorly. Sternum IX in *W. birneyi* is weakly sinuous posteriorly with

a shallow mesal concavity. Sternum IX in *W. pachita* is strongly projected sinuously posteriorly with a slender and elongate process mesally. When viewed ventrally, the basal segment of the inferior appendage in *W. birneyi* is narrowly elongate, equal in length, slightly wider than the apical segment. The basal segment in *W. pachita* is robust, elongate, and shorter (about 0.7 times) and wider than the apical segment.



FIGURES 21–24. *Wormaldia birneyi*, new species. Male genitalia: 21—left lateral view; 22—dorsal view; 23—ventral view; 24—phallus with sclerites, left lateral view.



FIGURES 25–26. *Wormaldia birneyi*, new species. Wings: 25—right forewing, dorsal view; 26—right hind wing, dorsal view.

Adult (in alcohol). Length of male forewing 5–6 mm (holotype: 5 mm). Head light brown, and with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae, fifth segment the longest, first segment the shortest, third longer than second and fourth, second and fourth subequal. Labial palps yellowish, with lighter setae, first and second segments sub-equal, third segment the longest. Dorsum of thorax light brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, light brown setae, with apical forks I, II, III, IV, and V present (Fig. 25). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 26).

Male genitalia (Figs. 21–24). Sternum VII with wide, convexly subtriangular, posteromesal process conspicuously elongate, about 0.5 times length of sternum VIII. Tergum VIII relatively straight posteriorly. Sternum VIII straight or very slightly convex posteromesally. Segment IX, when viewed dorsally, weakly concave anteriorly; when viewed laterally, nearly rectangular in appearance, convexly projected anteriorly, weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, slightly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, triangularly elongate, narrowest and rounded apically; when viewed laterally, subtriangular, narrowly rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, slender, elongate, narrowly rounded apically; when viewed laterally, very slightly shorter than segment X. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, strongly elongate, broadest and convex anteriorly, relatively straight posteromedially; api-

cal segment stout, elongate, slightly rectangular and broader anteromedially, slightly downcurved and slightly projected posteroventrally; when viewed ventrally, basal segments paired, united for about their anterior one-fifth, separated posteromesally by a prominent, strongly deep, broad, U-shaped emargination, each basal segment stout, noticeably slender and incurved anteriorly; apical segment conspicuously slender and elongate, relatively equal in length to basal segment, slightly incurved and narrowest posteriorly, with short, black, spine-shaped and peg-shaped setae scattered apicolaterally on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with group of many minute, elongate, slender, pointed, internal sclerites (Fig. 29) surrounded by highly convulated membranes.

Holotype: Male. **USA: California:** Del Norte Co: Six River National Forest, small creek jct Smith River Hwy 199, 3 mi [= 4.8 km] NE of Hiouchi [~ 41º 51' N, 124º 00' W], 1.vi.1991, Baumann and Stark (in alcohol, NMNH).

PARATYPES: USA: California: Humboldt Co.: Mossey stream, Hwy 299, 3 mi [= 4.8 km] E of Berry Summit [~ 40º 5' N, 124º 00' W], 22.vi.1985, Baumann and Nelson, 1 male (only the abdomen, in alcohol, BYU); Lake Co.: Trib. E. Fork Middle Creek, 7 mi [= 11.2 km] N of Upper Lake [~ 39º 10' N, 122º 55' W], 3.vi.1975, P.A. Peterson (in alcohol, CAS).

Etymology. Dedicated to the memory of Dr. Elmer C. Birney (1940–2000), in recognition of his numerous and outstanding contributions to Mammalogy. Dr. Birney was a member of the senior author's Ph.D. advisory committee, giving him the opportunity to have Dr. Birney's valuable advice and friendship.

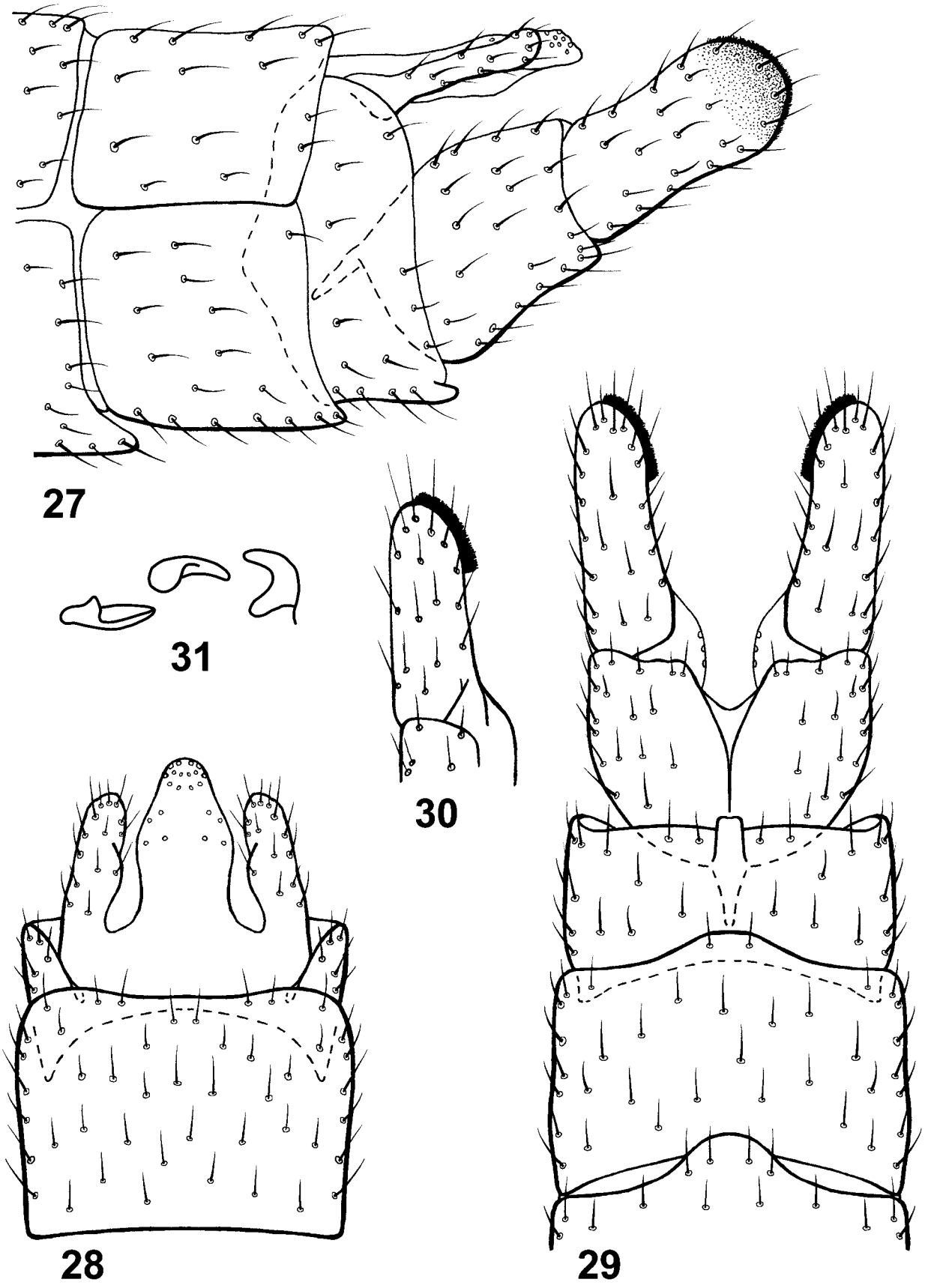
Distribution. USA: California.

***Wormaldia clauseni* Muñoz-Quesada and Holzenthal, new species**
Figures 27–33, 129

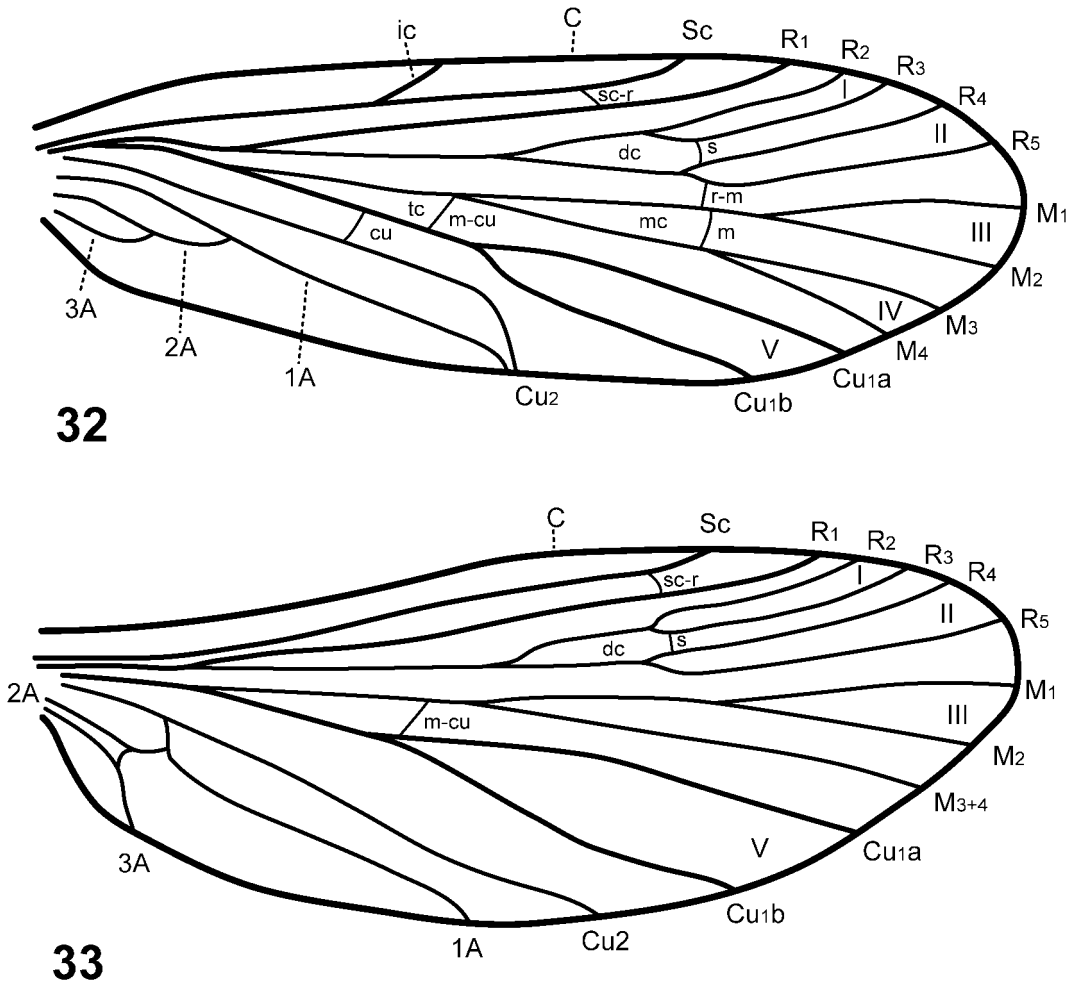
According to the species group proposals of Ross (1956) and Armitage (1996), this new species would be a member of the *W. anilla* Group (Table 1).

This new species is similar to *Wormaldia anilla* (Ross 1941a) and *W. occidea* (Ross 1938a), but differing from these two species in the shapes of sterna VII and IX, tergum X, and the inferior appendage. Sternum VII in *W. clauseni* has a broad and convex process posteromesally (less than 0.2 times the length of sternum VIII). Sternum VII in *W. anilla* lacks a process posteromesally, in *W. occidea* there is an elongate, broad, convexly subtriangular process posteromesally (longer than posteromesal process of *W. clauseni*). Sternum IX in *W. clauseni* has a stout, elongate, truncate process posteromesally that arises preapically. Sternum IX in *W. anilla* has a slender, pointed process posteromesally that arises preapically; in *W. occidea* the process is smaller and truncate posteromesally and arises subapically. Tergum X in *W. clauseni* is nearly triangular, broad, concave laterobasally, bulged medially, and widely rounded apically. Tergum X in *W. anilla* and *W. occidea* is triangular, straight laterally, and slightly pointed apically. When viewed laterally, the apical segment of the inferior appendage in *W. clauseni* is thick and very weakly concave medially, and with the apex uniformly and widely rounded. The apical segment of the inferior appendage in *W. anilla* is slightly concave medially and widely rounded apically; in *W. occidea* it is straight medially, and very slightly truncately rounded apically.

Adult. Length of male forewing 6 mm (holotype). Head brown, with yellowish setae. Antenna long, slender, brown, with small, lighter setae. Maxillary palps yellowish, with lighter setae, fifth segment the longest, first segment the shortest, third longer than second and fourth, second and fourth subequal. Labial palps yellowish, with lighter setae, first and second segments sub-equal, third segment the longest. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 32). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 33).



FIGURES 27–31. *Wormaldia clauseni,* new species. Male genitalia: 27—left lateral view; 28—dorsal view; 29—ventral view; 30—apical segment of right inferior appendage, dorsal view; 31—phallic sclerites, left lateral view.



FIGURES 32–33. *Wormaldia clauseni*, new species. Wings: 32—right forewing, dorsal view; 33—right hind wing, dorsal view.

Male genitalia (Figs. 27–31). Sternum VII with broad, convex posteromesal process, less than 0.2 times length of sternum VIII. Tergum VIII straight or weakly concave posteriorly. Sternum VIII with small, broad, convex posteromesal process, about 0.1 times length of posteromesal process of sternum VII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, slender and nearly rectangular in appearance, convexly projected anteriorly, weakly sinuous posteriorly; when viewed ventrally, weakly concave anteriorly, nearly straight posteriorly with stout, elongate, truncate, mesal process arising preapically. Segment X, when viewed dorsally, nearly triangular, elongate, concave anterolaterally, bulged medially, narrowest and widely rounded posteriorly; when viewed laterally, stout, rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, slightly shorter than segment X, slender, rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, elongate, broadest medially, convex dorsally, relatively straight ventrally; apical segment stout, rectangularly elongate, nearly equal in length, somewhat narrower than basal segment, weakly concave medially, widened and rounded posteriorly; when viewed dorsally, apical segment stout, tubularly elongate, narrowest and rounded posteriorly, with elongate apicolateral patch of short, thin, black, spine-shaped setae on inner margin; when viewed ventrally, basal segments paired, united for about their anterior three-quarters, separated posteromesally by a shallow, broad, concave emargination, each basal segment thick, widest medially, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous api-

cally, very lightly sclerotized, with three visible, small, sclerotized, internal processes (Fig. 31), surrounded by highly convulated membranes with a group of many minute, slender, pointed, internal sclerites.

Holotype: Male. **CANADA: British Columbia:** Agassiz [49º 14' N, 121º 46' W], 19.v.1927, H.H. Ross (in INHS, Type INHS # 16199).

PARATYPES: CANADA: same data as holotype except, 1 male (in UMSP, Type INHS # 16202); **British Columbia:** Cultus Lake, R. Ck. [49º 04' N, 121º 58' W], 12.v.1935, W.E. Ricker, 1 male (in INHS, Type INHS # 16200); same data except, 1 male (in NMNH, Type INHS # 16201).

Etymology. This species is named in honor of Dr. Philip J. Clausen of the University of Minnesota Insect Collection (UMSP), who is an exceptional and happy curator and human being. The senior author is deeply thankful for his valuable collaboration, advice, and friendship. Muchas Gracias Felipe!

Distribution. Canada: British Colombia.

***Wormaldia gabriella* (Banks)**
Figures 34–40, 130

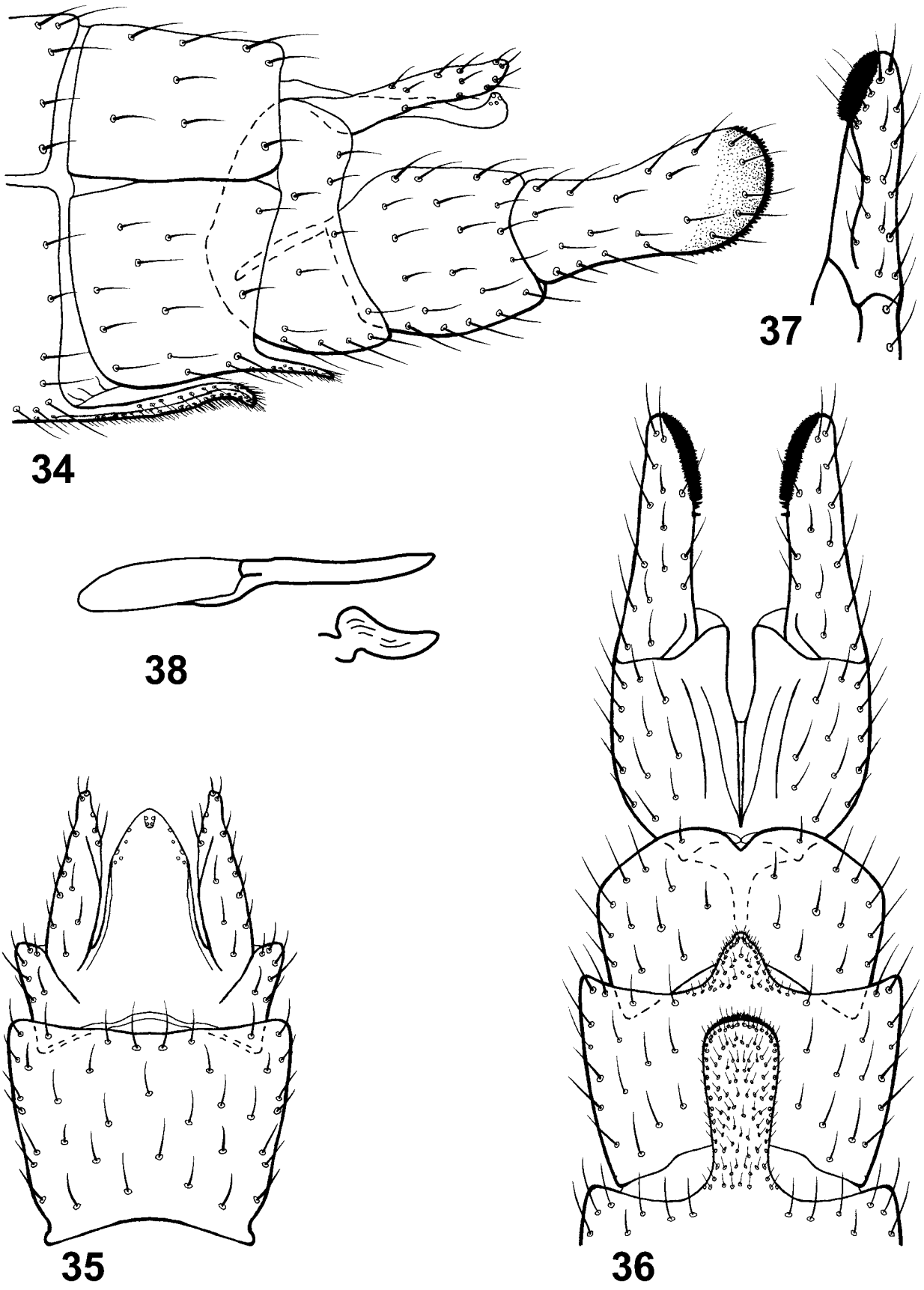
Wormaldia gabriella (Banks) 1930: 230, 231, pl. 12, fig. 14, male, California, USA (CAS) (in *Dolophiliella*); Betten 1934: 170 (*Dolophiliella* as subgenus of *Dolophilus*); Milne 1934–1936: 82, 83 (as *Dolophilus gabriella*); Ross 1938c: 7, 8 (lectotype [MCZ 16326] is male, as *Dolophilus gabriella*); Ross 1944: 292 (as *Dolophilus gabriella*); Ross 1949: 155, 156 (transferred to *Wormaldia*); Ross 1956: 42, 61, 65, fig. 84; Denning 1956a: 79; Denning 1956b: 248, fig. 10: 16C; Denning 1958: 93, figs. 4 A, B; Fischer 1961: 45; Fischer 1971: 190; Nimmo 1974: 316, 330, 333, 334, 336, 337, figs. 679 A–C, 770–779, 783; Schmid 1982: 31–33, 72 (map 15), figs. 146, 148, 149, 156, 157; Schmid 1991: 93; 1998: 45, 215, figs. 111–115; Armitage 1996: [work not paginated].

Ross (1949, 1956) and Armitage (1996) placed this species within the *W. moesta* Group.

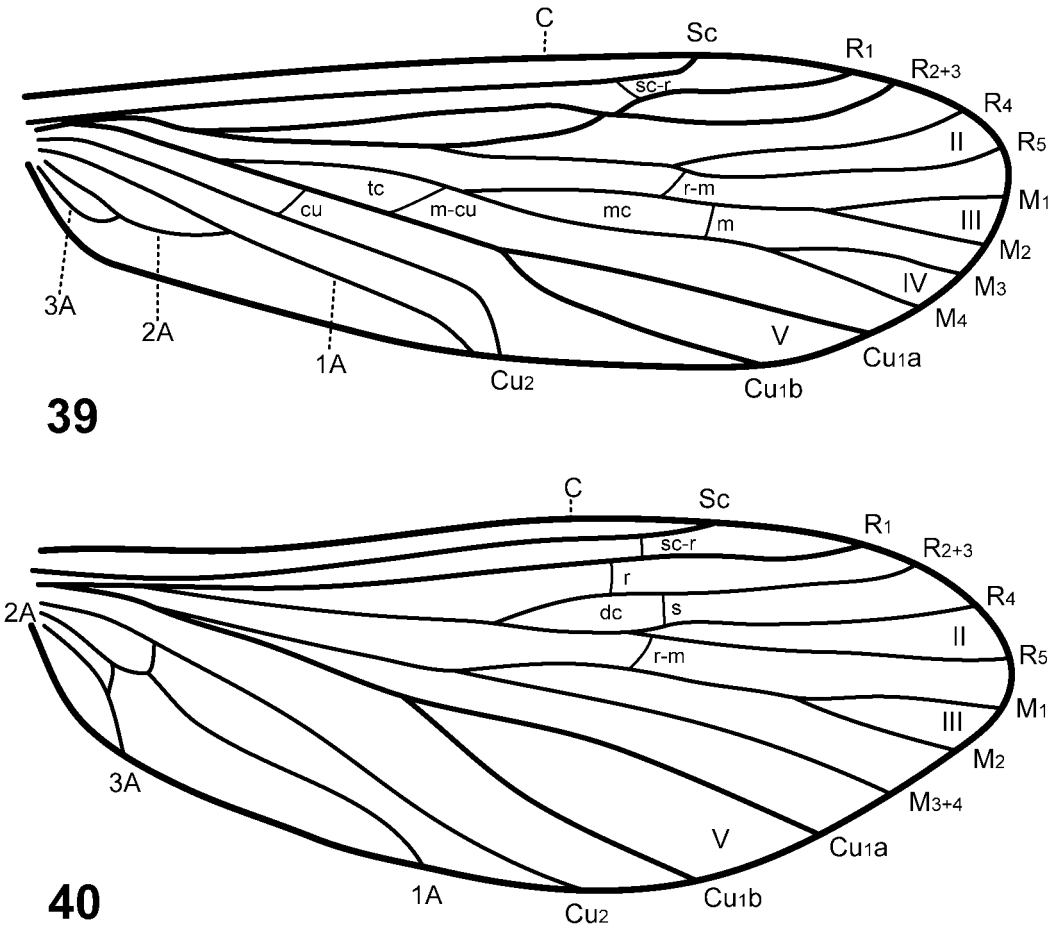
This species is closely related to *W. lacerna* Denning (1958) and *W. moesta* (Banks 1914). However, *W. gabriella* can be distinguished from those species in the shapes of tergum VIII, sterna VIII and IX, and the inferior appendage. Tergum VIII in *W. gabriella* is relatively straight posteriorly. Tergum VIII in *W. lacerna* has a U-shaped emargination posteromesally; in *W. moesta* it is slightly sinuous or slightly straight posteromesally. Sternum VIII in *W. gabriella* has an elongate and triangular process posteromesally. Sternum VIII in *W. lacerna* is slightly sinuous posteriorly with a convexity mesally; in *W. moesta* it has an elongate and digitate process posteromesally. Sternum IX in *W. gabriella* is convexly projected posteriorly with a small and V-shaped emargination mesally. Sternum IX in *W. lacerna* is weakly projected convexly posteriorly with a shallow concavity mesally; in *W. moesta* it has a slender and subtriangular process posteromesally. When viewed laterally, the apical segment of the inferior appendage in *W. gabriella* and *W. lacerna* is strongly elongate, longer than the basal segment, slightly concave dorsomedially, and with the apex extended and slightly projected posterodorsally. The apical segment of the inferior appendage in *W. moesta* is elongate, equal in length to the basal segment, straight medially, and the apex is narrowest and truncately rounded.

Adult. Length of male forewing 6–8 mm (holotype: 7 mm). Head brown, with yellowish setae. Antenna long, slender, yellowish with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks II, III, IV, and V present (Fig. 39; Schmid 1982: fig. 146, 1998: fig. 111). Hind wing translucent, with very few fine, small, brown setae, with apical forks II, III, and V present (Fig. 40; Schmid 1982: fig. 146, 1998: fig. 111).

Male genitalia (Figs. 34–38). Sternum VII with prominent, digitate posteromesal process strongly elongate, equal in length to sternum VIII, widely rounded apically. Tergum VIII relatively straight posteriorly. Sternum VIII with elongate, triangular, posteromesal process, about 0.3 times length of posteromesal process of sternum VII. Segment IX, when viewed dorsally, weakly concave anteriorly; when viewed laterally, nearly



FIGURES 34–38. *Wormaldia gabriella* (Banks). Male genitalia: 34—left lateral view; 35—dorsal view; 36—ventral view; 37—apical segment of left inferior appendage, dorsal view; 38—phallic sclerites, left lateral view.



FIGURES 39–40. *Wormaldia gabriella* (Banks). Wings: 39—right forewing, dorsal view; 40—right hind wing, dorsal view.

C-shaped in appearance, convex anteriorly, concave posteriorly; when viewed ventrally, concave anteriorly, convexly projected posteriorly with small and acute emargination mesally. Segment X, when viewed dorsally, triangularly elongate, slightly concave anteromedially, bulged preapically, narrowly rounded apically, with minute and knob-shaped projection apicomesally; when viewed laterally, slender, very slightly upcurved and produced apicodorsally. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, narrowly rounded apically; when viewed laterally, slender, tubularly elongate, nearly equal in length to segment X. Inferior appendages two segmented; when viewed laterally, basal segment broad, subrectangular, elongate, broadest and convex medially, apical segment, stout, rectangular, strongly elongate, longer (about 1.3 times) and narrower than basal segment, slightly concave and narrowest medially, produced and widely rounded posterodorsally; when viewed dorsally, apical segment subrectangularly elongate, narrowest and subovate posteriorly, with elongate and apicolateral patch of short, thin, black, stout, spine-shaped setae; when viewed ventrally, basal segments paired, united for about their anterior three-fifths, separated posteromesally by a narrow, deep, U-shaped emargination, each basal segment stout, broadest medially, with outer margin convexly curved anteromedially, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with two visible, internal sclerites (Fig. 38).

Material examined. CANADA: British Colombia: Cultus Lake, 24.vi.1932, W.E. Ricker, 1 male (INHS); same except, 7.vii.1932, S.Ck. & W.E. Ricker, 4 males (in alcohol, INHS); 30.vii.1932, W.E. Ricker, 1 male (INHS); same except, 11.ix.1933, 1 male (INHS); 18.ix.1933, 1 male (INHS); 18.ix.1933, 6 males, 10 females (INHS); 21.ix.1933, 1 male (INHS); 29.ix.1933, 7 males, 6 females (INHS); 30.x.1933, 1 male, 1

female (INHS); 5.xi.1933, 1 male (INHS); 8.xi.1933, 3 males, 2 females (INHS); 12.x.1936. 4 males, 11 females (INHS); 22.x.1936, 1 male (INHS); 1.xi.1936, 3 males (INHS); 23.vii.1936, H.H. Ross, 1 male (in alcohol, INHS); Oliver, 11.ix.1923, C.B. Garret, 2 males (INHS); same except, 12.ix.1923, 3 males (1 in CNC, 2 in INHS); 23.ix.1923, 3 males (2 in CNC, 1INHS); Vedder Crossing, 28.ix.1937, W.E. Ricker, 1 male, 1 female (in alcohol, INHS); Vancouver, Beaver Creek, 30.vi.1940, J.A. & H.H. Ross, 3 males, 7 females (in alcohol, INHS); S. Vancouver Is., 26.ix.1950. R. Guppy, 1 male (CNC); North of Haney, 12.viii.1946, E.T. Calvert, 1 male (in alcohol, INHS); **Manitoba:** Herchmer, 1.viii.1937, D.G. Denning, 1 male (UMSP). **USA: California:** small Creek nr. Flats Reservoir on King's Rd., 14.ii.1958, W.E. Ricker, 4 males, 1 female (in alcohol, INHS); Kern Co.: Kern River, Power House # 3, 25.ix.1940, Kaloostain & Simmons, 3 males, 4 females (in alcohol, INHS); Kern River at Kernville, 13.ii.1958, W.E. Ricker, 5 males (in alcohol, INHS); Lake Co.: Trib. E. Fork middle Creek, 7 mi [= 11.2 km] N of Upper Lake [~ 39º 10' N, 122º 55' W], 3.vi.1975, P.A. Peterson (in alcohol, CAS); Los Angeles Co.: Los Angeles National Forest, San Gabriel Canyon, Cold Brook at Camp Ground, 12.ii.1958, W.E. Ricker, 1 male, 1 female (in alcohol, INHS); *Lectotype*: Male, Mts. San Gabriel, 29.vi.(?) (in MCZ, # 16326); *Paratypes*: 4 Males, Mts. San Gabriel, 29.vi.(?) (3 males in MCZ, Paratype Types # 16326; 1 male in INHS, Paratype # 16326, INHS-Type # 16290); same except, Switzers Camp, 1 male (in MCZ, Type # 16326); Marin Co.: Sam P. Taylor State Park, Paper Mill Creek, 19.x.1976, L.D. Unzicker, V. Resh & D.G. Denning, 1 male (in alcohol, INHS); Mendocino Co.: South Fork, Eel River, Hickey Grove State Park, 26.vi.1950, W.E. Ricker, 1 male, 1 female (in alcohol, INHS); Mono Co.: Convic Creek, 19.ix.1937, H.J. Rayner, 4 males, 5 females (in alcohol, INHS); Monterey Co.: Big Sur State Park, 24.vii.1954, W. McDonald, 1 male (in alcohol, CAS); Placer Co.: Sout Fork Yuba River, 5 mi [= 8 km] E of Cisco Grove, 11.x.1966, D.G. Denning, 55 males, 18 females (in alcohol, CAS); Plumas Co.: Feather Rivet at Chester, 23.viii.1955. W.E. Ricker, 2 males, 1 female (in alcohol, INHS); San Luis Obispo Co.: Cuesta Canyon County Park, 11.vi.1975, D.G. Denning, 14 males (in alcohol, INHS); Santa Cruz Co.: Sempervirens Creek, Big Basin Redwoods State Park, 5.x.1973, Ross & Ross, 1 male, 1 female (in alcohol, INHS); Sonoma Co.: Creek near Colen Ellen, 18.viii.1974, D.G. Denning, 4 males, 2 females (in alcohol, CAS); **Colorado:** N West Creek, 20.viii.1958, Ross & Ross, 1 male (in alcohol, INHS); Larimer Co.: Big Thompson Creek along Hwy 34, 6.1 mi [= 11.3 km] NE Estes Park, 40º 24.531' N, 105º 23.892' W, 2100 m, 19.viii.1994, Holzenthal & Huisman, 1 male (UMSP); **Nevada:** Washoe Co.: Verdi, Fish Hatchery, 9.x.1953, C.S. Richards, 105 males, 9 females (in alcohol, INHS); **Oregon:** Benton Co.: Rock Creek, Philomath, 19.x.1934, 3 males (INHS); Clatsop Co.; Vic. Gronnel Rd., ca. 2 mi [= 3.2 km] E of Elsie, 22–23.vii.1937, S.G. Jewett, Jr. 1 male (in alcohol, INHS); Curry Co.: Humbug Mt. State Park, 11.viii.1948, K.M. Fender, 1 male (in alcohol, INHS); Klamath Co.: Deer Creek, NE Blg., 24.ix.1967, J. Schirk, 3 males, 4 females (in alcohol, CAS); Lincoln Co.: Yaquina River, Eddyville, 30.ix.1934, R.E. Dimick, 2 males (INHS); Linn Co.: Santiam River, Foster, 14.x.1934, 1 male (INHS); Marion Co.: Stayton, 16.vi.1965, F. Schmid, 3 males, 2 females (CNC); Yamhill Co.: Peavine Ridge, nr. McMinnville, 18.ix.1948, K.M. Fender, 1 male, 1 female (in alcohol, INHS); **South Dakota:** Lawrence Co.: Spearfish, 27.vii.1940, T.H. Jr. & T.H. Frison, 2 males (in alcohol, INHS); Black Hills National Forest, Boxelder Creek, 1.8 mi [= 2.8 km] W Nemo, 44º 11.846' N, 103º 32.024' W, el. 1470 m, Holzenthal & Huisman, 3 males (UMSP); **Utah:** Box Elder Co.: Mantua, 4.ix.1943, G.F. Knowlton, 9 males, 1 female (in alcohol, INHS); same except, 13.ix.1943, G.F. Knowlton, 6 males (in alcohol, INHS); Cache Co.: Logan, 3.ix.1943, G.F. Knowlton, 1 male (in alcohol, INHS); same except, 6.xi.1937, 4 males (INHS); Daggett Co.: Ashley National Forest, Sheep Creek on F.R. 221, 40º 53.363' N, 109º 53.049' W, el. 2590 m, 27.viii.1994, Holzenthal & Kjer, 11 males, 12 females (UMSP); Utah Co.: Provo River Survey, Vivien Park, 7.viii.1947, A.R. Gaufin, 33 males, 12 females (in alcohol, INHS); Weber Co.: Ogden Canyon, 9.x.1939, D.E. Hardy, 1 male (in alcohol, INHS); Wasatch Co.: Uintah National Forest, Daniels Creek, Hwy 40 at Center Canyon Rd., 40º 22.576' N, 111º 17.602' W, el. 2040 m, 28.viii,1994, Holzenthal & Kjer, 27 males, 3 females (UMSP); **Washington:** Whatcom Co.: Belligham, 29.vii.(?), 2 males (INHS); Olson Creek, 27.viii.1971, H.H. Ross, 2 males, 1 female (in alcohol, 2 vials, INHS); **Wyoming**: Park Co.: Yellowstone

National Park, Firehole River, North of Faithful Inn, 1.viii.1940, T.H. Jr. & T.H. Frison, 1 male (in alcohol, INHS); Teton Co.: Grand Teton National Park, Beaver Creek, 8.viii.1940, T.H. Jr. & T.H. Frison, 48 males, 7 females (in alcohol, 3 vials, INHS); same except, 10.viii.1940, 4 males, 1 female (in alcohol, INHS); Taggot Creek, 7.viii.1940, 1 male (in alcohol, INHS).

Distribution. Canada: AB, BC, MB (new record), NT, PQ, YT. USA: CA, CO, ID, MT, NV, OR, SD (new record), UT, WA, WY (new record).

***Wormaldia gesugta* Schmid**
Figures 41–45, 131

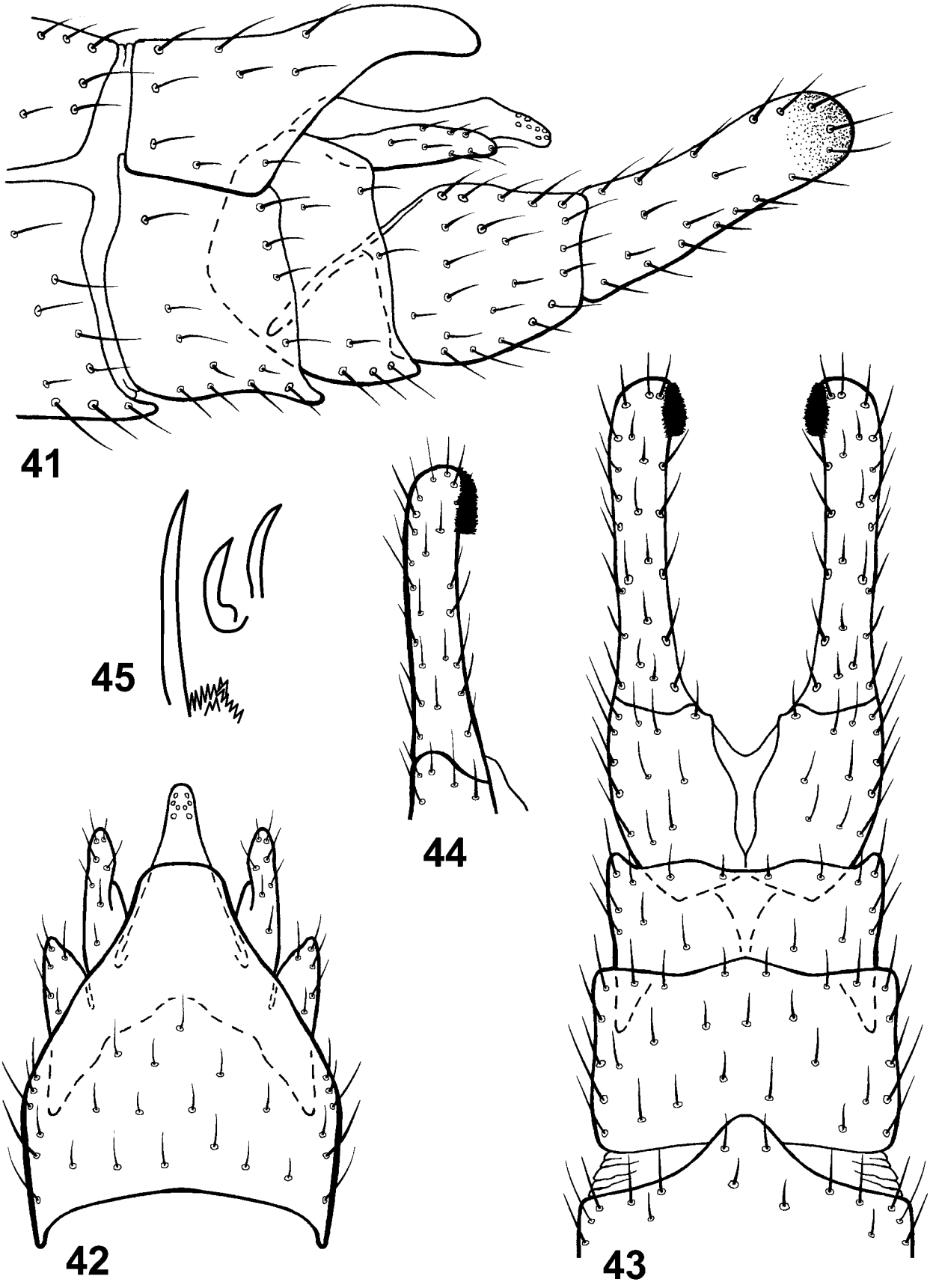
Wormaldia gesugta Schmid 1968: 674, figs. 1–4, male, California, USA (CNC), Denning 1989: 127 (as *W. quesugta*); Armitage 1996: [work not paginated].

According to the species group arrangement proposed by Ross (1956) and modified by Armitage (1996), *W. gesugta* would belong within the *W. thyria* Group (Table 1).

This species, *Wormaldia hamata* Denning (1951), *W. laona* Denning (1989), *W. oconee* Morse (1989), *W. mohri* (Ross 1948), and *W. thyria* Denning (1950), are similar in having tergum VIII strongly projected posteriorly, when viewed laterally, it is hood-shaped, which differentiates these six species from the other Nearctic *Wormaldia*. Finally, *W. gesugta* differs from all five former species as detailed in the diagnoses of those species.

Adult. Length of male forewing 5 mm (holotype). Head light brown, with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax light brown. Legs light brown, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, and V present. Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present.

Male genitalia (Figs. 41–45). Sternum VII with broad, convexly triangular, posteromesal process slightly elongate, about 0.2 times length of sternum VIII. Tergum VIII subtriangular in appearance, strongly projected posteriorly, reaching middle of tergum X, narrowest and rounded posteromesally; when viewed laterally, hood-shaped, slightly sinuous dorsally, concave posteriorly, with posterodorsal corner widely rounded apically. Sternum VIII with slightly convex and posteromesal process, smaller than posteromesal process of sternum VII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anteriorly, very weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, very weakly sinuous posteriorly and nearly straight mesally. Segment X, when viewed dorsally, triangularly elongate, narrowly rounded apically; when viewed laterally, sinuous dorsally, narrowly rounded apically. Superior appendages, digitate; when viewed dorsally, parallel with segment X, elongate, bulged medially, rounded apically; when viewed laterally, slightly shorter than segment X, stout, narrowly rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment thick, subrectangular, slightly elongate, broadest and convex medially, apical segment stout, rectangular, strongly tubularly elongate, longer (about 1.3 times) and narrower than basal segment, widely rounded posteriorly; when viewed dorsally, apical segment slender, tubularly elongate, wide and rounded posteriorly, with rounded and apicolateral patch of short, thin, black, spine-shaped setae on inner margin; when viewed ventrally, basal segments paired, united for about their anterior three-quarters, separated posteromesally by a broad, moderately deep, U-shaped emargination, each basal segment thick, widest medially, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 45).



FIGURES 41–45. *Wormaldia gesugta* Schmid. Male genitalia: 41—left lateral view; 42—dorsal view; 43—ventral view; 44—apical segment of right inferior appendage, dorsal view; 45—phallic sclerites, left lateral view.

Material examined. USA: California: *Holotype*: Male, Del Norte Co.: Gasquet [~ 41º 51' N, 124º 00' W], 4.vi.1965, F. Schmid (CNC, Type # 9645).

Distribution. USA: CA.

***Wormaldia hamata* Denning**

Figures 46–52, 131.

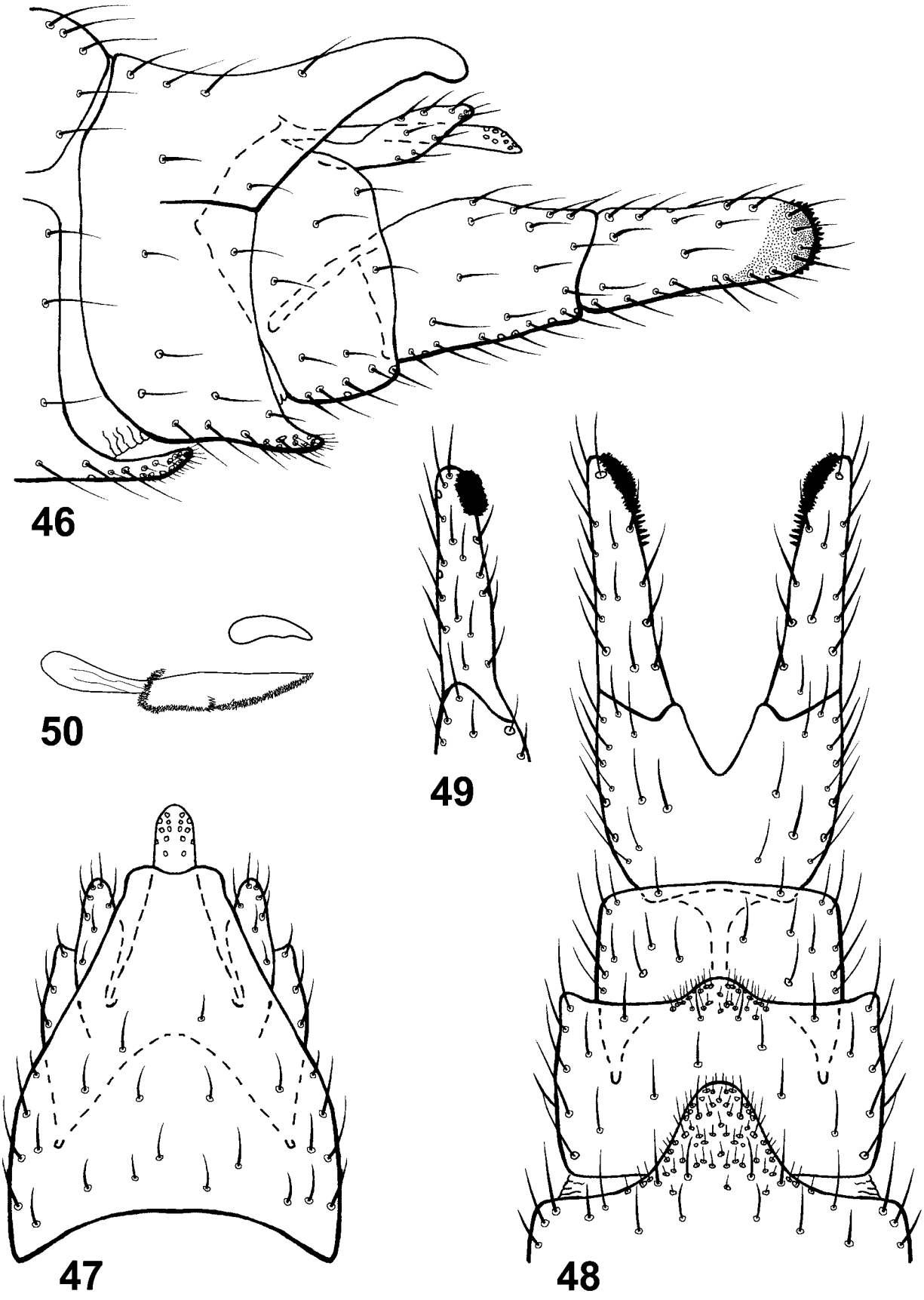
Wormaldia hamata Denning 1951: 158, figs. 2 A, B, male, California, USA (CAS); Ross 1956: 38, 61, 62, figs. 69 A–C; Denning 1956a: 79; Denning 1956b: 248, fig. 10: 16D; Fischer 1971: 191; Armitage 1996: [work not paginated].

Denning (1951) placed this species within subgroup 3 of the *W. moesta* Group of Ross (1949). Subsequently, Ross (1956) reconsidered his former species group proposal and transferred *W. hamata* to the *W. anilla* Group. In 1996, Armitage modified Ross's species group proposal and relocated *W. hamata* within the *W. thyria* Group (Table 1).

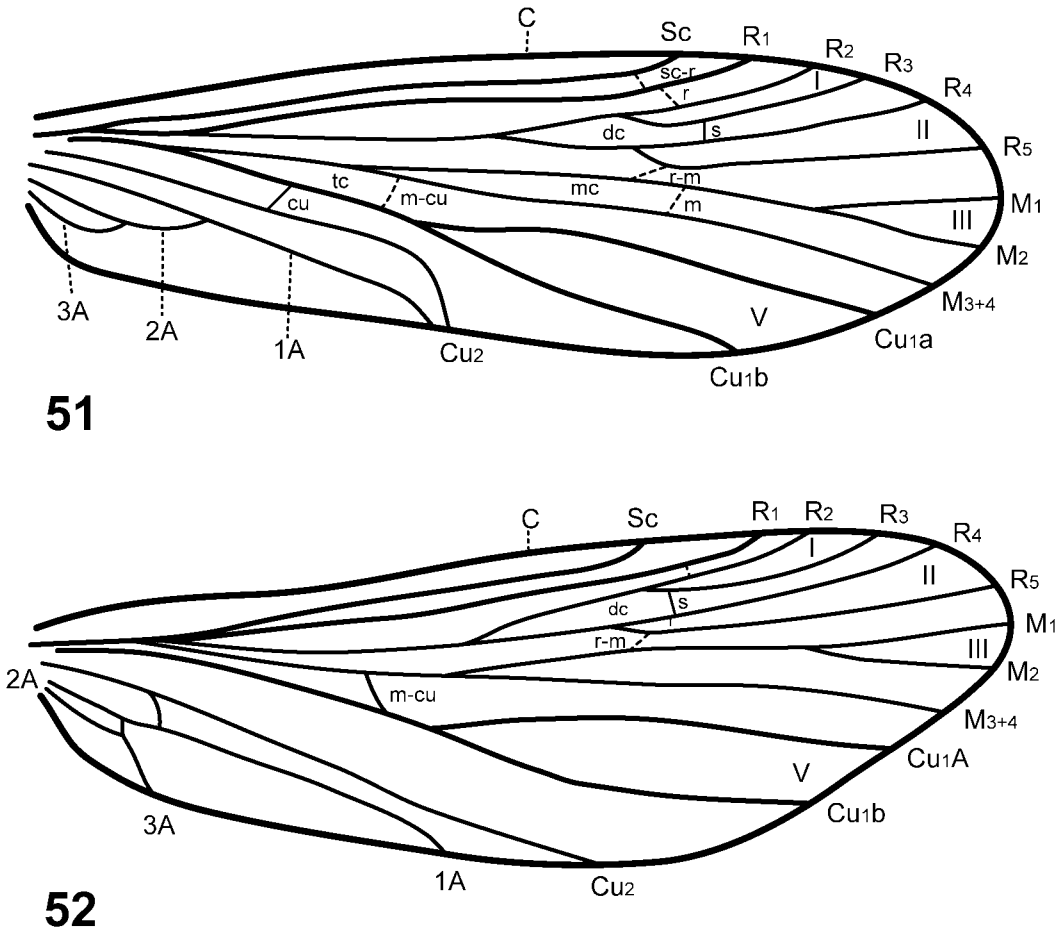
The genitalia of this species, *Wormaldia gesugta* Schmid (1968), *W. laona* Denning (1989), *W. mohri* (Ross 1948), *W. oconee* Morse (1989), and *W. thyria* Denning (1950) are similar in having tergum VIII strongly projected posteriorly, when viewed laterally it simulates a hood, which differentiates these six species from the other Nearctic *Wormaldia*. However, *W. laona, W. mohri,* and *W. oconee* can be separated from *W. hamata, W. gesugta,* and *W. thyria,* as detailed in the diagnoses of the first three species. This species can be separated from *W. gesugta* and *W. thyria* by the shapes of tergum VIII, segment IX, and the inferior appendage. Tergum VIII in *W. hamata* is strongly projected subtriangularly, beyond the middle of tergum X, and narrow and truncate posteromesally. Tergum VIII in *W. gesugta* is subtriangularly projected, reaching the middle of tergum X, and narrow and rounded posteromesally; in *W. thyria* it is slightly projected convexly, barely surpassing the bases of tergum X and superior appendages, and broad and slightly straight posteromesally. When viewed laterally, segment IX in *W. hamata* is acutely convex anteromedially. Segment IX in *W. gesugta* is convex anteriorly; in *W. thyria* it is broad with a strong projection convexly elongate anteromedially. Sternum IX in *W. hamata* is straight posteriorly. Sternum IX in *W. gesugta* is very weakly sinuous posteriorly; in *W. thyria* it has a deep, wide, and V-shaped emargination posteriorly. When viewed laterally, the basal segment of the inferior appendage in *W. hamata* and *W. thyria* is straight ventrally, elongate and equal in length to the apical segment. The basal segment of the inferior appendage in *W. gesugta* is convex ventrally, weakly elongate, and clearly shorter than the apical segment.

Adult (in alcohol). Length of male forewing 5 mm (holotype). Head brown, with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 51). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 52).

Male genitalia (Figs. 46–50). Sternum VII with prominent, broad, convexly triangular, posteromesal process strongly elongate, about 0.5 times length of sternum VIII. Tergum VIII subtriangular in appearance, strongly projected posteriorly, beyond middle of tergum X, narrowest and slightly truncate posteromesally; when viewed laterally, hood-shaped, sinuous dorsally, slightly concave posteriorly, with posterodorsal corner rounded apically. Sternum VIII with slight, convex, posteromesal process, about 0.2 times length of posteromesal process of sternum VII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, slender and nearly subrectangular in appearance, acutely convex anteriorly, relatively straight posteriorly; when viewed ventrally, concave anteriorly, straight posteriorly. Segment X, when viewed dorsally, triangularly elongate, narrowest and rounded apically; when viewed laterally, slender, slightly pointed apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, elongate, bulged medially, rounded apically; when viewed laterally, shorter than segment X, subovally elongate posteromedially. Inferior



FIGURES 46–50. *Wormaldia hamata* Denning. Male genitalia: 46—left lateral view; 47—dorsal view; 48—ventral view; 49—apical segment of right inferior appendage, dorsal view; 50—phallic sclerites, left lateral view.



FIGURES 51–52. *Wormaldia hamata* Denning. Wings: 51—right forewing; 52—right hind wing.

appendages two segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest medially, convex dorsally, straight ventrally, apical segment stout, rectangular, tubularly elongate, nearly equal in length, narrower than basal segment, wide and rounded posteriorly; when viewed dorsally, apical segment as in ventral view, when viewed ventrally, basal segments paired, united for about their anterior three-fifths, separated posteromesally by a wide, moderately deep, V-shaped emargination, each basal segment stout, widest medially, with outer margin slightly convexly curved anteriorly, apical segment slender, subtriangularly elongate, narrowest and subovate posteriorly, with elongate and apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with many small, visible, internal sclerites (Fig. 50), surrounded by highly convulated membranes.

Material examined. USA: California: *Holotype*: Male, Trinity Co.: Hayden Flats, Trinity River, 30.vii.1950, 1200 ft [= 366 m], C.P. Alexander (in alcohol, CAS).

Distribution. USA: CA.

***Wormaldia lacerna* Denning**
Figures 53–59, 130

Wormaldia lacerna Denning 1958: 93, 94, figs. 2 A–C, male, Washington, USA (CAS); Fischer 1971: 191; Armitage 1996: [work not paginated].

Denning (1958) placed this species within the *W. moesta* Group, as defined by Ross (1956) for this genus and accepted by Armitage (1996) (Table 1).

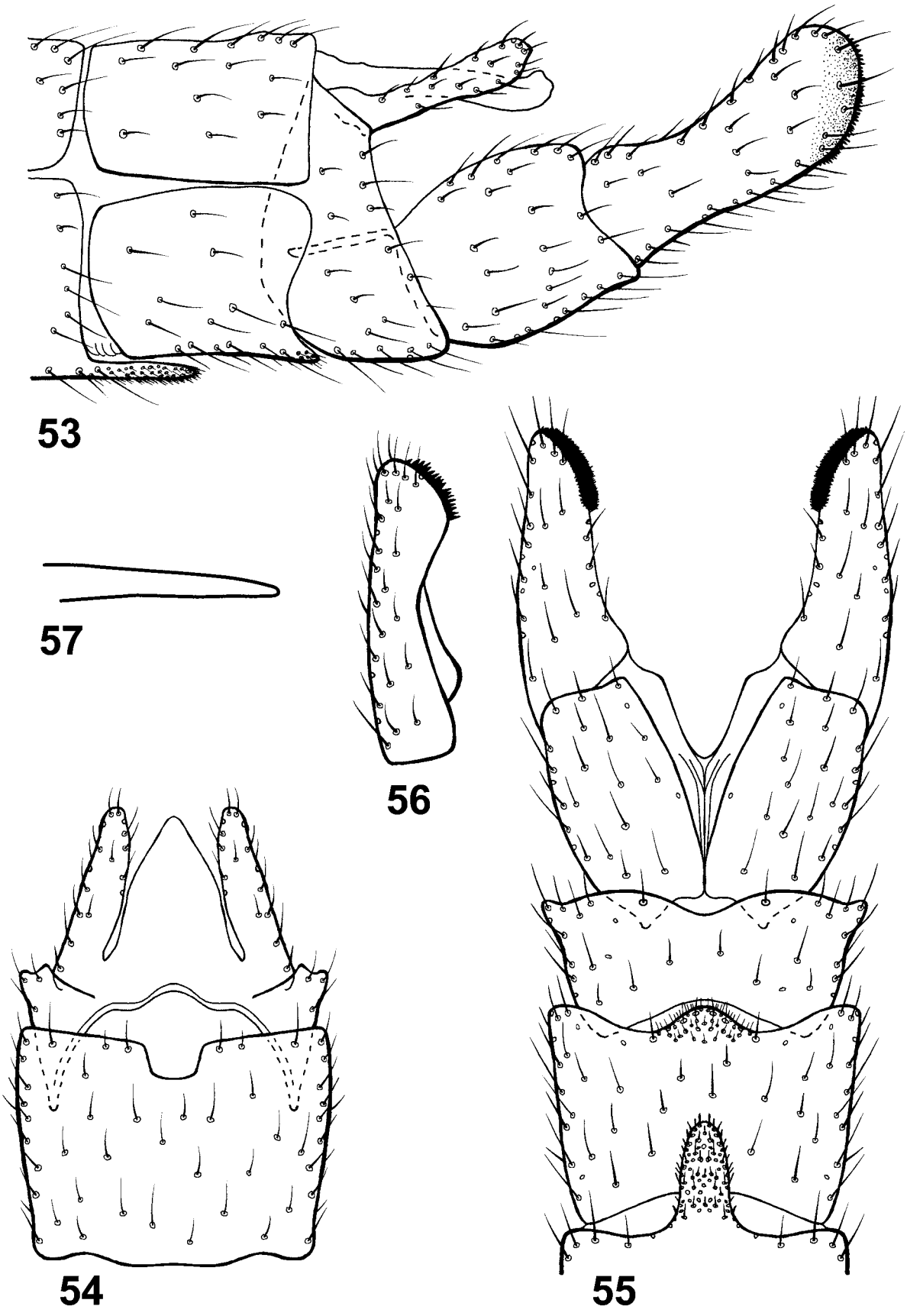
This species is similar to *Wormaldia moesta* (Banks 1914), but differing by the shapes of tergum VIII, sterna VIII and IX, and the inferior appendage. Tergum VIII in *W. lacerna* has a U-shaped emargination posteromesally. Tergum VIII in *W. moesta* is slightly sinuous or slightly straight posteromesally. Sternum VIII in *W. lacerna* is slightly sinuous posteriorly with a convexity mesally. Sternum VIII in *W. moesta* has an elongate and digitate process posteromesally. Sternum IX in *W. lacerna* is weakly projected convexly posteriorly with a shallow concavity mesally. Sternum IX in *W. moesta* has a slender and subtriangular process posteromesally. When viewed laterally, the apical segment of the inferior appendage in *W. lacerna* is strongly elongate, longer than the basal segment, slightly concave dorsomedially, and with the apex extended and slightly projected posterodorsally. The apical segment of the inferior appendage in *W. moesta* is elongate, equal in length to the basal segment, straight medially, and the apex is narrowest and truncately rounded. Otherwise, *W. lacerna* is similar to *W. gabriella*, but can be differentiated as detailed in the diagnosis of that species.

Adult (in alcohol). Length of male forewing 6 mm (holotype). Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps light brown, with lighter setae. Labial palps light brown, with lighter setae. Dorsum of thorax brown. Legs light brown, with small, yellowish setae. Forewing yellowish, covered with fine, small, light brown setae, with apical forks II, III, IV, and V present (Fig. 58). Hind wing translucent, with very few fine, small, brown setae, with apical forks II, III, and V present (Fig. 59).

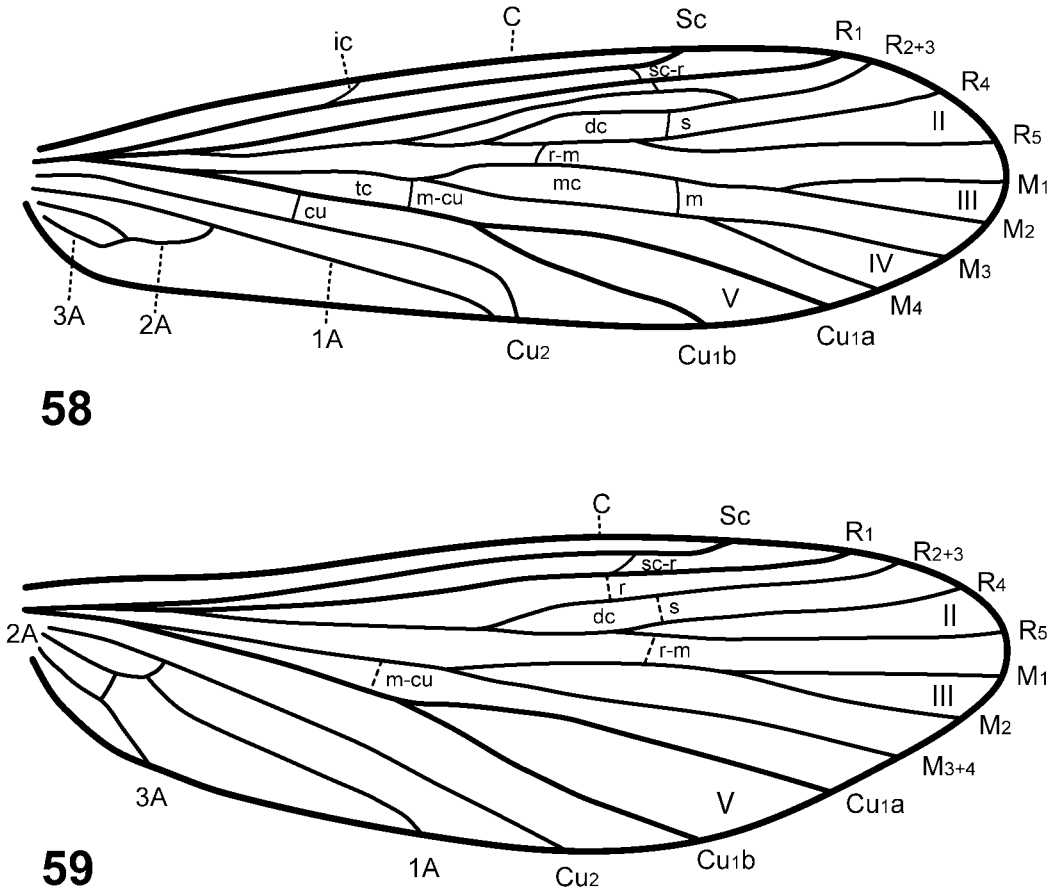
Male genitalia. (Figs. 53–57). Sternum VII with conspicuous, digitate, posteromesal process strongly elongate, about 0.5 times length of sternum VIII, rounded apically. Tergum VIII straight posteriorly with conspicuous, U-shaped, mesal emargination. Sternum VIII sinuous posteriorly with wide and mesal convexity. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broadest ventrally and nearly subrectangular in appearance, convex anteriorly, nearly straight posteriorly; when viewed ventrally, slightly concave anteriorly, slightly convexly projected posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, triangularly elongate, slightly bulged medially, narrowly rounded apically; when viewed laterally, slender, rounded and weakly produced apicodorsally. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, nearly equal in length to segment X, tubularly elongate. Inferior appendages two segmented; when viewed laterally, basal segment broad, subrectangular, elongate, broadest and convex medially, apical segment stout, rectangular, strongly elongate, longer (about 1.3 times) and narrower than basal segment, slightly concave and narrowest medially, produced and widely rounded posterodorsally; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments paired, united for about their anterior three-fifths, separated posteromesally by a deep and U-shaped emargination, each basal segment robust, widest medially, with outer margin slightly convexly curved, apical segment stout, slightly incurved medially, narrowest and subovate posteriorly, with elongate and apicolateral patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, spear-shaped, internal sclerite (Fig. 57).

Material examined. USA: Washington: *Holotype*: Male, Klickitat Co.: Satus Creek, near Goldendale, 2.x.1952, D.G. Denning (in alcohol, CAS).

Distribution. USA: WA.



FIGURES 53–57. *Wormaldia lacerna* Denning. Male genitalia: 53—left lateral view; 54—dorsal view; 55—ventral view; 56—apical segment of right inferior appendage, dorsal view; 57—phallic sclerite, left lateral view.



FIGURES 58–59. *Wormaldia lacerna* Denning. Wings: 58—right forewing; 59—right hind wing.

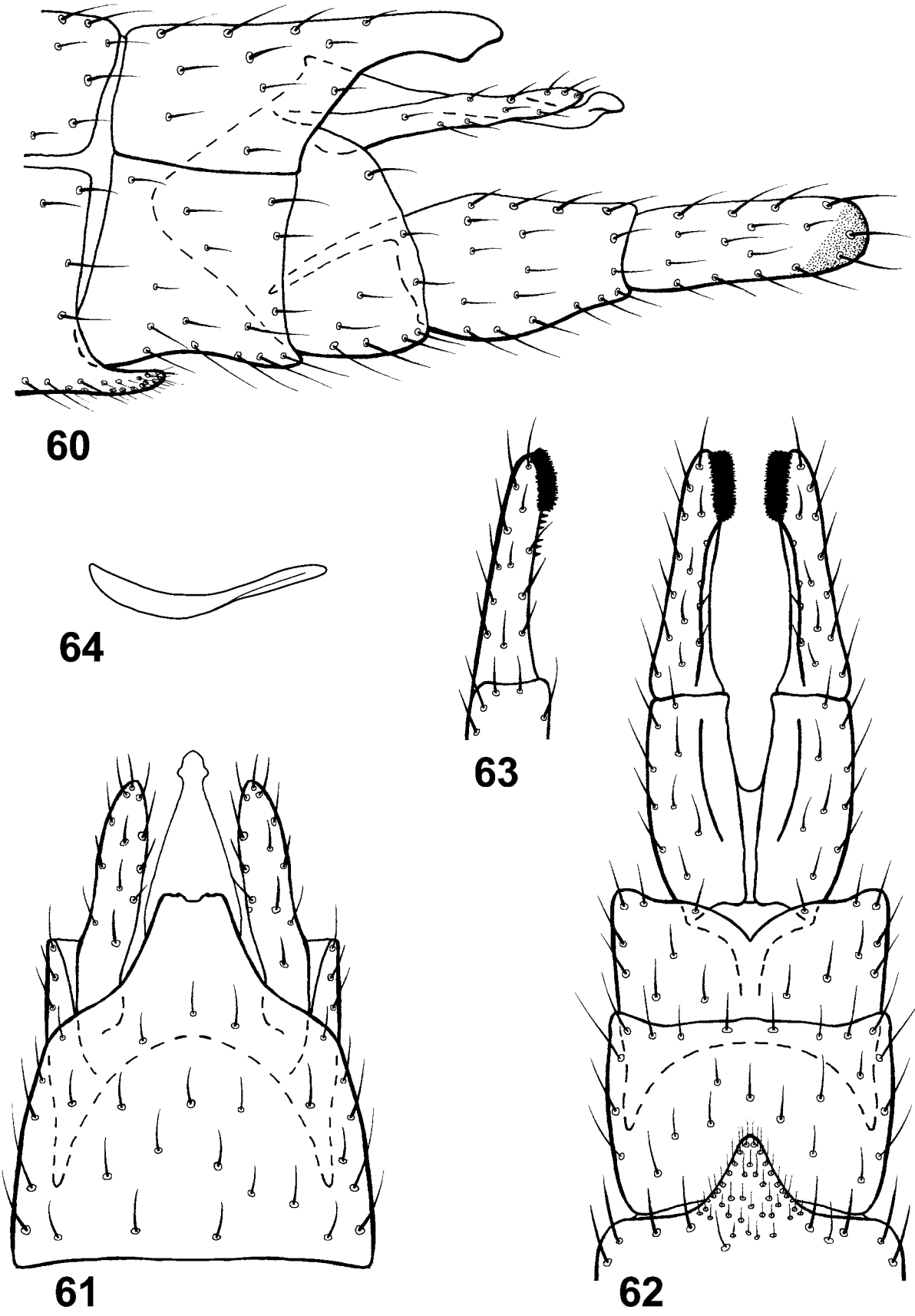
***Wormaldia laona* Denning**
Figures 60–66, 131

Wormaldia laona Denning 1989: 127, fig. 7, male, California, USA (CAS); Armitage 1996: [work not paginated].

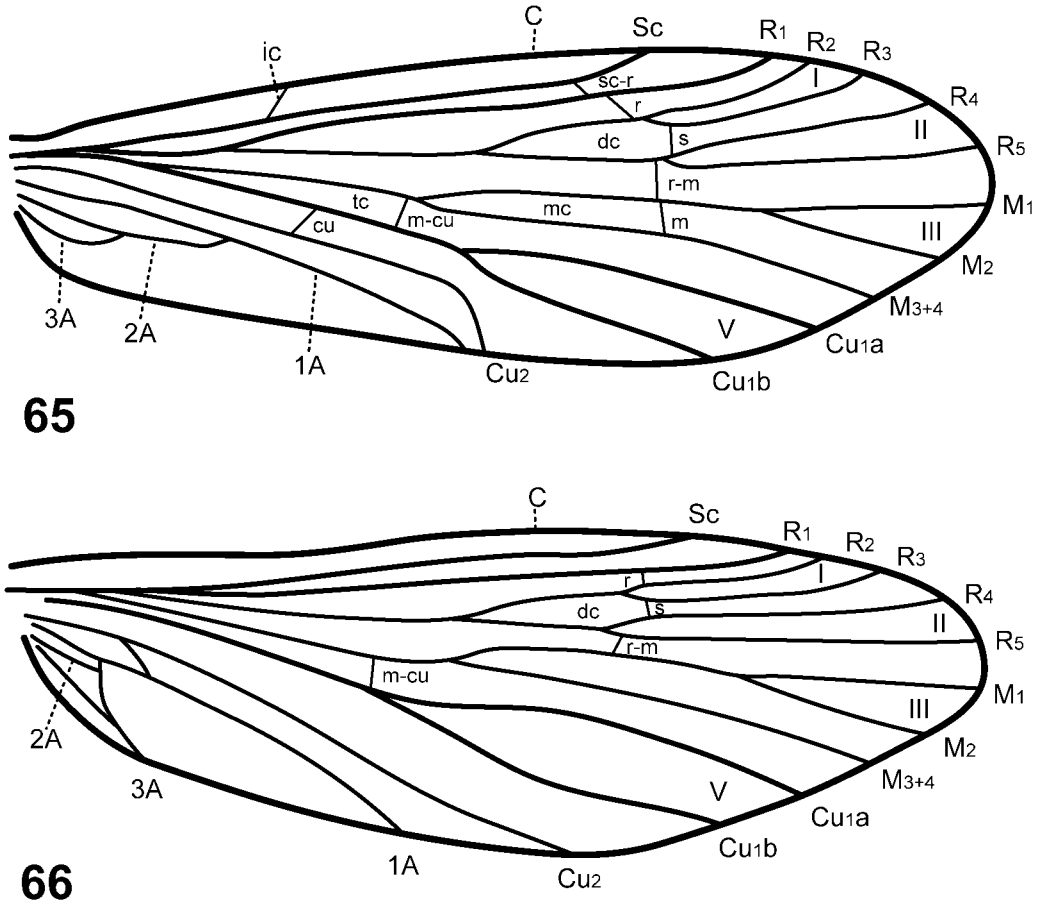
Denning (1989) placed *W. laona* within the *W. thyria* Group [= *thyria* Complex of Ross (1956) for *Wormaldia*]. Subsequently, Armitage (1996) modified Ross' (1956) species group proposal and considered *W. laona* within the *W. thyria* Group (Table 1).

The genitalia of this species, *W. gesugta* Schmid (1968), *W. hamata* Denning (1951), *W. mohri* (Ross 1948), *W. oconee* Morse (1989), and *W. thyria* Denning (1950) are similar in having tergum VIII strongly projected posteriorly; when viewed laterally it looks like a hood, which differentiates these six species from the other Nearctic species of *Wormaldia*. However, *W. laona* is discernible from those five species and other members of *Wormaldia* by the shapes of sternum IX and tergum X. Sternum IX in *W. laona* presents a conspicuous, acute, and V-shaped emargination posteromesally. Tergum X has a concave and preapical constriction; when viewed laterally, it is slender and curved preapically.

Adult (in alcohol). Length of male forewing 6 mm (holotype). Head brown, with yellowish setae. Antenna long, slender, yellowish, and with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, lighter setae, with apical forks I, II, III, and V present (Fig. 65). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 66).



FIGURES 60–64. *Wormaldia laona* Denning. Male genitalia: 60—left lateral view; 61—dorsal view; 62—ventral view; 63—apical segment of right inferior appendage, dorsal view; 64—phallic sclerite, left lateral view.



FIGURES 65–66. *Wormaldia laona* Denning. Wings: 65—right forewing; 66—right hind wing.

Male genitalia (Figs. 60–64). Sternum VII with conspicuous, triangular, posteromesal process strongly elongate, about 0.3 times length of sternum VIII. Tergum VIII subtriangular in appearance, strongly projected posteriorly, reaching middle of tergum X, narrowest and slightly truncate posteromesally, when viewed laterally, hood-shaped, straight dorsally, concave posteriorly, with posterodorsal corner wide and rounded apically. Sternum VIII relatively straight posteriorly. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly subtriangular in appearance, with strong and broad projection convexly elongate anteromedially, convex posteriorly; when viewed ventrally, concave anteriorly, with conspicuous, acute, V-shaped emargination posteromesally. Segment X, when viewed dorsally, triangularly elongate, with conspicuous, concave, lateral constriction preapically, rounded apically; when viewed laterally, slender, curved preapically, slightly pointed apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, slightly shorter than segment X, slender, narrowly rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, elongate, slightly broadest and slightly convex medially, apical segment stout, rectangular, tubularly elongate, nearly equal in length, slightly narrower than basal segment, rounded and wide posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments paired, united for about their anterior halves, separated posteromesally by a narrow, deep, U-shaped emargination, each basal segment stout, slightly widest medially, with outer margin slightly convexly curved anteromedially, apical segment slender, tubularly elongate, narrowest and rounded posteriorly, with rounded and apicolateral patch of short, thin, black, stout, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 64).

Material examined. USA: California: *Holotype*: Male, Santa Clara Co.: Swanson Creek, Uvas Canyon Park, 2.vi.1974, D.G. Denning (in alcohol, CAS).

Distribution. USA: CA.

***Wormaldia moesta* (Banks)**

Figures 67–75, 130, 133

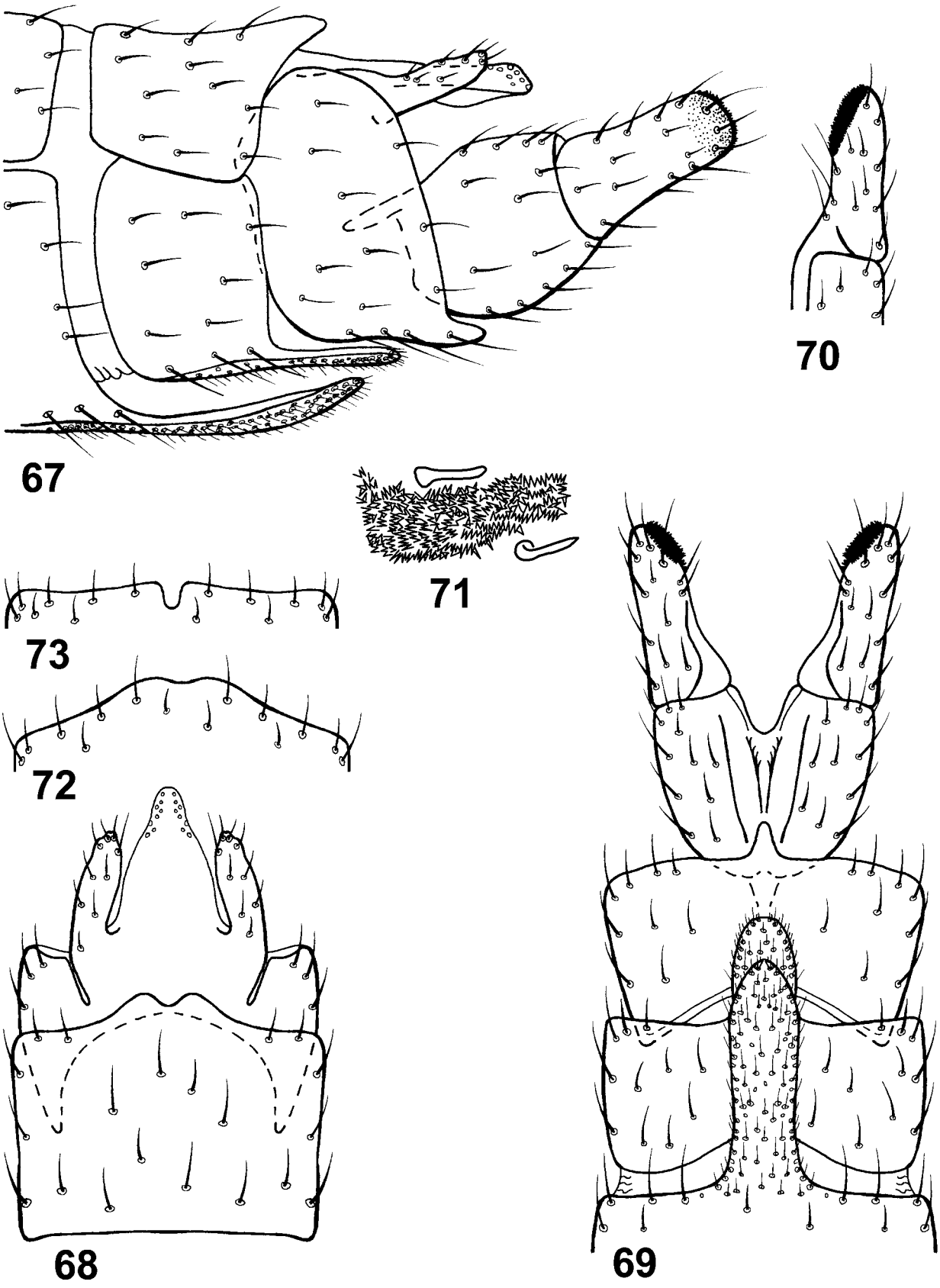
Wormaldia moesta (Banks) 1914: 202, pl. IX, figs. 18, 20, 23, male, North Carolina, USA (MCZ) (as *Paragapetus moestus*); Betten 1934: 169 (mentioned as *Dolophilus moestus*); Milne 1934–1936: 82, 83 (as *D. moestus*); Ross 1941a: 51 (as *D. moestus*); Ross 1944: 8, 45, 46, 47, 292, figs. 161, 165, 167, 168; Ross 1949: 155, 156 (transferred to *Wormaldia*); Ross 1956: 42, 46, 61, 65, figs. 83 A–C (*Paragapetus* as synonymy of *Wormaldia*); Denning 1956a: 79: Fischer 1961: 48; Fischer 1971: 192; Schmid 1982: 31–33, 72 (map 15), figs. 150, 151, 160, 161; Schmid 1991: 93; Moulton & Stewart 1996: 181, 182, fig. 508; Armitage 1996: [work not paginated].

Dolophilus breviatus Banks 1914: 254, pl. XX, fig. 61, male, New York, USA (Banks, N. collection, MCZ); Betten 1934: 168, 169, pl. 15, figs. 13, 14, pl. 16, figs. 1–5; Milne 1934–1936: 82, 83 (as synonym of *D. moestus*); Ross 1938c: 7 (lectotype [MCZ 11518] is male, mentioned as *D. breviatus*); Ross 1944: 292 (as *D. moestus*); Ross 1949: 154–156 (*D. moestus* transferred to *Wormaldia*).

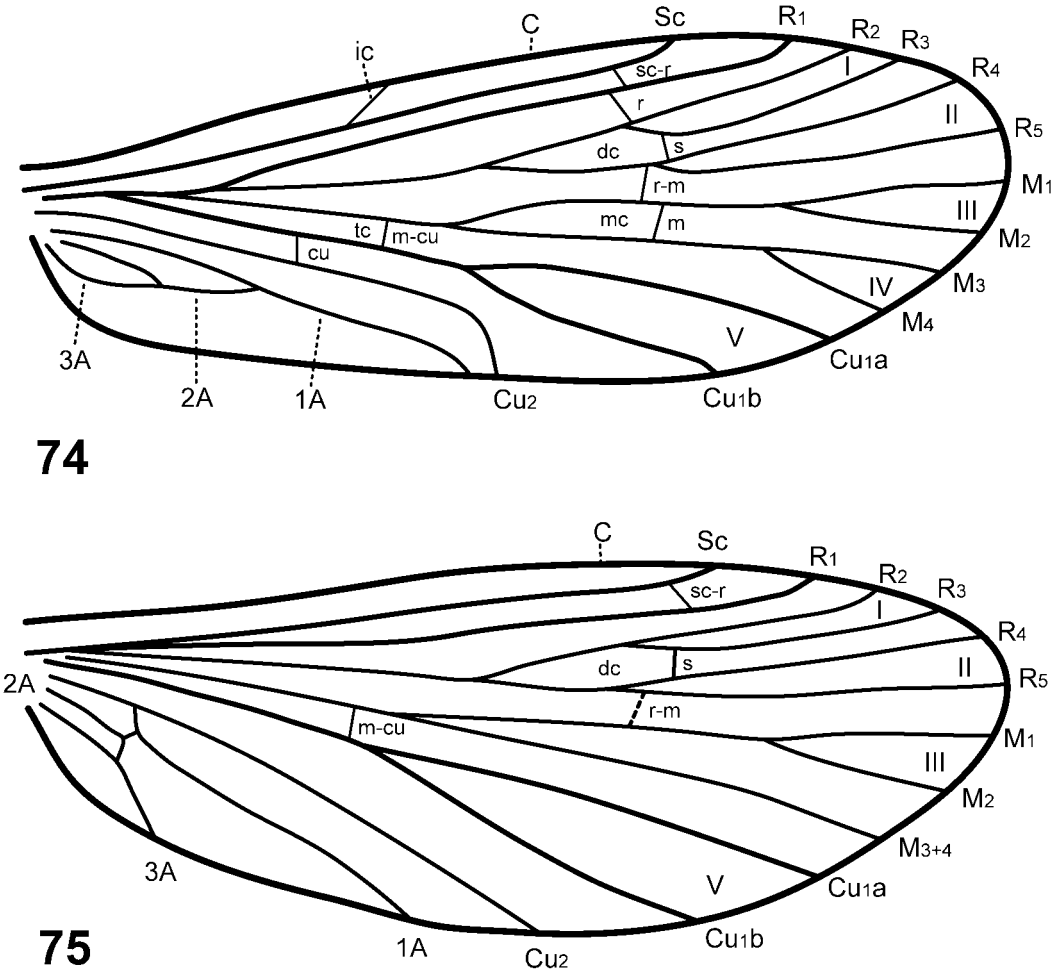
Ross (1949) established subgroup 2 of the *W. moesta* Group with *W. moesta* (Banks 1914) and *W. gabriella* (Banks 1930), species from Canada and the Uniteds States. In 1956, Ross rearranged his former species group proposal. For the *W. moesta* Group, he removed subgroup 2 and to the two species formerly mentioned added two species *W. chinensis* (Ulmer 1932) from China and *W. relicta* (Martynov 1935) from India. Later, Schmid (1991, 1998) suggested that all former species, with the exception of *W. moesta*, should be placed together within the *W. relicta* Group instead of Ross's *W. moesta* Group. Schmid also added to the *W. relicta* Group the four following species: *W. ephestion* Schmid (1991) and *W. therapion* Schmid (1991) from India, *W. simulans* Kimmins (1955b) from Burma, and *W. uonumana* Kobayashi (1980) from Japan. He adopted this change since *W. moesta* only has one character among those that define the species group. However, Schmid recognized that the characters that define the *W. relicta* Group are not constant in the seven species of his *W. relicta* Group (Schmid 1991). Armitage (1996) maintained the Ross proposal for this species group (Table 1).

This species is similar to *Wormaldia gabriella* (Banks 1914) and *W. lacerna* Denning (1958), but can be recognized from them by the shapes of tergum VIII, sterna VIII and IX, and the inferior appendage, as discussed in the diagnoses of those species. *Wormaldia moesta* specimens from Little Pigeon (Tennessee) and Turkey Run S.P., Newby Gulch (Indiana) showed variation in the shape of the posterior margin of tergum VIII from that of the holotype. The posterior margin in those specimens is relatively straight mesally or straight with a small, narrow emargination mesally (Figs. 72–73).

Adult (Fig. 133) Length of male forewing 6–7 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish and brown rings of small setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax light brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, and with several small, scarce patches of yellowish setae, one conspicuous, mesal patch, slightly elongate anteroposteriorly on posterior margin, with apical forks I, II, III, IV, and V present (Fig. 74; Betten 1934: pl. 15. fig. 13). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 75; Betten 1934: pl. 15, fig. 14).



FIGURES 67–73. *Wormaldia moesta* (Banks). Male genitalia: 67—left lateral view; 68—dorsal view; 69—ventral view; 70—apical segment of left inferior appendage, dorsal view; 71—phallic sclerites, left lateral view; 72—posterior margin of tergum VIII from Turkey Run S. P. (IN), USA, dorsal view; 73—posterior margin of tergum VIII from Little Pigeon (TN), USA, dorsal view.



FIGURES 74–75. *Wormaldia moesta* (Banks). Wings: 74—right forewing; 75—right hind wing.

Male genitalia (Figs. 67–73). Sternum VII with stout, prominent, digitate, posteromesal process extremely elongate, longer than sternum VIII, narrowly rounded apically. Tergum VIII slightly sinuous or nearly straight posteromesally; when viewed laterally, slightly concave posteriorly. Sternum VIII slightly concave anteriorly, with conspicuous, digitate, posteromesal process, 0.5 times length of posteromesal process of sternum VII, rounded apically. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly rectangular in appearance, slightly convex anteriorly, slightly convex posteriorly; when viewed ventrally, concave anteriorly, nearly straight posteriorly with small, slender, subtriangular process arising posteromesally. Segment X, when viewed dorsally, triangularly elongate, very weakly bulged medially, narrowest and rounded apically; when viewed laterally, stout, rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, shorter than segment X, slightly enlarged basally, rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment thick, subrectangular, weakly elongate, broadest and convex medially, apical segment stout, rectangularly elongate, nearly equal in length, narrower than basal segment, and truncately rounded and narrowest posteriorly; when viewed dorsally, apical segment stout, subtriangularly elongate, narrowest and subovate posteriorly, with slightly elongate and apicolateral patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments paired, united for about their anterior three-quarters, separated posteromesally by a moderately deep and U-shaped emargination, each basal segment stout, widest medially, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, when viewed dorsally, with many visible, small, spine-shaped, internal sclerites (Fig. 71), surrounded by highly convulated membranes.

Material examined. CANADA: Nova Scotia: Kentville, 28.vii.1924, R.P. Gorham, 1 male (CNC); Baddle-K, 23.vi.1936, T.N. Freeman, 1 male (CNC); **Ontario:** Burke Falls, 13.vii.1926, F.P. Ide, 1 male (INHS); Algonquin Park, Costello Lake, Ontario Fish. Res. Lab., 24.vi.1934, W.M. Sprules, 2 males (in alcohol, INHS); same except, 13.vi.1939, 2 males (in alcohol, INHS); 20.vi.1939, 2 males (in alcohol, INHS); Maynooth, Spring # 2, 19.vi.1953, J.F. McAlpine, 11 males, 1 female (in alcohol, INHS); same except, Spring # 1, 22.vi.1953, 20 males, 9 females (in alcohol, INHS). **USA: Alabama:** Lawrence Co.: Rogersville, stream margin WE. Snow, 23.v.1953, 2 males (in alcohol, INHS); **Arkansas:** Montgomery Co.: Buttermilk Springs, 3 mi [= 4.8 km] Caddo Gap, T4S R24W Sec. 6, 19.v.1982. H.W. Robison & D.D. Koyn, 1 male (in alcohol, INHS); **Georgia:** Fannin Co.: Chattahoochee, N. F. Roek Creek, 25.x.1971, U. of GA, Ent. Class, 1 male (in alcohol, INHS); Lumpkin Co.: (Walnut, Cat. N-2938-2), 29.vi.1938, L. Berner, 1 male (in alcohol, INHS); Towns Co.: Young Harris, 24.iv.1938, Ross & Burks, 2 males (in alcohol, INHS); Union Co: Helton Creek, 5 mi [= 8 km] N. Neels Gap, 5.vi.1946, P.W. Fatig, 1 male (in alcohol, INHS); **Illinois:** Kane Co.: Botanical Garden, Elgin, 23.v.1939, Burks & Riegel, 1 male (in alcohol, INHS); same except, 9.vi.1939, Ross & Burks, 2 males (in alcohol, INHS); 19.ix.1939, Ross & Mohr, 1 male (in alcohol, INHS); 20.iii.1940, B.D. Burks, 2 males, 1 female (in alcohol, 1 male in CNC, 1 male, 1 female in INHS); Union Co.: Pine Hills Rec. Area, 1.vi.1958, E.L. Mackford, 1 male, 2 females (in alcohol, INHS); Trib. # 7, Ditch 1.7 mi [= 2.7 km] E of Wolf Lake, SW/NW/SW Sec. 2 T11S R3W, 4.vi.1986, E.A. Lisowski, 1 male (in alcohol, INHS); **Indiana:** Montgomery Co.; Shades State Park, 3–4.vi.1950, M.W. Sanderson, 1 male (in alcohol, INHS); same except, 16.iii.1958, Ross & Mohr, 1 male (in alcohol, INHS); Parke Co.: Turkey Run, Newby Gulch, 9.iv.1940, Frison & Ross, 7 males, 4 females (5 males, 4 females, in alcohol, INHS); **Kentucky:** Menifee Co.: Murder Cave, 23.x.1966, Barr & Norton, 4 males, 6 females (in alcohol, INHS); **Maine:** Bar Harbor, 12.viii.1940, A.E. Brower, 1 male (MCZ); **Massachusetts:** Middlesex Co.: Waltham, 18.vi.1888, 1 male (MCZ); Worcester Co.: Petersham, 2.vii.1935, Milne & Greene, 1 male (in INHS); **Missouri:** Champion Springs, Annapolis, 5.iv.1953, C.A. Ulrich, 1 male (in alcohol, INHS); **Minnesota:** Cook Co.: Hovland, 10.vii.1965, D. Etnier, 1 male (in alcohol, UMSP); **New Hamsphire:** Coos Co.: Glen House, Mt. Washington, 22.vi.1941, Frison & Ross, 2 males, 1 female (in alcohol, INHS); same except, Gibbs Brook, 7 males (in alcohol, INHS); Imp. Creek, Pinkham, nr. Mt. Washington, 23.vi.1941, Frison & Ross, 1 male (in alcohol, INHS); Grafton Co.: Whitcherville Brook, nr. Benton, 21.vi.1941, Frison & Ross, 1 male, 1 female (in alcohol, INHS); N. Woodstock, 21.vi.1941, Frison & Ross, 1 male (in alcohol, INHS); Pemigewasset River, nr. Woodstock, 22.vi.1941, Frison & Ross, 1 male (in alcohol, INHS); W. of Divide at Moosilauke Lake, Benton, 21.vi.1941, Frison & Ross, 1 male (in alcohol, INHS); **New York:** Fulton Co.: Woodworth Lake, 23.vi.1910, N. Banks, 1 male (MCZ); same except, 25.vi.1910, 1 male (MCZ); St. Lawrence Co.: Bear Brook, nr. Blue Mt. Lake, Adirondack Park, 19.vi.1941, Frison & Ross, 1 male (in alcohol, INHS); same except, High Rock Pound, outlet nr. Eagle Bay, 1 male, 2 females (in alcohol, INHS); *Lectotype* & *Syntype*: 2 males, Tompkins Co.: Coy Glen, Ithaca, vii–viii.(?) [in MCZ, Types (2) & (5) 11518]; **North Carolina:** Rainbow Gap, 24.iv.1938, Ross & Burks, 2 males (in alcohol, INHS); Haywood Co.: Great Smoky Mountains N. P., Mt. Sterling Cr. on St. Rte 284, 35º 42.495' N, 83º 05.870' W, el. 1057 m, 22.v.1996, Holzenthal & Huisman, 5 males, 1 female (UMSP); same except, Chesnut Cr., Big Cr.cmpg, 35º 45.591' N, 83º 06.341' W, el. 500 m, Holzenthal & Huisman, 24.v.1996, 17 males, 4 females (UMSP); Henderson Co.: Smoke Mt. 14.vi.1935, H.H. Ross, 1 male (in alcohol, INHS); Mt. Mitchell, 6000 ft [= 1829 m], 7.vi.1940, C.P. Alexander, 1 male (INHS); Macon Co.: Shope Creek, Coweeta Exp. Forest, 3 mi [= 4.8 km] W. Otto, 2000 ft [= 610 m], 14.i.1953, 2 males (in alcohol, INHS); same except, Ball Creek, 2.vi.1953, 1 male (in alcohol, INHS); Wayah Creek, cpg spring, 30.v.1981, J.S. Weaver & R.W. Holzenthal, 1 male (in alcohol, UMSP); Swain Co.: Deep Creek, Smoky Mts., Bryson City, 2000 ft [= 610 m], 1 male (INHS); same except, 23.viii.1930, N. Banks, 2 males (MCZ); Yancey Co. - Buncombe Co.: North Fork Swannanoa River, Black Mts., v.(?), 1 male [MCZ, Type (3) 11518]; **Ohio:** Dean Forest, v.1934, C. Neis Wander, 1 male (in alcohol, INHS); same except, vi.1939, 1 male (in alcohol, INHS); Hocking Co.: 26.v.1938, D.J. & J.N. Knull Collrs, 1 male (in alcohol, INHS); **Pennsylvania:** Dauphin Co.: McDonald Creek, Meach Lake, nr. Hill, nr. Harrisburg,

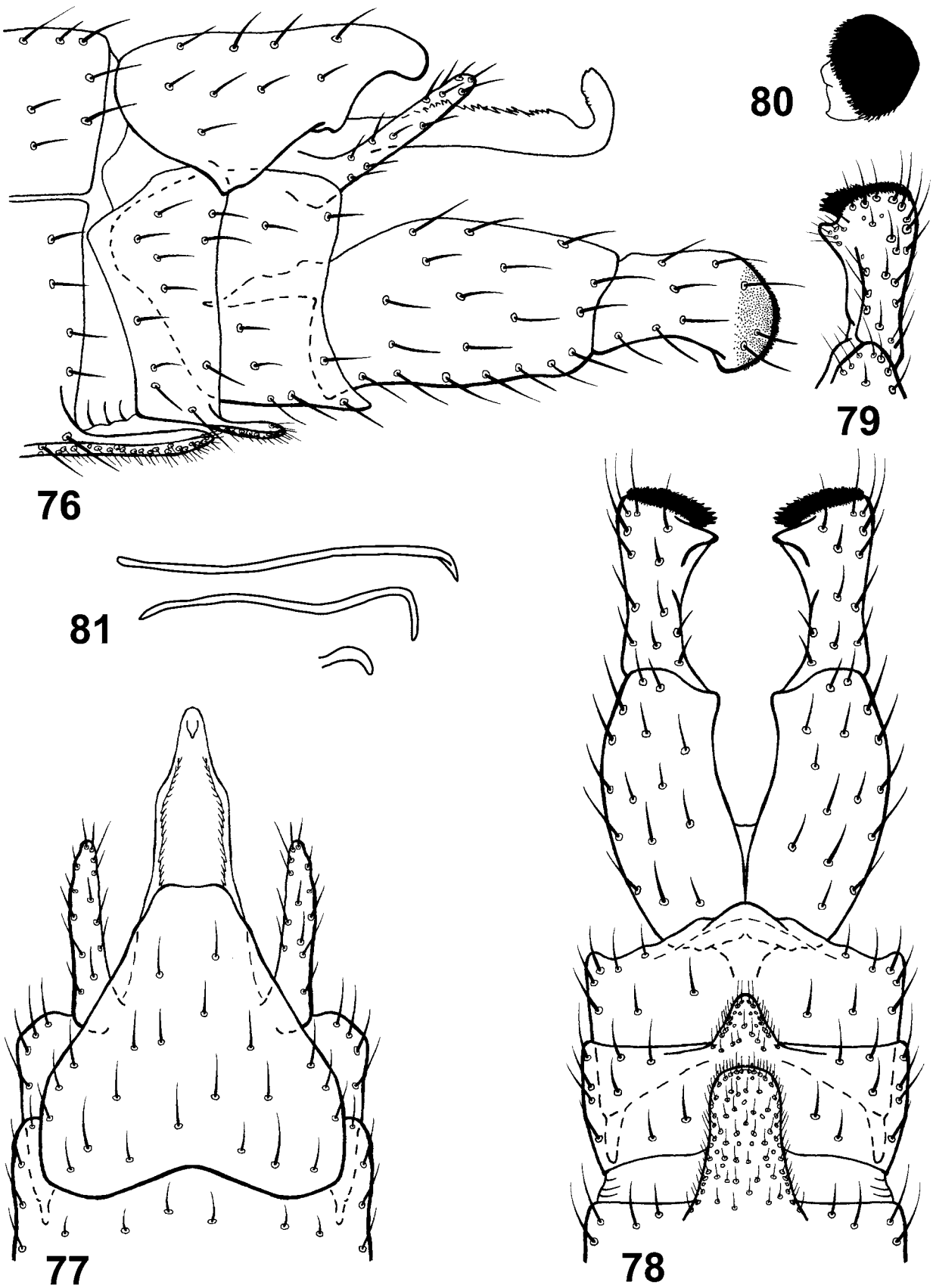
20.vi.1964, W.E. Ricker, 1 male, 4 females (in alcohol, INHS); **Tennessee:** Campbell Co.: Jellico, 13.v.1939, Frison & Ross, 1 male (in alcohol, INHS); Cocke Co.: English Creek at Carson's Sp., nr. Newport Cockeco, 3–8.vi.1946, Mike Wright, 1 male (in alcohol, INHS); Cumberland Co.: Crossville, 27.v.1957, 1 male (in alcohol, INHS); Decatur Co.: small stream, Perryville, 21.v.1959, Ross & Stawnard, 1 male (in alcohol, INHS); Lawrence Co.: Loretto, 13.v.1957, 1 male (in alcohol, INHS); Polk Co.: Parksville, 25.iv.1938, Ross & Burks, 4 males (in alcohol, INHS); Scott Co.: Smoky Mts., 2100 ft [= 640 m], 10.vi.1939, C.P. Alexander, 1 male (INHS); Sevier Co.: Fighting Creek, Fork Little Pigeon River, Gatlinburg, 27.v.1934, T.H. Frison, 1 male, 1 female (in alcohol, INHS); Fighting Creek Gap, Gatlinburg, 15.vi.1939, Frison & Ross, 2 males (in alcohol, INHS); Gatlinburg, in town, 11.v.1944, Frison & Ross, 2 males (in alcohol, INHS); Great Smoky Mts. National Park [GSMNP], Camp Ground nr. Chimneys, 11.v.1944, Frison & Ross, 9 males, 1 female (in alcohol, INHS); same except, Cole Branch, 8–10.vi.1949, W.E. Ricker, 1 male (in alcohol, INHS); Newfound Gap [GSMNP], 19.vi1938, T.H. Jr. & T.H. Frison, 1 male (in alcohol, INHS); same except, 5000–5200 ft [= 1524–1585 m], N. Banks, 1 male (MCZ); Between pass & chimneys [GSMNP], 11.v.1944, Frison & Ross, 1 male (in alcohol, INHS); Trib. Little Pigeon River [GSMNP], 14.v.1939, Frison & Ross, 3 males (in alcohol, INHS); nr. Hq., Little Pigeon River [GSMNP], 28–29.ix.1950, W.E. Ricker, 1 male (in alcohol, INHS); Smoky Mts. National Park, Trout Branch, 3500 ft [= 1067 m], 21.iv.1949, W.E. Ricker, 2 males (in alcohol, INHS); same except, Walker Prong [SMNP], 26.v.1949, W.E. Ricker, 1 male (in alcohol, INHS); small creek at Walker Prong, 30.vii.1949, 2 males, 1 female (in alcohol, 2 vials, INHS); **Virginia:** Greene Co.: Lydia, 20.iv.1938, Ross & Burks, 1 male (in alcohol, INHS); Page Co.: Shenandoah Nat. Park, Hog Camp, 8.vii.1961, O. & R. Flint, 1 male (CNC); G. Washington National Forest, Passage Creek, For. Rt. 274, 38.725º N, 78.540º W, 1300 ft [= 396 m], 19.ix.1992, R. Blahnik & A. Contreras, 1 male, 1 female (UMSP); Waynesboro Co.: Creek at Waynesboro, 18.iii.1950, W.E. Ricker, 1 male (in alcohol, INHS); **Vermont:** Windham Co.: Halifax George, 5.vi.1973, G.K. Pratt, 5 males, 1 female (in alcohol, INHS); **West Virginia:** Pendleton Co.: Blow Hole Cave, 13.vii.1969, T.G. Maroh & J.M. Carpenter, 3 males, 4 females (in alcohol, INHS).

Distribution. Canada: MB, NB, NF, NS, ON, PQ. USA: AL, AR, CT, DE, FL, GA, IL, IN, KY, MA, ME, MN, MO, MS, NC, NH, NJ, NY, OH, OK, PA, SC, TN, VA, VT, WI, WV.

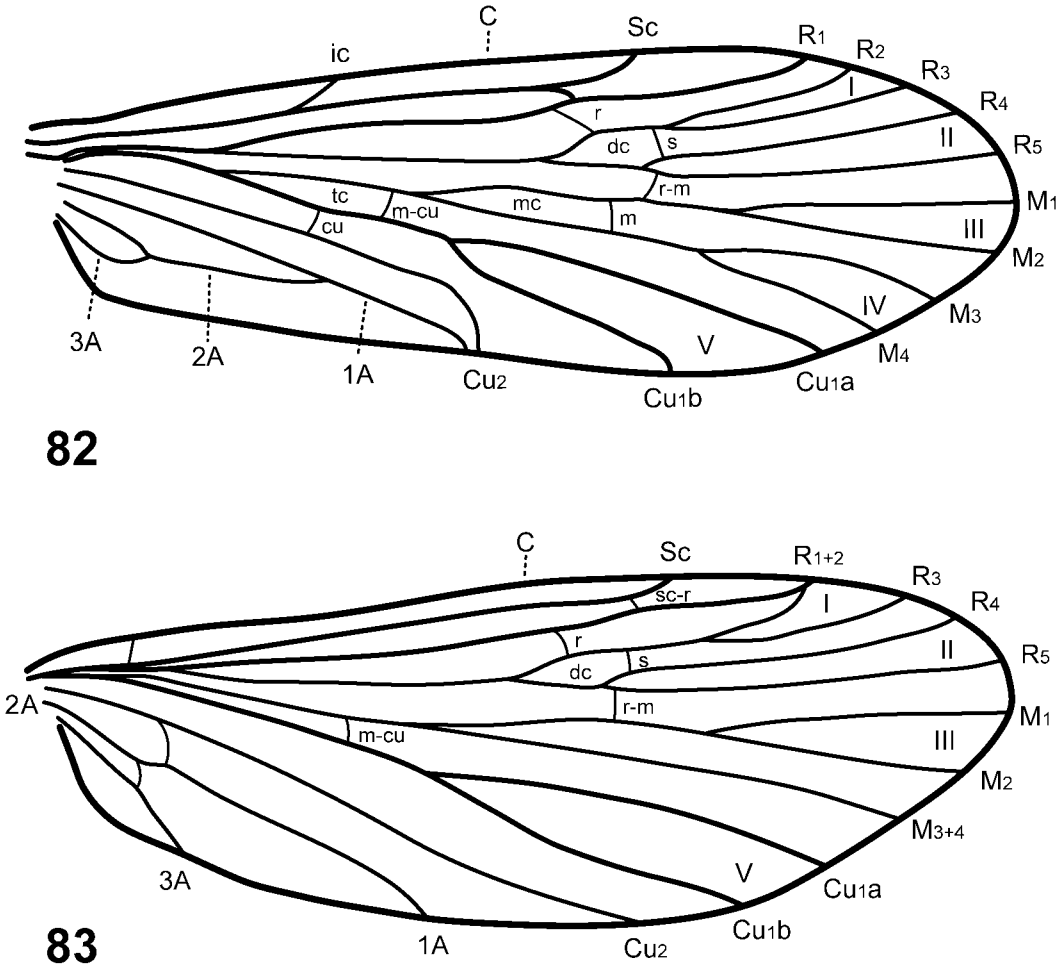
***Wormaldia mohri* (Ross)**
Figures 76–83, 131

Doloclanes mohri (Ross) 1948: 23, pl. I, figs. 5, 5 A–C, male, North Carolina, USA (INHS) (as *Gatlinia*); Ross 1956: 38, 45, 65, 66, fig. 95 (*Gatlinia* as synonym of *Doloclanes*, a subgenus of *Wormaldia*); Fischer 1971: 202; Schmid 1989: 110, fig.252; Schmid 1991: 89, 98; Armitage 1996: [work not paginated]; Neboiss 1999: 286, 289; Flint *et al.* 2004: 40.

Ross (1956) placed this species and eight more species of *Doloclanes* within the *Wormaldia montana* Group. However, this arrangement of the *W. montana* Group of Ross (1956) and Armitage (1996) has not been followed for subsequent authors (Malicky 1993a, b, 1994, 1995; Malicky & Chantaramongkol 1993a, b, 1996; Mey 1993, 1996; Neboiss 1999; Schmid 1991) who treated it as a species of *Doloclanes*. Schmid (1989, 1991) indicated that the species formerly in *Doloclanes*, as in several other Oriental and East Palearctic Trichoptera genera, were dispersed in a secondary trans-Bering migration to the Nearctic Region from those regions where this genus is diverse and widely distributed. The general appearance of the genitalia of *W. mohri* is similar to those of *Wormaldia* species within the North American *W. thyria* Group of Armitage (1996) where it is here placed (Table 1).



FIGURES 76–81. *Wormaldia mohri* (Ross). Male genitalia: 76—left lateral view; 77—dorsal view; 78—ventral view; 79—apical segment of left inferior appendage, dorsal view; 80—apical segment of right inferior appendage, posterior view; 81—phallic sclerites, left lateral view.



FIGURES 82–83. *Wormaldia mohri* (Ross). Wings: 82—right forewing; 83—right hind wing.

This species shares with *Wormaldia gesugta* Schmid (1968), *W. hamata* Denning (1951), *W. laona* Denning (1989), *W. oconee* Morse (1989), and *W. thyria* Denning (1950), tergum VIII strongly elongate and projected posteriorly, when viewed laterally, appearing as a hood. However, in *W. mohri*, when viewed laterally, segment X has small serrations dorsomedially, and is strongly upcurved preapically with the apex directed dorsally. In addition, the apical segment of the inferior appendage in *W. mohri* has a conspicuous spine-shaped and subapical projection directed laterally on the inner margin (Figs. 78–80). Veins R_1 and R_2 of the few *W. morhi* examined are fused before reaching the wing margin of the hind wing (Fig. 83). In the other Nearctic *Wormaldia*, the R veins are not fused apically in the hind wing.

Adult. Length of male forewing 5.5–6.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellow rings of small setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs brown, with small, light brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 82; Ross 1948: fig. 5B). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 83; Ross 1948: fig. 5C).

Male genitalia (Figs. 76–81). Sternum VII with broad, digitate, posteromesal process strongly elongate, projecting beyond middle of segment VIII. Tergum VIII triangular in appearance, strongly projected posteriorly, reaching middle of tergum X, narrowest and slightly truncated posteromesally; when viewed laterally, hood-shaped, anterior and posterior margins forming V-shaped projection mesoventrally, posterior margin sinuous. Sternum VIII with stout, triangular, posteromesal process, about 0.4 times length of posteromesal

process of sternum VII; when viewed laterally, slender and nearly rectangular in appearance, with V-shaped projection anteriorly. Segment IX, when viewed laterally, with strong and wide projection convexly elongate anteriorly, slightly concave posteriorly; when viewed ventrally, concave anteriorly, convexly projected posteriorly with slightly convex and mesal projection arising subapically. Segment X, when viewed dorsally, strongly triangularly elongate, with small lateral serrations medially and preapically, narrowly rounded apically, with pointed knob-shaped projection; when viewed laterally, slender, strongly upcurved preapically, with apex rounded and directed dorsally. Superior appendages digitate; when viewed dorsally, parallel with segment X, elongate, apically rounded; when viewed laterally, clearly shorter than segment X, slender, slightly enlarged and upcurved basally. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, strongly elongate, broadest medially, convex dorsally, weakly sinuous ventrally, apical segment stout, rectangular anteromedially, slightly downcurved posteriorly, shorter (about 0.7 times) and narrower than basal segment; when viewed posteriorly, apex of apical segment rounded with inner and subapical projection, slightly indented laterally; when viewed ventrally, basal segments paired, united for about their anterior two-fifths, separated posteromesally by a deep, narrow, U-shaped emargination, each basal segment stout, widest medially, incurved medially, apical segment stout, subrectangularly elongate, widened and rounded posteriorly, with rounded apical patch of short, thin, black, spine-shaped setae, and with stout, spine-shaped, subapical projection directed laterally on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with three visible, internal sclerites (Fig. 81).

Material examined. USA: North Carolina: [Henderson Co.(?)]: Mt. Mitchell, 3100 ft [= 945 m], 5.vi.1940, C.P. Alexander, 1 male (INHS); same except, Game Refuge, 6.vi.1940, C.P. Alexander, 1 male (INHS); **North Carolina - Tennessee:** Swain Co. - Sevier Co.: Great Smoky Mts. National Park, Chimneys Camp, 4.vi.1952, M.W. Sanderson, 1 male (in alcohol, INHS); **Tennessee:** Sevier Co.: Smoky Mountains National Park, Little Pigeon River at Park Hdqts., 26.v.1949, 3 males, 1 female (in alcohol, INHS).

Distribution. USA: NC, SC, TN, VA.

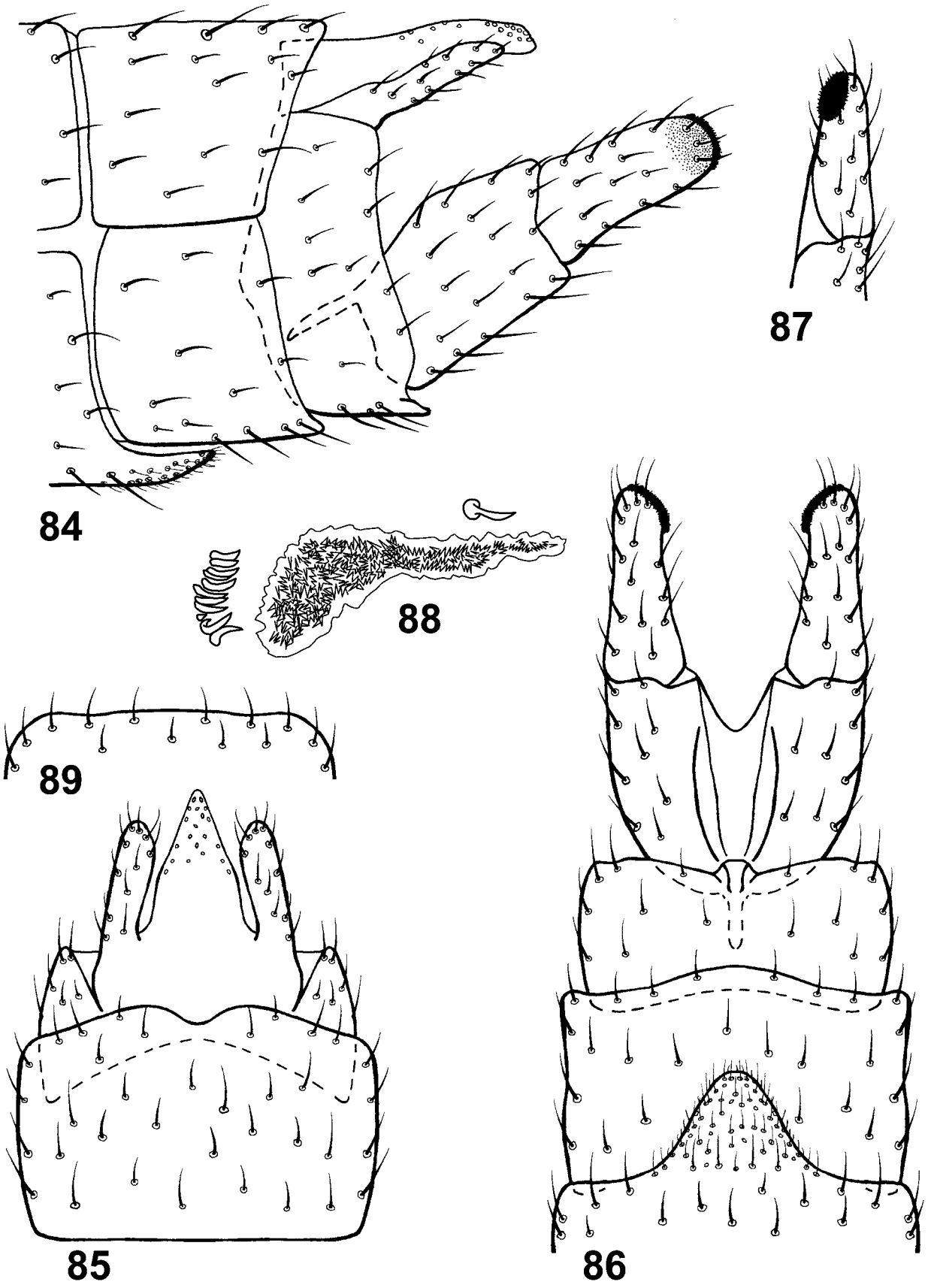
***Wormaldia occidea* (Ross)**
Figures 84–91, 129

Wormaldia occidea (Ross) 1938a: 134; fig. 54, male, Oregon, USA (INHS) (as *Dolophilus occideus*); Ross 1944: 292; Ross 1949: 155, 156 (transferred to *Wormaldia*); Ross 1956: 38, 40, 61, 62, figs. 65 A, B; Denning 1956a: 79; Denning 1956b: 248, fig. 10: 16G; 1958: 94; Fischer 1961: 49; Fischer 1971: 192; Schmid 1982: 31–34, 72 (map 15), figs. 147, 154, 155; Schmid 1998: 215, fig. 110; Armitage 1996: [work not paginated].

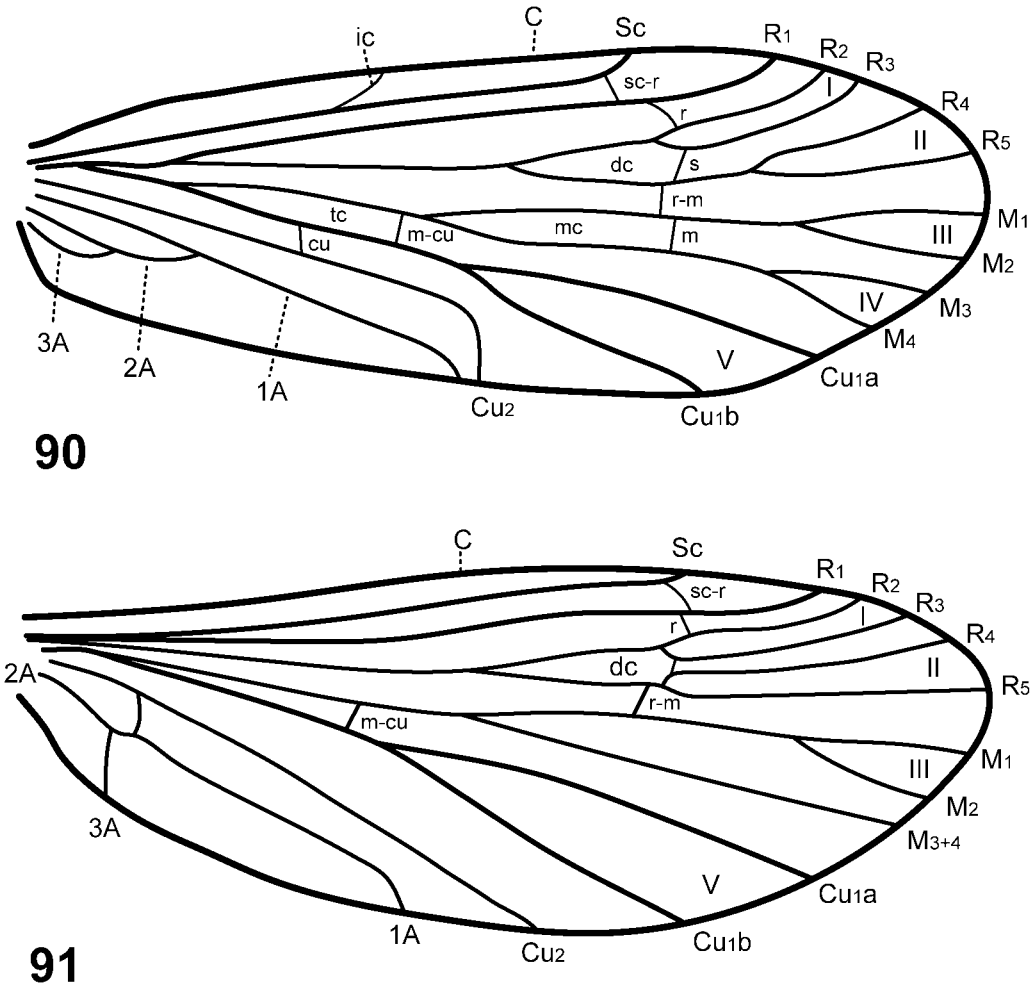
Dolophilus cruzensis (Ling) 1938: 64, male, California (CAS); Ross 1944: 292; Ross 1949: 155, 157 (transferred to *Wormaldia*); Ross 1956: 38, 62; Denning 1956a: 79; Denning 1956b: 248, fig. 10: 16E; Denning 1958: 94 (as synonym of *W. occidea*).

Ross (1949) placed this species within subgroup 3 of the *W. moesta* Group. In 1956, he redefined his former species group arrangement and transferred *W. occidea* to the *W. anilla* Group, which was retained by Armitage (1996) (Table 1).

This species is closely related to *W. anilla* (Ross 1941a) and *W. clauseni*, new species. However, it can be differentiated from those species by the shapes of sterna VII and IX, tergum X and the inferior appendage, as explained in the diagnoses of those species. Specimens of this species from Benton Co. (Oregon) showed variation in the shape of the posterior margin of tergum VIII from that of the holotype. In those specimens, the posterior margin is relatively straight (Fig. 89).



FIGURES 84–89. *Wormaldia occidea* (Ross). Male genitalia: 84—left lateral view; 85—dorsal view; 86—ventral view; 87—apical segment of left inferior appendage, dorsal view; 88—phallic sclerites, left lateral view; 89—posterior margin of tergum VIII from Benton Co. (OR), USA, dorsal view.



FIGURES 90–91. *Wormaldia occidea* (Ross). Wings: 90—right forewing; 91—right hind wing.

Adult. Length of male forewing 5–7 mm (holotype: 5 mm). Head brown, with lighter setae. Antenna long, slender, brown, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs brown, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 90; Schmid 1982: fig. 147, 1998: fig. 110). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 91).

Male genitalia (Figs. 84–89). Sternum VII with conspicuous, broad, convexly subtriangular, posteromesal process strongly elongate, about 0.5 times length of sternum VIII. Tergum VIII relatively straight or slightly sinuous posteromesally; when viewed laterally, posterodorsal corner truncated or weakly projected. Sternum VIII slightly convex posteromesally. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, slender and nearly rectangular in appearance, slightly convex anteriorly, slightly sinuous posteriorly; when viewed ventrally, very weakly concave anteriorly, weakly projected convexly posteriorly with small, truncate, mesal process arising subapically. Segment X, when viewed dorsally, triangularly elongate, narrowest and pointed apically; when viewed laterally, stout, rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, slightly shorter than segment X, narrowly rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, elongate, broadest medially, convex dorsally, straight ventrally, apical segment stout, rectangularly elongate, shorter (about 0.9 times) and narrower than basal segment, truncately rounded and narrowest posteriorly; when viewed dorsally, apical segment stout, subtriangularly elongate, narrowest and rounded posteriorly, with oval and apicolateral patch of short, thin, black, spine-

shaped setae on inner margin; when viewed ventrally, basal segments paired, united for about their anterior three-quarters, separated posteromesally by a moderately deep and U-shaped emargination, each basal segment robust, widest medially, with outer margin convexly curved anteromedially, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with many visible, internal sclerites (Fig. 88), surrounded by highly convulated membranes.

Material examined. CANADA: British Columbia: Agassiz, 19.v.1927, H.H. Ross, 1 male (INHS). **USA: Alaska:** Wrangell-Petersburg Co.: Alvin Bay, Kuiu Isl., 21.viii.1951, B. Malking, 1 male (in alcohol, INHS); **California:** Siskiyou Co.: Clear Cr., 6.vi.1965, F. Schmid, 2 males (CNC); **Montana:** Missoula Co.: Butler Creek, Snow Bowl, 15.iv.1972, R.A. Haick, 1 male (in alcohol, INHS); same except, 18.v.1972, 3 males, 1 female (in alcohol, INHS); **Oregon:** Benton Co.: Blodgett, 11.v.1947, B. Malkin, 1 male (in alcohol, INHS); Clackamas Co.: Salmon River, Welches, 18.vi.1933, R.E. Dimick, 1 male (INHS); Beaver Creek, Mt. Hood, 1.viii.1948, K.M. Fender, 4 males (in alcohol, INHS); Douglas Co.: Clearwater Cr., 8.vi.1965, F. Schmid, 1 male (CNC); Klamath Co.: Odell Lake, 1.viii.1948, K.M. Fender, 1 male, 2 females (in alcohol, INHS); *Holotype*: Male, Lincoln Co.: Yew Creek, Alsea Mountains., 3.v.1936, R.E. Rieder (in alcohol, INHS); Linn Co.: 1 mi [= 1.6 km] W. Marion Fork, N. Santiam Hwy, 9.viii.1952, K.M. Fender, 2 males, 1 female (in alcohol, 2 vials, INHS); Multnomah Co.: Troutdale, 15.iv.1939, S.G. Jewett, Jr., 1 male (in alcohol, INHS); Wallowa Co.: Lostine R., French Forest Camp, Wallowa Mts., 17.viii.1952, K.M. Fender, 4 males, 1 female (in alcohol, INHS); Yamhill Co.: Peavine Ridge, nr. McMinnville, 5.v.1947, K.M. Fender, 2 males, 1 female (in alcohol, INHS); same except, Sta. 3A, 12.v.1947, K. M. Fender, 7 males, 1 female (in alcohol, INHS); 19.v.1947, 24 males, 4 females (in alcohol, INHS); 23.v.1947, 1 male (in alcohol, INHS); 29.v.1947, 14 males, 2 females (in alcohol, INHS); 2.vi.1948, 8 males, 2 females (in alcohol, INHS); 8.vi.1948, 14 males, 2 females (in alcohol, INHS); 15.vi.1948, 12 males, 5 females (in alcohol, INHS); 16.vi.1948, 1 male (in alcohol, INHS); 17.v.1951, 15 males (in alcohol, INHS); 23.v.1951, 16 males (in alcohol, 2 vials, INHS); 22.v.1952, 4 males, 2 females (in alcohol, INHS); 3.vi.1952, 12 males, 1 female (in alcohol, INHS); 5.vi.1952, 1 male, 3 females (in alcohol, INHS); 9.vi.1952, 1 male (in alcohol, INHS); 25.vi.1952, 13 males, 1 female (in alcohol, INHS); 3.vii.1952, 8 males, 2 females (in alcohol, INHS); 13.vi.1953, 7 males, 5 females (in alcohol, OSAC); **Washington:** Skagit Co.: Baker Lake, 27.v.1965, F. Schmid, 1 male (CNC); Whatcom Co.: Shuksan, 25.v.1965, F. Schmid, 5 males (CNC).

Distribution. Canada: BC. USA: AK (new record), CA, MT, OR, WA.

***Wormaldia oconee* Morse**

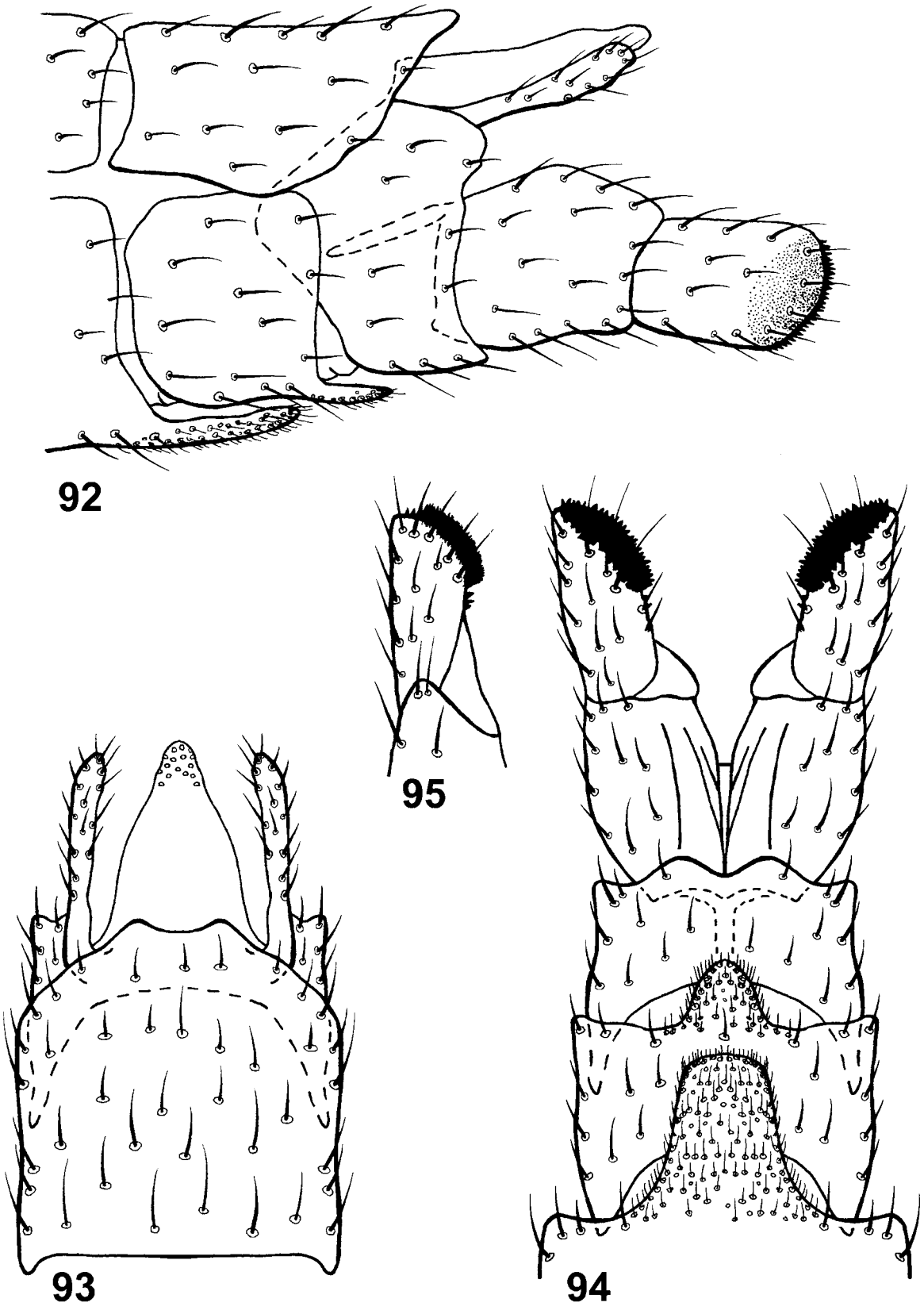
Figures 92–95, 131

Wormaldia oconee Morse 1989, in Morse *et al.* 1989: 28, figs. 3 A–E, male, South Carolina, USA (NMNH); Armitage 1996: [work not paginated].

Morse (Morse *et al.* 1989) placed this species within the *W. thyria* Complex of the *W. anilla* Group, as defined by Ross (1956). Subsequently, Armitage (1996) considered this *W. thyria* Complex as the *W. thyria* Group (Table 1).

The genitalia of this species, *Wormaldia gesugta* Schmid (1989), *W. hamata* Denning (1951), *W. laona* Denning (1989), *W. mohri* (Ross 1948), and *W. thyria* Denning (1950) are similar in having tergum VIII projected posteriorly; when viewed laterally, it resembles a hood, which differentiates these six species from the other Nearctic species of *Wormaldia*. However, *W. oconee* is distinguished from the five formerly mentioned species and other members of *Wormaldia* by the shapes of tergum VIII and the inferior appendage. Tergum VIII in this species has the posterior margin slightly projected, barely surpassing bases of tergum X and the superior appendages, and with a very shallow, broad, and U-shaped emargination mesoapically; when viewed laterally, it has the posterior margin convex. Finally, when viewed laterally, the inferior appendage in *W.*

oconee has the basal segment subrectangular and slightly elongate, and the apical segment is widely rectangular and very slightly tubularly elongate.



FIGURES 92–95. *Wormaldia oconee* Morse. Male genitalia: 92—left lateral view; 93—dorsal view; 94—ventral view; 95—apical segment of right inferior appendage, dorsal view.

Adult (in alcohol). Length of male forewing 5 mm (holotype). Head brown, with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax lighter brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with some fine, small, brown setae (most of them rubbed away), with apical forks I, II, III, and V present (Morse *et al.* 1989: fig. 3E). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Morse *et al.* 1989: fig. 3E).

Male genitalia (Figs. 92–95). Sternum VII with prominently broad, digitate, posteromesal process strongly elongate, about 0.7 times length of segment VIII. Tergum VIII slightly subtriangularly projected posteriorly, slightly surpassing bases of tergum X and superior appendages, with shallow concavity posteromesally; when viewed laterally, hood-shaped, posterior margin convex, with posterodorsal apex narrowly rounded. Sternum VIII concave anteriorly, with conspicuous, broad, convexly triangular process posteromesally, about 0.5 times length of posteromesal process of sternum VII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, nearly subtriangular in appearance, with strong and wide projection convexly elongate anteriorly, slightly concave posteriorly; when viewed ventrally, concave anteriorly, sinuously projected posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, triangularly elongate, weakly bulged medially, narrowest and rounded apically; when viewed laterally, stout, narrowly rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, slender, elongate, narrowly rounded apically; when viewed laterally, approximately equal length to segment X, rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment broad, subrectangular, slightly elongate, broader medially, convex dorsally, slightly sinuous ventrally, apical segment broadly rectangular, slightly tubularly elongate, slightly shorter (about 0.8 times) and narrower than basal segment, widely rounded posteriorly, when viewed dorsally, apical segment stout, tubularly elongate, narrowest and subovate posteriorly, with elongate and apicolateral patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments paired, united for about their anterior two-thirds, separated posteromesally by a moderately deep and V-shaped emargination, each basal segment thick, widest medially, with outer margin convexly curved anteromedially, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with highly convulated membranes with several internal sclerites, difficult to distinguish.

Material examined. USA: South Carolina: *Holotype*: Male, Oconee Co.: Coley Creek, Duke Power Company, 1400 ft [= 427 m], 20–21.vii.1987, S.W. Hamilton & K.M. Hoffman (in alcohol, NMNH).

Distribution. USA: SC.

Wormaldia pachita **Denning**

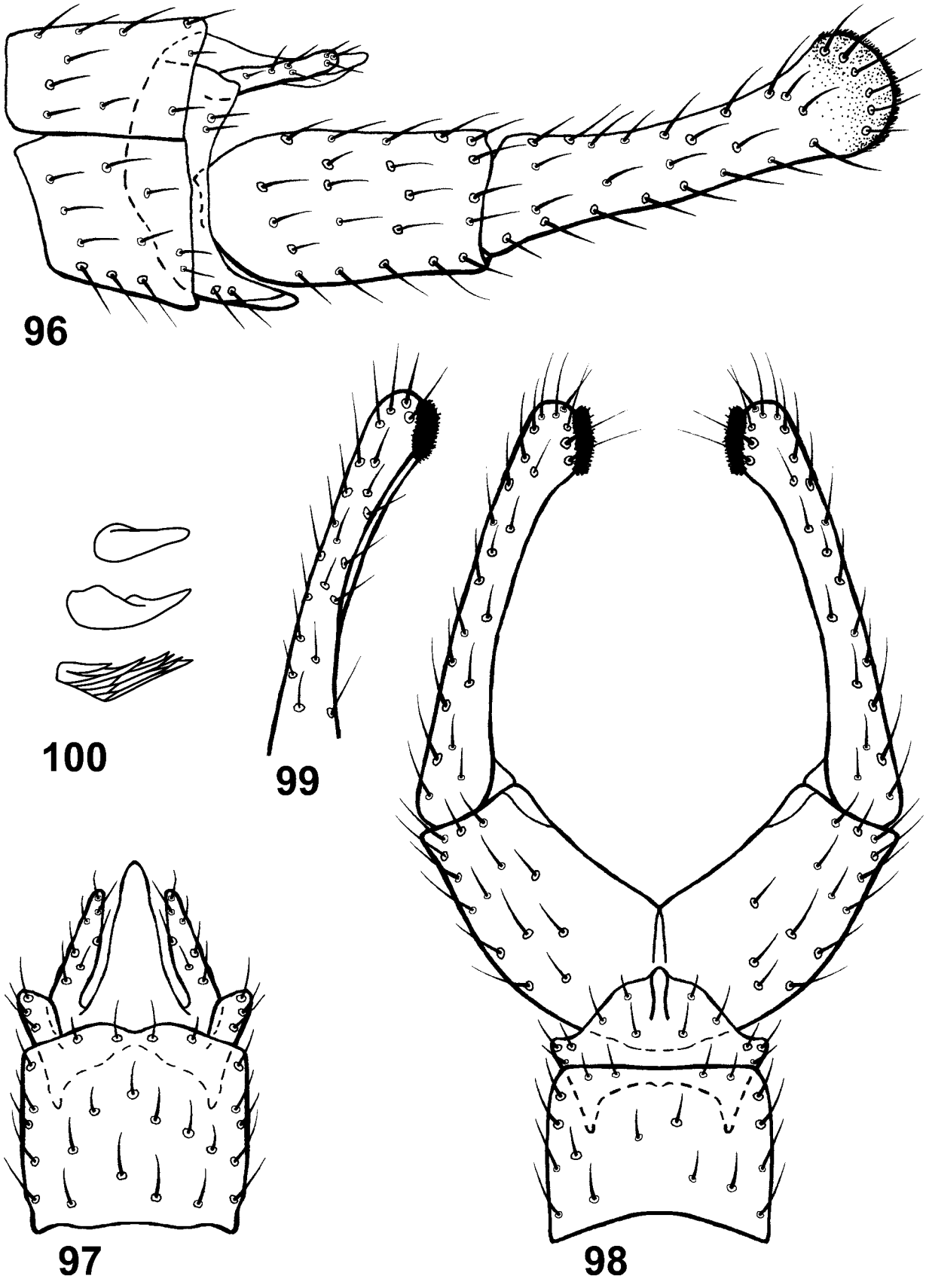
Figures 96–100, 132

Wormaldia pachita Denning 1956a: 78, 79, figs. 6 A–C, male, California, USA (CAS); Denning 1956b: 248, 269, fig. 10: 37; Fischer 1971: 195; Armitage 1996: [work not paginated].

Denning (1956) placed this species within the *W. moesta* Group proposed by Ross in 1949. However, Ross (1956) reconsidered his previous proposal for this species group. According to Ross (1956) and Armitage (1996), *W. pachita* should belong within the *W. anilla* Group (Table 1).

This species and *Wormaldia birneyi* are similar to *W. shawnee* (Ross 1938a) and *W. strota* (Ross 1938b), but are distinguishable from those two species and the other Nearctic *Wormaldia* by the widely divergent basal segments of the inferior appendages when viewed ventrally. In *W. birneyi* these basal segments are incurved and considerably narrow and elongate. Finally, *W. pachita* can be identified from *W. birneyi* by the shapes of sterna VII and IX, and the inferior appendage, as discussed in the diagnosis of that species.

Adult (in alcohol, male holotype) Head light brown, with lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax light brown. Legs yellowish, with small, lighter setae.



FIGURES 96–100. *Wormaldia pachita* Denning. Male genitalia: 96—left lateral view; 97—dorsal view; 98—ventral view; 99—apical segment of right inferior appendage, dorsal view; 100—phallic sclerites, left lateral view.

Male genitalia (Figs. 96–100). Sternum VII straight posteriorly without process mesally. Tergum VIII shallowly sinuous posteriorly. Sternum VIII slightly concave anteriorly, straight posteriorly without process mesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, slender and nearly C-shaped in appearance, convex anteriorly, concave posteriorly, when viewed ventrally, concave anteriorly, strongly projected sinuously posteriorly with elongate, slender, mesal process arising preapically. Segment X, when viewed dorsally, triangularly elongate, narrowest and rounded apically; when viewed laterally, slender and pointed. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate; when viewed laterally, slightly shorter than segment X, slender, rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, strongly tubularly elongate, convex anteriorly, apical segment slender, tubular appearance, strongly elongate, longer (about 1.4 times) and narrower than basal segment, weakly upcurved medially, widened and rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments paired, united for about their anterior one-third, separated posteromesally by a prominent, strongly deep, broad, V-shaped emargination, each basal segment stout, widest anteromedially, clearly incurved, apical segment, slender, tubularly elongate, inner margin very weakly concave, slightly widened and rounded posteriorly, with small, oval, apicolateral apical patch of short, thin, black, spine-shaped. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 100).

Material examined. USA: California: *Holotype*: Male, Nevada Co.: Grass Valley, 2350 ft [= 716 m], 5.v.1946, H.P. Chandler (in alcohol, CAS).

Distribution. USA: CA.

Wormaldia planae **Ross and King**

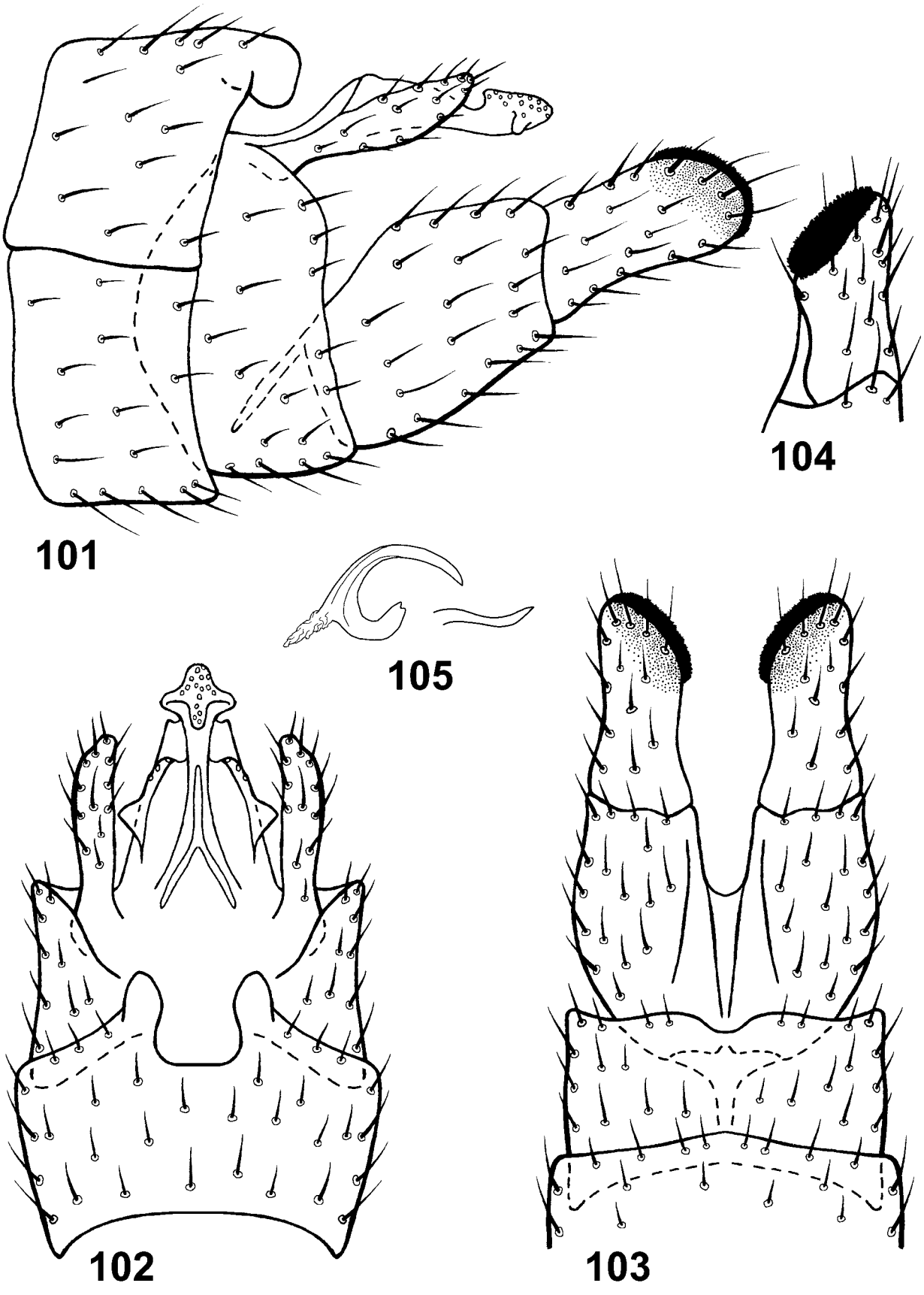
Figures 101–107, 129

Wormaldia planae Ross and King, in Ross 1956: 38, 40, 61, 64, figs. 75 A, B, 123 A, B, 130, male, Chiapas, Mexico (INHS); Flint 1968: 9, figs. 10, 11; Flint 1971: 20, figs. 17, 18; Flint 1981: 10, figs. 14, 15; Flint 1991: 31, figs. 47, 48; Flint 1995: 7–8; Fischer 1971: 195; Bueno-Soria & Flint 1978: 194 (distribution); Holzenthal 1988: 58 (distribution); Aguila 1992: 535 (distribution); Botosaneanu 2002: 91 (distribution).

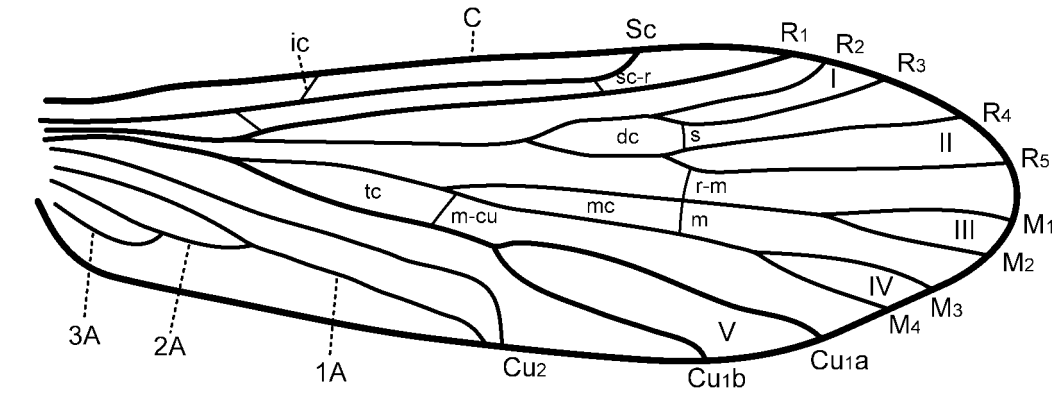
This species was placed within the *W. arizonensis* Group, as defined by Ross (1956) (Table 1).

This species can be distinguished from the other Nearctic species of this genus by the shapes of tergum VIII and segment X. Tergum VIII in *W. planae* has two conspicuous lateromesal processes posteriorly that enclose a broad U-shaped mesal emargination. Tergum X is complex and subtriangularly elongate with various lobate processes anteromesally and lateromedially, with the apex having a triangular appearance. Some specimens examined showed a slight morphological variation in the shape of the posterior margin of tergum VIII from that of the holotype. In those specimens examined, the two lateromesal processes are slightly shorter, and the U-shaped mesal emargination is shallow. The new records of *W. planae* in Arizona result in a new Nearctic distribution for this species; its previously distribution was typically Neotropical.

Adult (in alcohol). Length of male forewing 4.5–5 mm. Head light brown, and with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, light brown setae, with apical forks I, II, III, IV, and V present (Fig. 106). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 107).



FIGURES 101–105. *Wormaldia planae* Ross and King. Male genitalia: 101—left lateral view; 102—dorsal view; 103—ventral view; 104—apical segment of left inferior appendage, dorsal view; 105—phallic sclerites, left lateral view.



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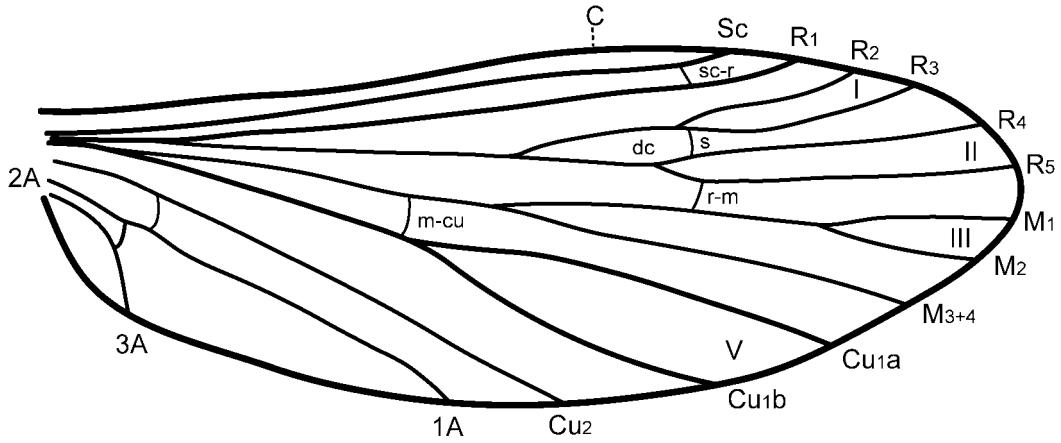


107

FIGURES 106–107. *Wormaldia planae* Ross and King. Wings: 106—right forewing; 107—right hind wing.

Male genitalia (Figs. 101–105). Sternum VII straight posteriorly without process mesally. Tergum VIII with two conspicuous, stout, knob-shaped, lateromesal processes posteriorly that fence a broad, deep, U-shaped, mesal emargination; when viewed laterally, posterodorsal corner with rounded apex of posterolateral process. Sternum VIII relatively straight or very weakly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convex anteriorly, very weakly sinuous posteriorly; when viewed ventrally, weakly concave anteriorly, very shallowly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, bearing anteromedially Y-shaped and mesal process strongly elongate, reaching middle of tergum, lateromedially with obtusely triangular process elongate and widest basally, projected laterally, with apex of tergum triangular in appearance, with lobate projections laterally and anteromesally; when viewed laterally, convexly extended dorsomedially, concavely curved preapicodorsally, subovally elongate apically with oval projection. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate; when viewed laterally, shorter than segment X, subovally elongate posteromedially. Inferior appendages two segmented; when viewed laterally, basal segment stout, rectangular, strongly elongate, broadest and convex medially, apical segment stout, rectangularly elongate, shorter (about 0.9 times) and narrower than basal segment, weakly concave ventromedially, subovate and wide posteriorly; when viewed dorsally, apical segment stout, rectangularly elongate, subovate and wide posteriorly, with elongate and apicolateral patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments paired, united for about their anterior three-fifths, separated posteromesally by a deep and U-shaped emargination, each basal robust, widest medially, with

outer margin convexly curved; apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with two visible, internal sclerites (Fig. 105).

Material examined. USA: Arizona: Gila Co. - Yavapai Co.: Line Fossil Creek, 30.viii.1986, A.R. Brigham & M.W. Sanderson, 1 male (in alcohol, INHS); Fossil Creek, Rd. 708, SE Camp Verde, 3–4.vi.1981, M.W. Sanderson, 2 males, 4 females (in alcohol, INHS); Yavapai Co: Beaver Creek, Ejct. 17–179, 9–10.v.1984, M.W. Sanderson, 1 male (in alcohol, INHS); same except, 14–15.v.1984, 1 male (in alcohol, INHS); ca. 2 mi [= 3.2 km] N Camp Ground, 23.v.1987, M.W. Sanderson, 1 male, 2 females (in alcohol, INHS); bellow outlet of Montezuma Well, 29–30.viii.1985, M.W. Sanderson, 1 male (in alcohol, INHS); stream ex. Chas. Ward Ranch, Rd. 618, 19–20.v.1984, M.W. Sanderson, 1 male (in alcohol, INHS).

Distribution: Mexico: Chiapas. USA: AZ (new record).

***Wormaldia shawnee* (Ross)**
Figures 108–112, 132

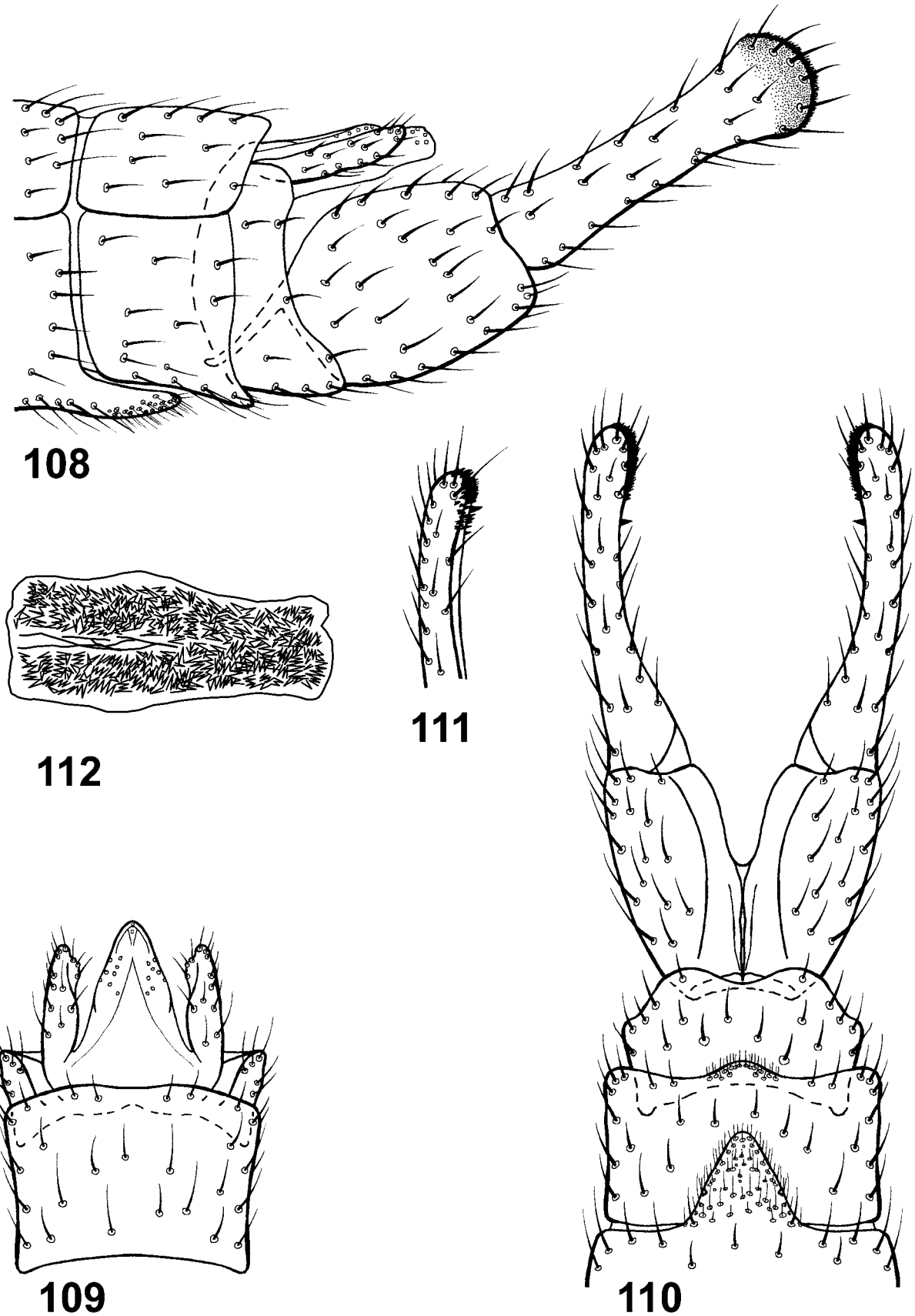
Wormaldia shawnee (Ross) 1938a: 133, figs. 52, 53, male, Illinois, USA (INHS) (as *Dolophilus*); Ross 1944: 7, 14, 45, 46, 47, 292, figs. 61, 157, 160, 163, 164, 166 A, B, 169, 170, 173; Ross 1949: 155, 156 (transferred to *Wormaldia*); Ross 1956: 40, 46, 61, 62, fig. 67A; Denning 1956a: 79; Fischer 1961: 55; Fischer 1971: 196; Moulton & Stewart 1996: 182, 183, figs. 511, 512; Armitage 1996: [work not paginated]; Wiggins *et al.* 2001: 187, 188.

Ross (1949) placed *W. shawnee* within subgroup 3 of the *W. moesta* Group. In 1956, Ross reordered his former *W. moesta* Group proposal and transferred this species to the *W. anilla* Group, which was retained by Armitage (1996) (Table 1).

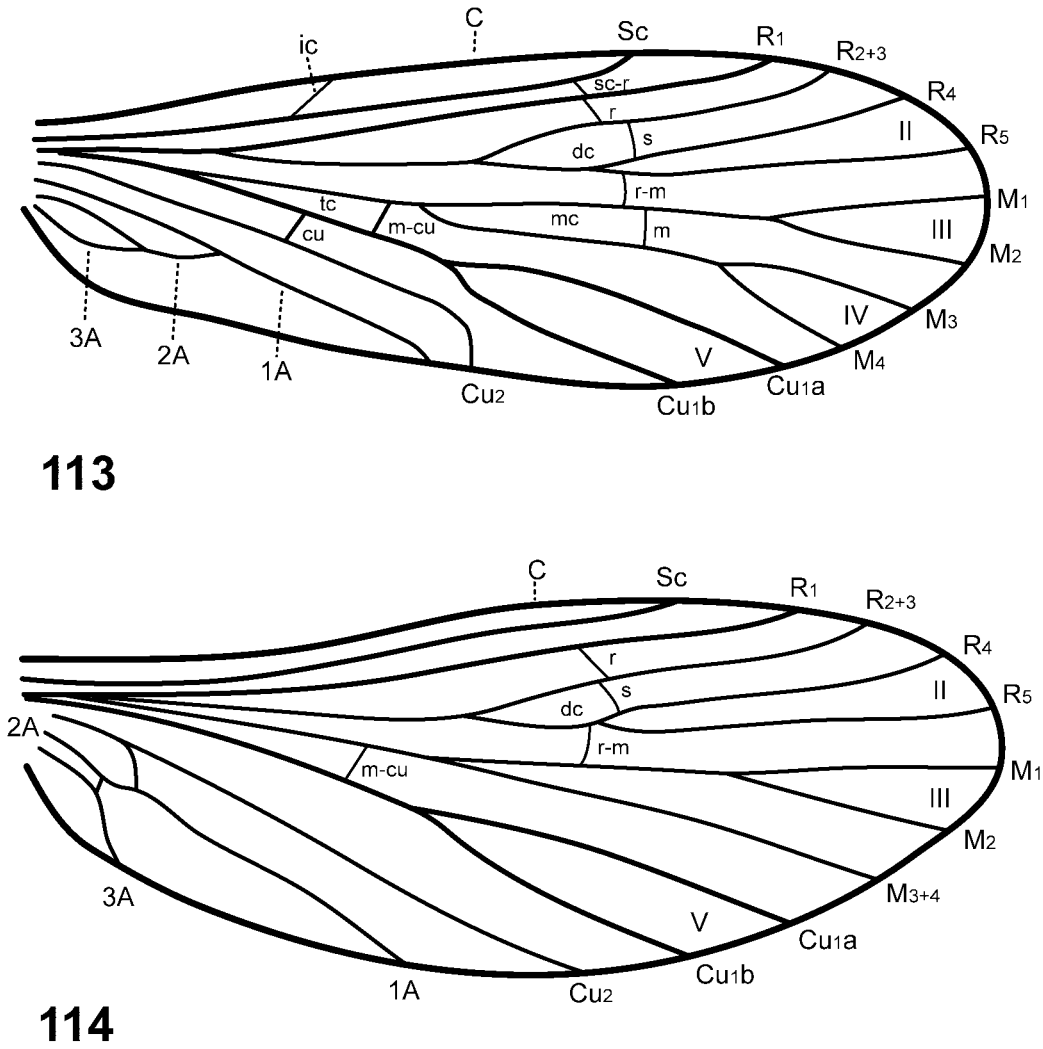
This species and *Wormaldia strota* (Ross 1938b) are similar to *W. birneyi*, new species and *W. pachita* Denning (1956a), however the first two species can be separated by the shape of the basal segment of the inferior appendage, as mentioned in the diagnoses of those two last species. Additionally, *W. shawnee* is closely related to *W. strota*, but they differ in the shapes of sternum VII, segments IX and X, and the inferior appendage. Sternum VII in *W. shawnee* has an elongate and triangular process posteromesally. Sternum VII in *W. strota* is without a process posteromesally. When viewed laterally, segment IX in *W. shawnee* is clearly narrow and nearly C-shaped in appearance. Segment IX in *W. strota* is clearly broad and enlarged ventrally, and straight anteriorly. Tergum X in *W. shawnee* is triangular, very weakly bulged medially, and rounded apically. Tergum X in *W. strota* is triangular, concave laterally, and truncate apically. When viewed laterally, the basal segment of the inferior appendage in *W. shawnee* is subrectangular, slightly elongate, clearly convex medially and conspicuously broader than the apical segment. The basal segment in *W. strota* is rectangular, strongly elongate, with lateral margins relatively straight medially, and slightly wider than the apical segment.

Adult. Length of male forewing 6–6.5 mm (holotype: 6 mm). Head brown, with lighter setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax light brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks II, III, IV, and V present (Fig. 113; Ross 1944: fig. 163). Hind wing translucent, with very few fine, small, brown setae, with apical forks II, III, and V present (Fig. 114).

Male genitalia (Figs. 108–112). Sternum VII with conspicuous, broad, triangular posteromesal process strongly elongate, about 0.5 times length of sternum VIII. Tergum VIII relatively straight posteriorly; when viewed laterally, nearly rectangular. Sternum VIII with slightly convex and posteromesal process, smaller than posteromesal process of sternum VII. Segment IX, when viewed dorsally, weakly concave anteriorly; when viewed laterally, slender and nearly C-shaped in appearance, convex anteriorly, concave posteriorly; when viewed ventrally, weakly concave anteriorly, strongly projected sinuously posteriorly with shallow, mesal



FIGURES 108–112. *Wormaldia shawnee* (Ross). Male genitalia: 108—left lateral view; 109—dorsal view; 110—ventral view; 111—apical segment of right inferior appendage, dorsal view; 112—phallic sclerites, dorsal view.



FIGURES 113–114. *Wormaldia shawnee* (Ross). Wings: 113—right forewing; 114—right hind wing.

concavity. Segment X, when viewed dorsally, triangularly elongate, very weakly bulged medially, narrowest and rounded apically; when viewed laterally, stout, widely rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, bulged medially, rounded apically; when viewed laterally, slightly shorter than segment X, narrowly rounded apically. Inferior appendages two segmented; when viewed laterally, basal segment thick, subrectangular, slightly elongate, broadest and convex medially; apical segment slender, rectangular, strongly tubularly elongate, longer (about 1.5 times) and narrower than basal segment, rounded and widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments paireduniteed for about their anterior halves, separated posteromesally by a deep, narrow, U-shaped emargination, each basal segment stout, slightly widest medially, with outer margin slightly convex, apical segment slender, tubularly elongate, weakly incurved and narrowest medially, rounded posterrioly, with slightly elongate and apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with many visible, small, spine-shaped, internal sclerites (Fig. 112), surrounded by highly convulated membranes.

Material examined. USA: Connecticut: Tolland Co.: Storrs, 19.vi.1954, J.A. Slater, 1 male (in alcohol, INHS); **Illinois:** Pope Co.: Bell Smith Springs, nr. McCormick. 25.v.1957, M.W, Sanderson, 1 male (in alcohol, INHS); Lusk Creek, Eddyville, 7.vi.1946, Mohr & Burks, 1 male (in alcohol, INHS); Herod, 29.v.1935, Ross & Mohr, 1 male (INHS); *Holotype*: Male, same except, Gibbons Creek, 26.v.1936, Mohr & Burks (in INHS, reared, INHS Type 22262); *Paratypes*: 2 males, same holotype data (in alcohol, INHS); same except,

27.v.1936, Burks & Mohr, 1 male (in alcohol, INHS); Gibbons Creek, 0.8 mi [= 1.2 km] NW Herod, NE/SW/SW Sec. 4, T11S R7E, 3.vi.1986, E.A. Lisowski, 1 male (in alcohol, INHS); **New Hampshire:** [Strafford Co., (?)]: Lee, 30.vi.1948, 1 male (in alcohol, INHS); **West Virginia:** Morgan Co.: Cacapon State Park Lodge, 17.vi.1967, 2 males, 6 females (in alcohol, INHS).

Distribution. USA: AL, CT (new record), IL, KY, MO, NC, NH, OH, PA, SC, TN, VA, WV (new record).

***Wormaldia strota* (Ross)**
Figures 115–119, 132

Wormaldia strota (Ross) 1938b: 118, pl. 12, figs. 6, 6A, male, Oklahoma, USA (INHS) (as *Dolophilus strotus*); Ross 1944: 292; Ross 1949: 155, 156 (transferred to *Wormaldia*); Ross 1956: 61, 62, fig. 66 A; Denning 1956a: 79; Fischer 1961: 55; Fischer 1971: 197; Moulton & Steward 1996: 181, 183, figs. 509, 510; Armitage 1996: [work not paginated].

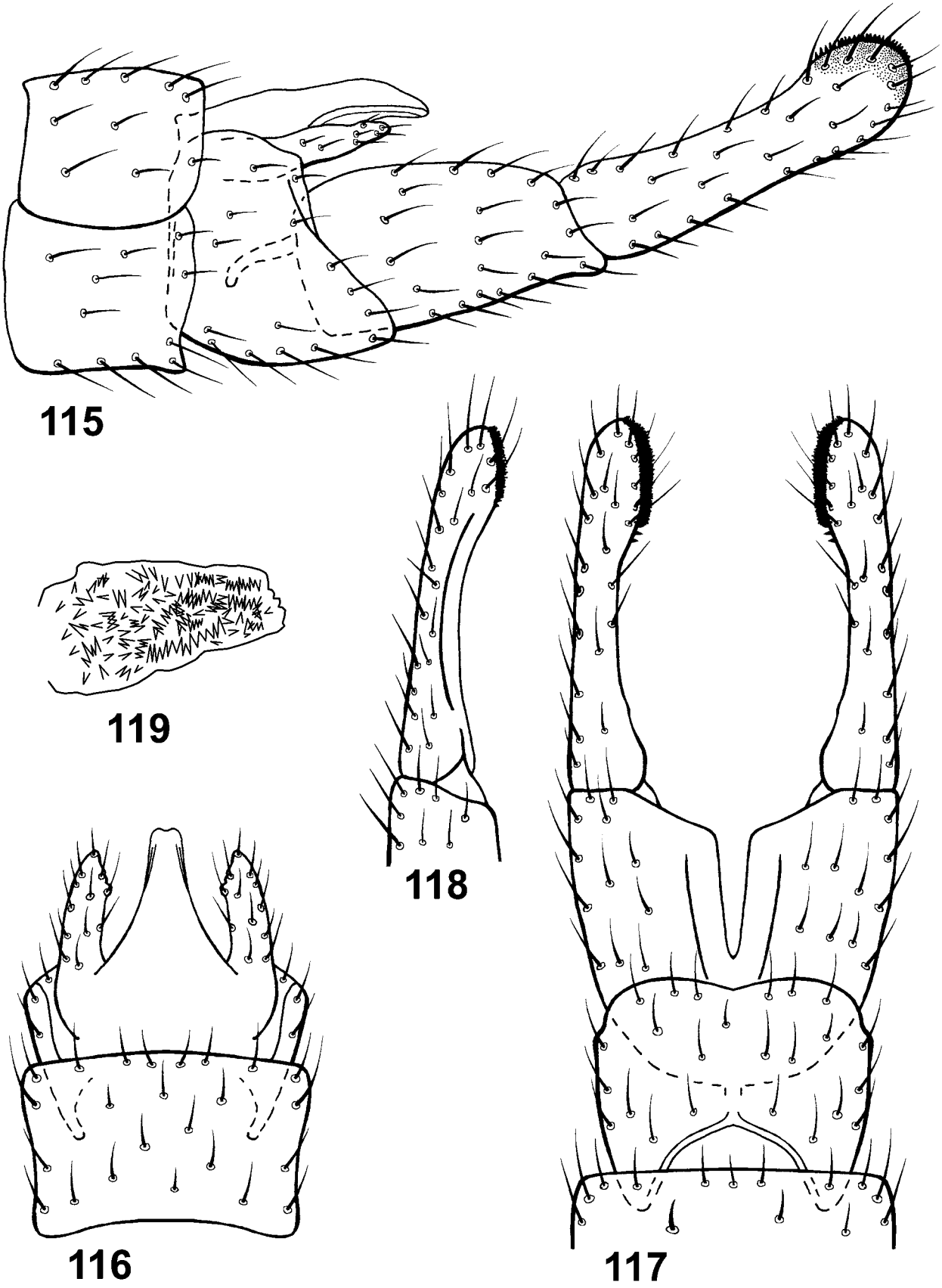
Ross (1949) placed this species within subgroup 3 of the *W. moesta* Group. However, he redefined that species group and transferred *W. strota* to the *W. anilla* Group (Ross1956), which was maintained by Armitage (1996) (Table 1).

This species is related to *Wormaldia shawnee* (Ross 1938a), but can be recognized by the shapes of sternum VII, segments IX and X, and the inferior appendage, as detailed in the diagnosis of *W. shawnee*. Additionally, *W shawnee* and *W. strota* are similar to *W. birneyi* and *W. pachita* Denning (1956a), however they can be separated by the shape of the basal segment of the inferior appendage, as mentioned in the diagnoses of *W. birneyi* and *W. pachita*.

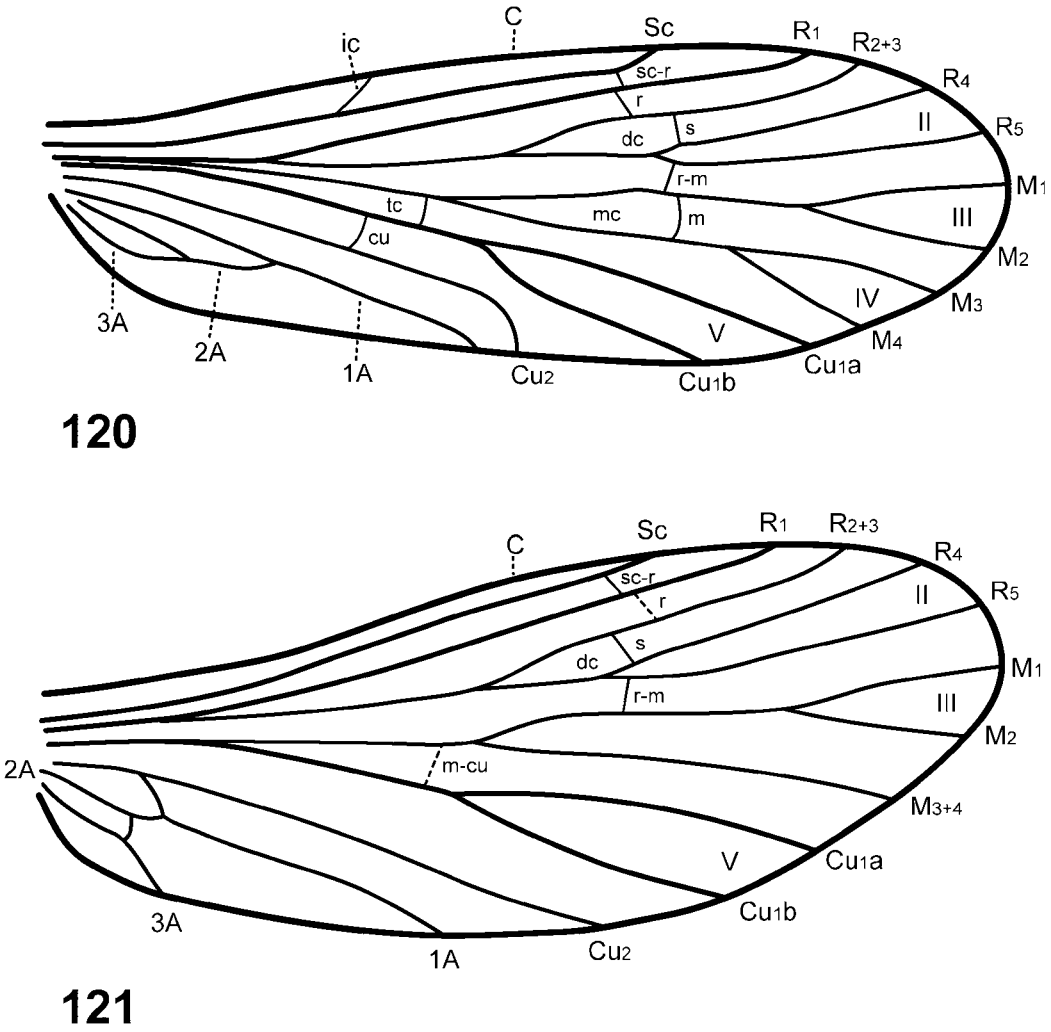
Adult (in alcohol). Length of male forewing 4–5 mm (holotype: 4 mm). Head brown, with lighter setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs yellowish, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks II, III, IV, and V present (Fig. 120). Hind wing translucent, with very few fine, small, brown setae, with apical forks II, III, and V present (Fig. 121).

Male genitalia (Figs. 115–119). Segment VII straight posteriorly without process mesally. Tergum VIII straight posteriorly; when viewed laterally, margins nearly straight. Sternum VIII straight posteriorly without process mesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broader and enlarged ventrally, straight anteriorly, concave posteriorly; when viewed ventrally, concave anteriorly, strongly projected convexly posteriorly with very tiny and very shallow concavity mesally. Segment X, when viewed dorsally, triangularly elongate, slightly concave laterally, slightly truncate apically; when viewed laterally, slightly triangular apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, slightly shorter than segment X, slightly pointed apically. Inferior appendages two segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broader anteromedially, slightly convex dorso and ventrally, apical segment stout, rectangular, strongly tubularly elongate, longer (about 1.2 times) and narrower than basal segment, weakly concave dorsomedially, nearly straight ventrally, slightly widened and rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments paired, united for about their anterior two-fifths, separated posteromesally by a deep, narrow, deep, V-shaped emargination, each basal segment thick, widest posteromedially, with outer margin convexly curved anteromedially, apical segment, slender, tubularly elongate, inner margin concave medially, slightly widened and subovate posteriorly, with elongate and apicolateral patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, when viewed dorsally,

with many visible, tiny, spine-shaped, internal sclerites (Fig. 119), surrounded by highly convulated membranes.



FIGURES 115–119. *Wormaldia strota* (Ross). Male genitalia: 115—left lateral view; 116—dorsal view; 117—ventral view; 118—apical segment of right inferior appendage, dorsal view; 119—phallic sclerites, dorsal view.



FIGURES 120–121. *Wormaldia strota* (Ross). Wings: 120—right forewing; 121—right hind wing.

Material examined. USA: Arkansas: Independence Co.: Piney Creek, ca. 5 mi [= 8 km] E of Pleasant Plains, 31.v.1986, 68 males, 57 females (in alcohol, INHS); Johnson Co.: Gee Creek, 1.5 mi [= 2.4 km] from Haw Creek Rec. Area, 22.v.1981, H.W. Robison, 2 males, 2 females (in alcohol, INHS); Perry Co.: Bear Creek, 2 mi [= 3.2 km] S. Hollis, 11.vi.1983, H.W. Robison, 1 male (in alcohol, INHS); Fourchela Fave R., 6.1 mi [= 11.3 km] S. Hollis, 11.vi.1983, H.W. Robison, 2 males, 2 females (in alcohol, INHS); Polke Co.: Board Camp Creek, ca. 1 mi [= 1.6 km] W of Board Camp, H. W. Robison, 21.v.1982, 2 males (in alcohol, INHS); **Oklahoma:** *Holotype*: Male, Le Flore Co.: Page, 23.vi.1937, Standish-Kaiser (in alcohol, INHS); Pushmataha Co.; Cloudy Creek, nr. Cloudy, 4.v.1940, R. Weddle, 1 male (in alcohol, INHS); same except, 7–8.v.1986, H.P. Brown, 9 males, 11 females (in alcohol, INHS).

Distribution. USA: AR, MO, OK.

***Wormaldia thyria* Denning**

Figures 122–128, 131

Wormaldia thyria Denning 1950: 98, pl. II, figs. 3, 3 A, B, male, North Carolina, USA (CAS); Ross 1956: 38, 61, 62, figs. 68 A–C; Denning 1956a: 79; Fischer 1971: 199; Frazer *et al.* 1991: 19; Armitage 1996: [work not paginated].

Denning (1950) placed this species within subgroup 3 of the *W. moesta* Group established by Ross (1949). However, Ross (1956) redefined his former species group proposal and transferred *W. thyria* to the *W. anilla*

Group. Finally, Armitage (1996) placed this species within the *W. thyria* Group (Table 1).

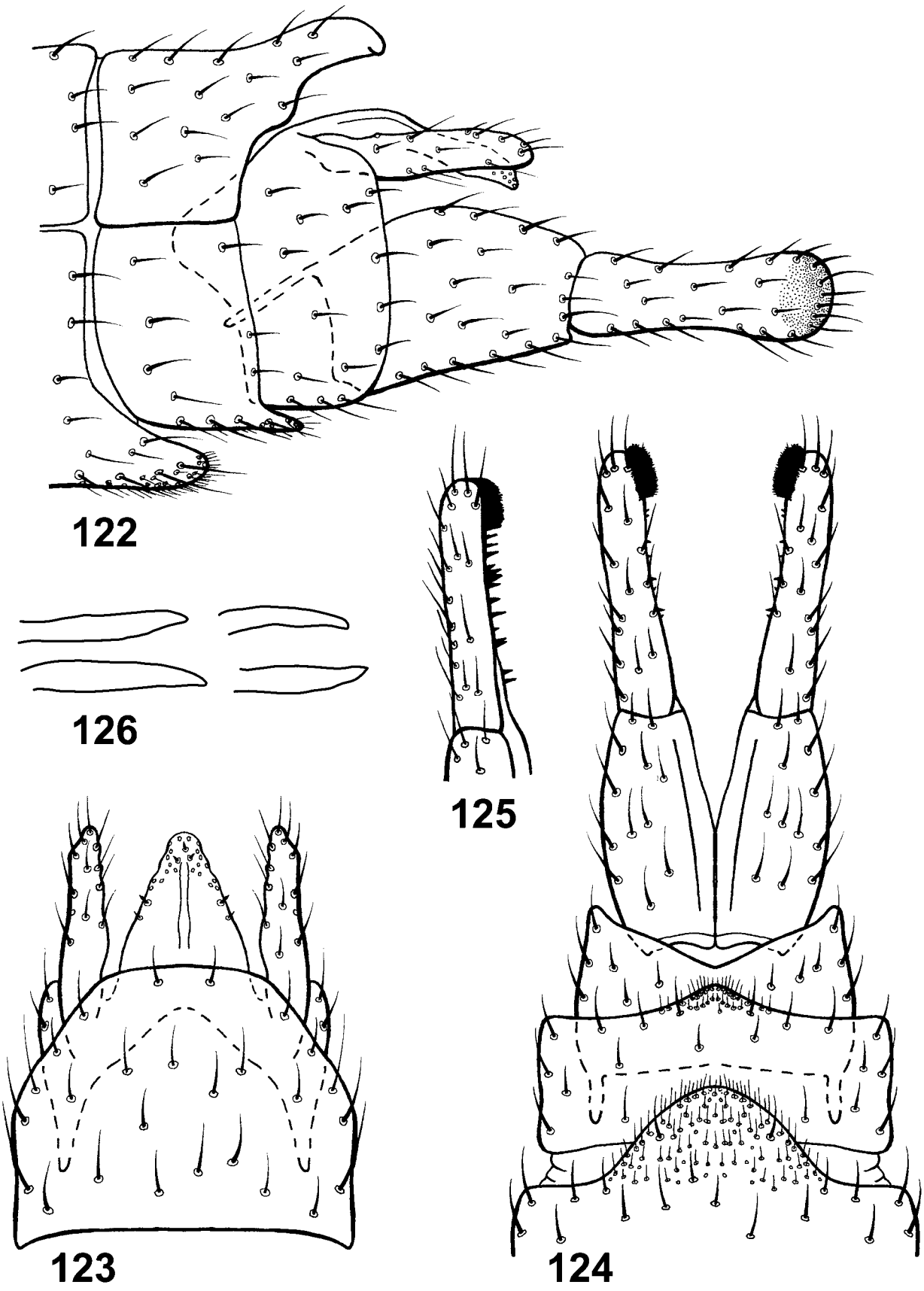
The genitalia of this species, *Wormaldia gesugta* Schmid (1968), *W. hamata* Denning (1951), *W. laona* Denning (1989), *W. mohri* (Ross 1948), and *W. oconee* Morse (1989) are similar in having tergum VIII strongly projected posteriorly, when viewed laterally it simulates a hood, which differentiates these six species from the other Nearctic species of *Wormaldia*. However, *W. hamata*, *W. laona*, *W. mohri*, and *W. oconee* can be recognized from *W. gesugta* and *W. thyria*, as detailed in the diagnoses of the first three species. Finally, it differs from *W. gesugta* by the shapes of tergum VIII, segment IX, and the inferior appendage. Tergum VIII in *W. thyria* is slightly projected convexly, barely surpassing the bases of tergum X and superior appendages, and broad and slightly straight posteromesally. Tergum VIII in *W. gesugta* is subtriangularly projected, reaching the middle of tergum X, and narrow and rounded posteromesally. When viewed laterally, segment IX in *W. thyria* has a broad and strong projection convexly elongate anteromedially. Segment IX in *W. gesugta* is convex anteriorly. Sternum IX in *W. thyria* has a deep, wide, and V-shaped emargination posteriorly. Sternum IX in *W. gesugta* is very weakly sinuous posteriorly. When viewed laterally, the basal segment of the inferior appendage in *W. thyria* is straight ventrally, elongate and equal in length to the apical segment. The basal segment of the inferior appendage in *W. gesugta* is convex ventrally, weakly elongate, and clearly shorter than the apical segment.

Adult (in alcohol). Length of forewing 5 mm (holotype). Head brown, with lighter setae. Antenna long, slender, brown, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax brown. Legs brown, with small, lighter setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 127). Hind wing translucent, with very few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 128).

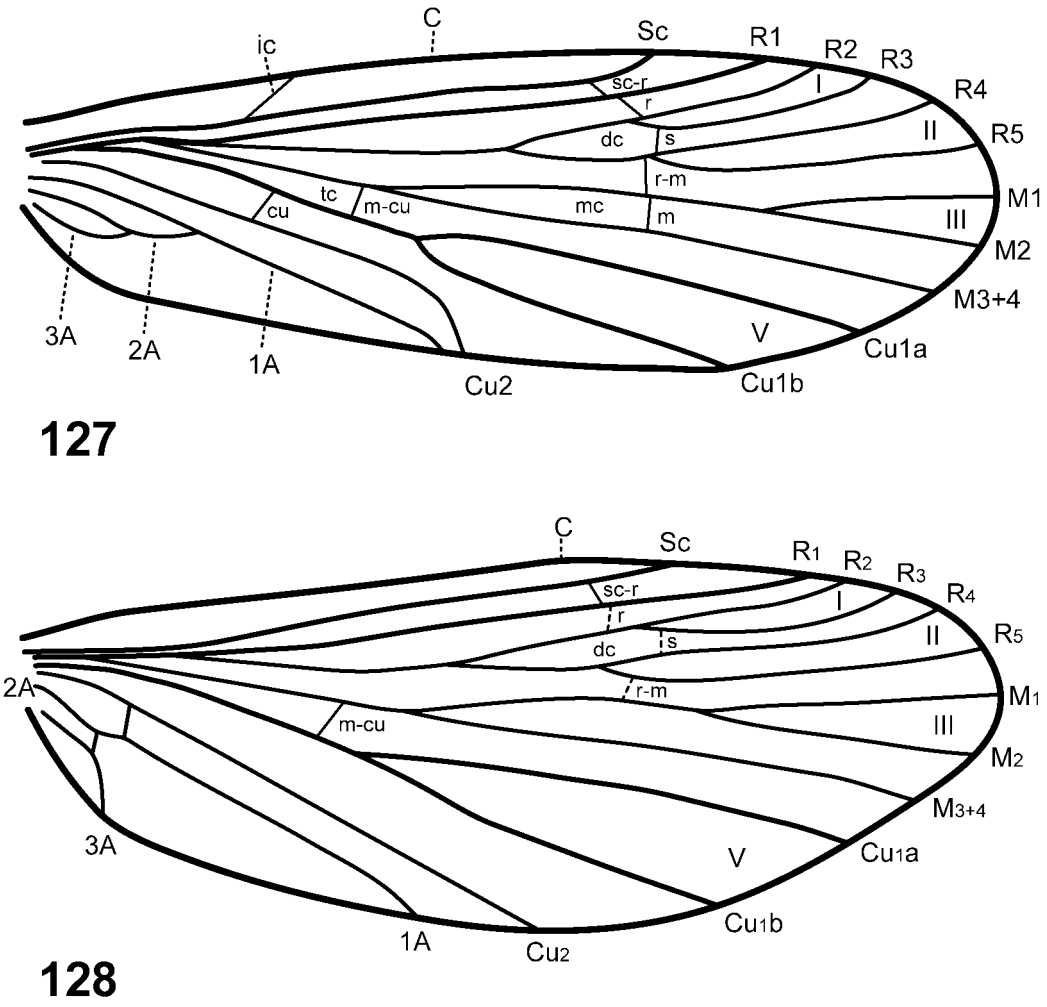
Male genitalia (Figs. 122–126). Sternum VII with prominent, broad, convexly subtriangular, posteromesal process strongly elongate, about 0.5 times length of sternum VIII. Tergum VIII subtriangular in appearance, convexly projected posteriorly, slightly surpassing bases of tergum X and superior appendages, broad and slightly straight posteromesally; when viewed laterally, hood-shaped, sinuous dorsally, posterior margin sinuous, with posterodorsal corner widely rounded apically. Sternum VIII with slight, wide, convex, posteromesal process, noticeably smaller than posteromesal process of sternum VII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly subtriangular in appearance, with broad, strong projection convexly elongate anteriorly, convex posteriorly; when viewed ventrally, with shallow and broad emargination anteriorly, with wide, deep, V-shaped, posterior emargination. Segment X, when viewed dorsally, triangularly elongate, with minute, stout, spine-shaped processes lateromedially and mesoapically, narrowest and rounded apically; when viewed laterally, narrowly rounded apically. Superior appendages digitate; when viewed dorsally, parallel with segment X, stout, elongate, rounded apically; when viewed laterally, nearly equal in length to segment X, tubularly elongate. Inferior appendages two segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest medially, convex dorsally, straight ventrally, apical segment stout, rectangular, tubularly elongate, nearly equal in length and narrower than basal segment, slightly concave medially, rounded and slightly widened posteriorly; when viewed dorsally, apical segment slender, tubularly elongate, rounded posteriorly, with short, black, spine-shaped and peg-shaped setae scarcely medially and in rounded and apicolateral patch on inner margin; when viewed ventrally, basal segments paired, united for about their anterior halves, separated posteromesally by a deep and V-shaped emargination, each basal segment stout, slightly widest medially, with outer margin slightly convex, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, when viewed dorsally, with four visible, slender, elongate, spine-shaped, internal sclerites (Fig. 126).

Material examined. USA: North Carolina: *Holotype*: Male, [Henderson Co., (?)]: Neels Creek, Game Refuge, Mt. Mitchell, 30.v.1946, J.F. Hanson (in alcohol, CAS).

Distribution. USA: AL, NC, SC, TN, VA.



FIGURES 122–126. *Wormaldia thyria* Denning. Male genitalia: 122—left lateral view; 123—dorsal view; 124—ventral view; 125—apical segment of right inferior appendage, dorsal view; 126—phallic sclerites, dorsal.



FIGURES 127–128. *Wormaldia thyria* Denning. Wings: 127—right forewing; 128—right hind wing.

Key to males of Nearctic *Wormaldia*

It is recommended that users of this identification key read the section "Morphological considerations" in "Material and methods" before using this key. Some morphological characters that are used as diagnostic tools for separating and identifying species exhibited some variation in shape from that of the holotype in some species. To obtain a successful species identification in *Wormaldia* as in other Trichoptera genera, it is necessary to use a combination of several diagnostic morphological characters of the male genitalia. Therefore, users of this identification key are recommended to corroborate their species determinations with the respective extensive diagnoses, descriptions, illustrations, maps, and distributional data that have been provided in this work. Sternum VII is not shown in the illustrations when its posterior margin is straight or does not present any process. Illustrations of the hypothetical male genitalia of *Wormaldia* with its components and detailed terminology are presented in Figs. 1–5.

1. Sternum VII with posteromesal process (e.g., Figs. 29, 36, 43).....8
- Sternum VII with posterior margin straight, without mesal process (e.g., Fig. 3) 2
2 (1'). Sternum VIII with slight, convex, posteromesal process (e.g., Figs. 8, 29, 43, 48, 86) 7
- Sternum VIII with posterior margin straight, without mesal process (e.g., Figs. 3, 16, 62, 98, 117) 3

3 (2'). Tergum X complex, subtriangular, with conspicuous, lobate processes anteriorly or lateromedially (Figs. 15, 102) 6

- Tergum X simple, triangular, without conspicuous, lobate processes (e.g., Figs. 7, 35, 77, 109) 4

4 (3'). Segment IX, when viewed laterally, posteriorly straight; inferior appendages, when viewed ventrally, paired basal segments united for about their anterior 2/3, separated posteromesally by shallow, U-shaped emargination (Figs. 6–13, 129) ..... *W. anilla* (Ross)

- Segment IX, when viewed laterally, posteriorly concave; inferior appendages, when viewed ventrally, paired basal segments united for about their anterior 2/5, separated posteromesally by deep emargination (Figs. 98, 117) 5

5 (4'). Segment IX, when viewed laterally, narrow, C-shaped in appearance, anterior margin convex, when viewed ventrally, posteriorly projected sinuously with mesal process; inferior appendages, when viewed ventrally, with paired basal segments separated posteromesally by wider emargination (Figs. 96–100, 132) ..... *W. pachita* Denning

- Segment IX, when viewed laterally, broad in appearance, enlarged ventrally, anterior margin straight, when viewed ventrally, posteriorly convexly projected with mesal concavity; inferior appendages, when viewed ventrally, with paired basal segments separated posteromesally by narrower emargination (Figs. 115–121, 132) ..... *W. strota* (Ross)

6 (3). Segment X, when viewed laterally, its apex prominently balloon-shaped, without lobate projection; superior appendage, when viewed laterally, with dorsomedial margin extended convexly (Figs. 14–20, 129) ..... *W. arizonensis* (Ling)

- Segment X, when viewed laterally, its apex semiovate, with lobate projections; superior appendage, when viewed laterally, dorsomedial margin straight (Figs. 101–107, 129) *W. planae* Ross and King

7 (2). Tergum X simple, triangular, without lobate processes (Figs. 6–13, 129) .....*W. anilla* (Ross)

- Tergum X complex, subtriangular, with several processes anteromesally and lateromedially (Figs. 101–107, 129) ..... *W. planae* Ross and King

8 (1). Sternum VII with conspicuous, elongate, digitate, posteromesal process (Figs. 36, 55, 69, 78, 94) 17

- Sternum VII posteromesally slightly convex (Figs. 29, 43), or with convex process (Fig. 23), or with process convexly subtriangular (Figs. 48, 55, 62, 86, 110, 124) 9

9 (8'). Tergum VIII, when viewed laterally, hood-shaped, posterodorsal apex strongly projected, reaching middle of segment X (Figs. 41, 46, 60, 122) 14

- Tergum VIII, when viewed laterally, nearly rectangular, with posterodorsal apex reaching or slightly surpassing base of segment X (Figs. 21, 27, 53, 84, 108) 10

10 (9'). Sternum IX posteriorly sinuous, without mesal process; inferior appendages, when viewed ventrally, paired basal segments united for at most their anterior 1/2, separated posteromesally by deep emargination (Figs. 23, 55, 110) 12

- Sternum IX with stout, posteromesal process; inferior appendages, when viewed ventrally, paired basal segments united for at least their anterior 3/4, separated posteromesally by shallow, U-shaped concavity (Figs. 29, 86) 11

11 (10'). Sternum VII with slight, convex, posteromesal process, less than 0.2 times length of sternum VIII; tergum X concave anterolaterally, bulged medially, rounded posteriorly (Figs. 27–33, 129) .... *W. clauseni*, new species

- Sternum VII with elongate, convexly subtriangular, posteromesal process, about 0.5 times length of sternum VIII; tergum X triangular, relatively straight laterally, acutely rounded posteriorly (Figs. 84–91, 129) ..... *W. occidea* (Ross)

12 (10). Tergum VIII with conspicuous, U-shaped, posteromesal emargination; inferior appendages, when viewed ventrally, apical segments thick (Figs. 53–59, 130) ..... *W. lacerna* Denning

- Tergum VIII posteriorly straight, without mesal emargination; inferior appendages, when viewed

ventrally, apical segments slender (Figs. 23, 110) 13

13 (12'). Segment IX, when viewed laterally, broad, subrectangular in appearance; inferior appendages, when viewed ventrally, slender, paired basal segments united for about their anterior 1/5, separated posteromesally by deeper, wide emargination, basal and apical segments nearly equal in length (Figs. 21–26, 132) ..... *W. birneyi*, new species

- Segment IX, when viewed laterally, slender and nearly C-shaped in appearance; inferior appendages, when viewed ventrally, stout, paired basal segments united for about their anterior 1/2, separated posteromesally by deep, narrow emargination, apical segments longer than basal segments (Figs. 108–114, 132) ..... *W. shawnee* (Ross)

14 (9). Segment IX, when viewed laterally, with broad, elongate, convex, anterior projection (Figs. 60, 122); when view ventrally, with wide, deep, V-shaped posteromesal emargination (Figs. 62, 124) ... .16

- Segment IX, when viewed laterally, anteriorly convex (Figs. 41, 46); when viewed ventrally, posteriorly straight or weakly sinuous (Figs. 43, 48) 15

15 (14'). Sternum IX posteriorly slightly sinuous; inferior appendage, when viewed laterally, basal segment broad, convex medially, shorter than apical segment (Figs. 41–45, 131) ..... *W. gesugta* Schmid

- Sternum IX posteriorly straight; inferior appendage, when viewed laterally, basal segment straight ventromedially, elongate, nearly equal in length to apical segment (Figs. 46–52, 131)..... ..... *W. hamata* Denning

16 (14). Sternum VII with narrowly subtriangular, posteromesal process; tergum VIII strongly projected posteriorly, narrow posteromesally, reaching middle of tergum X; tergum X with concave, preapical constriction (Figs. 60–66, 131) ..... *W. laona* Denning

- Sternum VII with prominently wide, convex, posteromesal process; tergum VIII convexly projected posteriorly, barely surpassing bases of tergum X and superior appendages; tergum X without preapical constriction (Figs. 122–128, 131) ..... *W. thyria* Denning

17 (8). Tergum VIII, when viewed laterally, nearly rectangular in appearance, posteriorly straight or slightly concave (Figs. 34, 53, 67) 18

- Tergum VIII, when viewed laterally, hood-shaped in appearance, projected posteriorly, surpassing bases of tergum X and superior appendage (Figs. 76, 92) 20

18 (17). Sternum VIII posteromesally convex or with triangular process; sternum IX posteromesally slightly concave or emarginated (Figs. 36, 55); inferior appendage with basal segment clearly shorter than apical segment (Figs. 34, 53) 19

- Sternum VIII with elongate, digitate, posteromesal process; sternum IX with small, subtriangular, posteromesal process; inferior appendage with basal and apical segments nearly equal in length (Figs. 67–75, 130) ..... *W. moesta* (Banks)

19 (18). Tergum VIII posteriorly straight; sternum VIII with triangular, posteromesal process (Figs. 34–40, 130) ..... *W. gabriella* (Banks)

- Tergum VIII with U-shaped, posteromesal emargination; sternum VIII posteriorly sinuous, with mesal convexity (Figs. 53–59, 130).....*W. lacerna* Denning

20 (17'). Tergum X, when viewed laterally, dorsal margin smooth, straight; inferior appendage, when viewed ventrally, basal segment slightly longer than apical segment, apical segment without spine-shaped, preapical projection on inner margin (Figs. 92–95, 131) ..... *W. oconee* Morse

- Tergum X, when viewed laterally, dorsal margin serrated medially, strongly upcurved preapically; inferior appendage, when viewed ventrally, basal segment clearly longer than apical segment, apical segment with spine-shaped, preapical projection on inner margin (Figs. 76–83, 131) .... *W. mohri* (Ross)

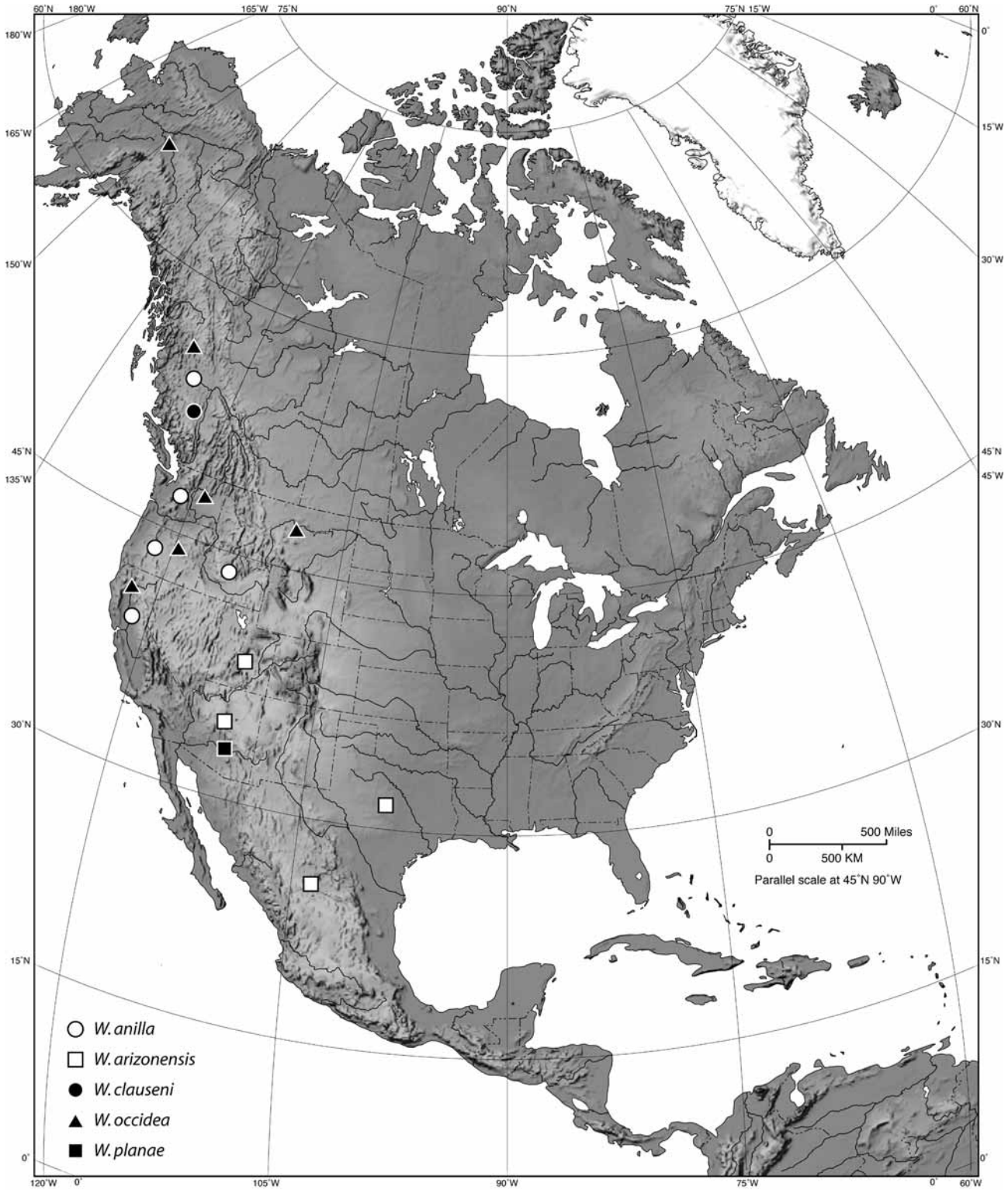


FIGURE 129. Nearctic distribution by state or province of *Wormaldia anilla*, *W. arizonensis*, *W. clauseni*, new species, *W. occidea*, and *W. planae* See text for detailed locality information.

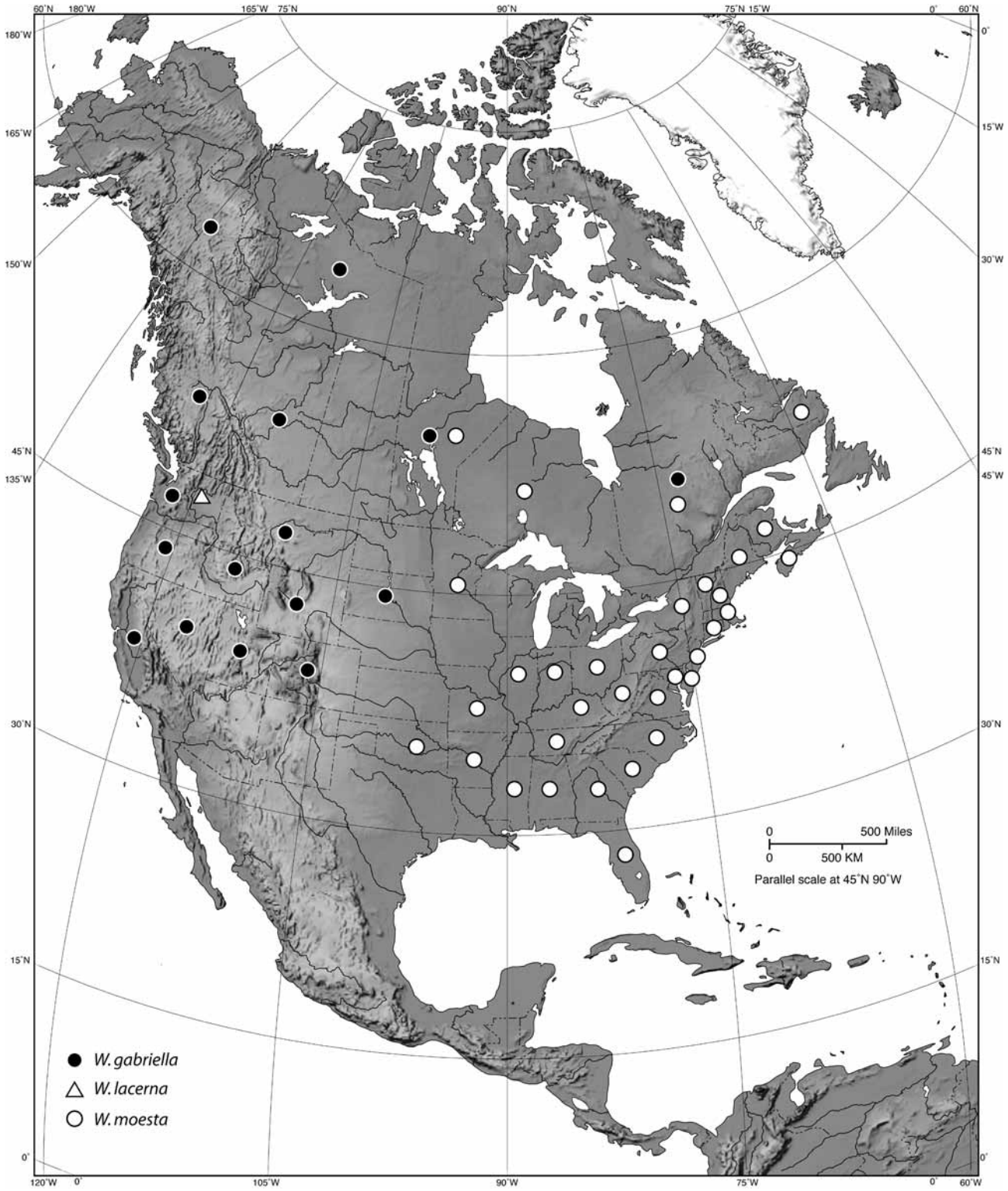


FIGURE 130. Nearctic distribution by state or province of *Wormaldia gabriella*, *W. lacerna*, and *W. moesta*. See text for detailed locality information.

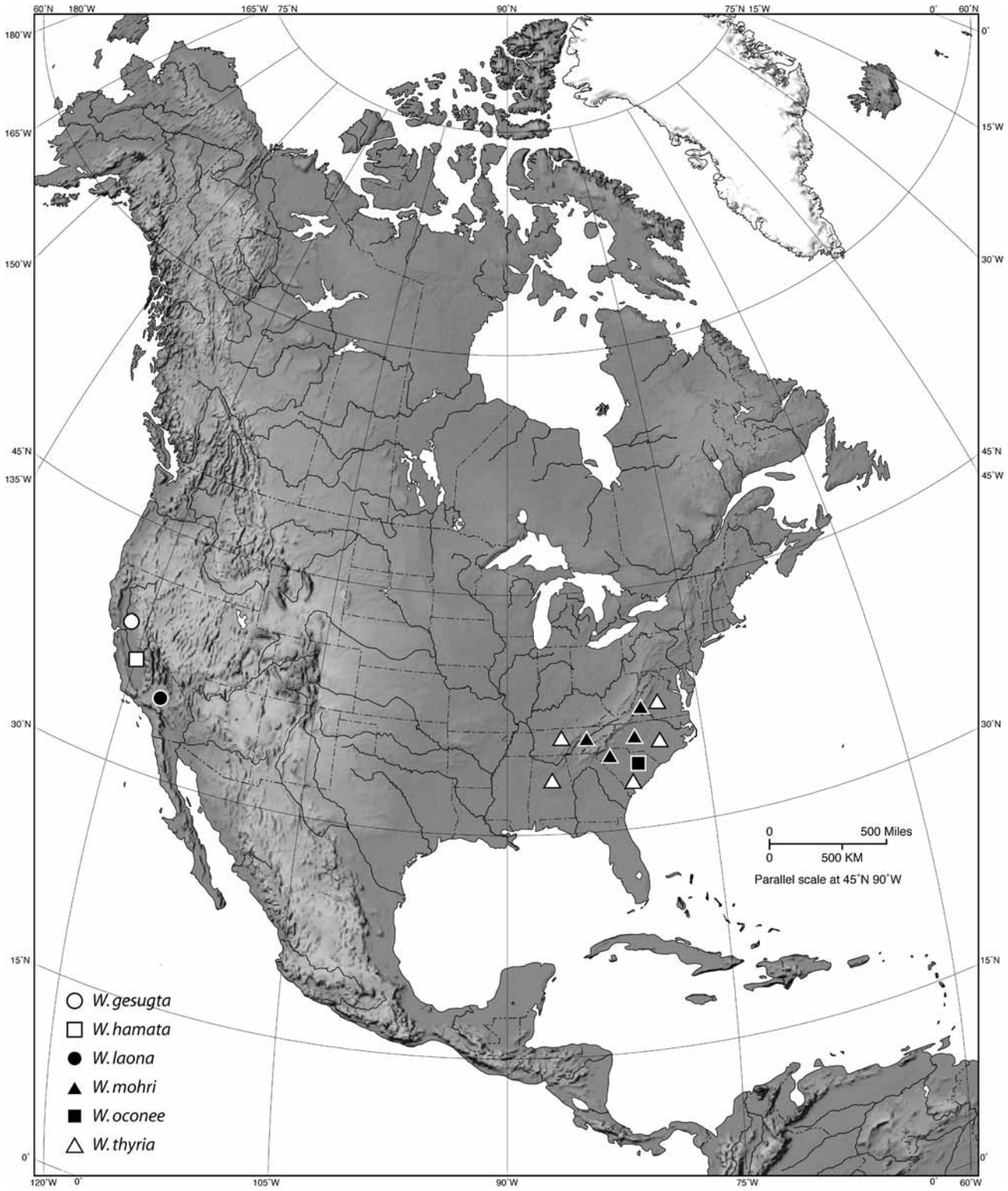


FIGURE 131. Nearctic distribution by state or province of *Wormaldia gesugta*, *W. hamata*, *W. laona*, *W. mohri*, *W. oconee*, and *W. thyria*. See text for detailed locality information.

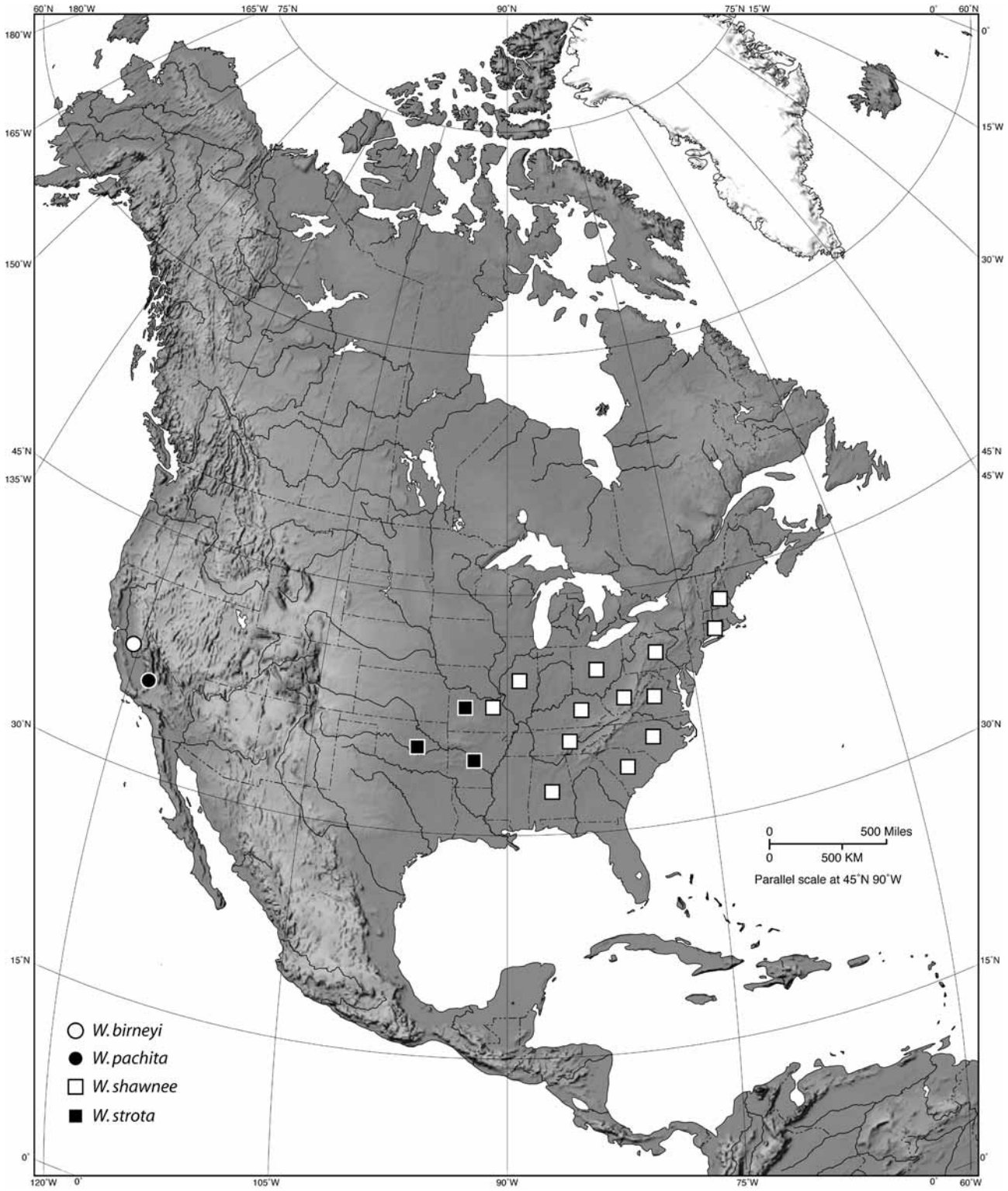


FIGURE 132. Nearctic distribution by state or province of *Wormaldia birneyi*, new species, *W. pachita*, *W. shawnee*, and *W. strota*. See text for detailed locality information.

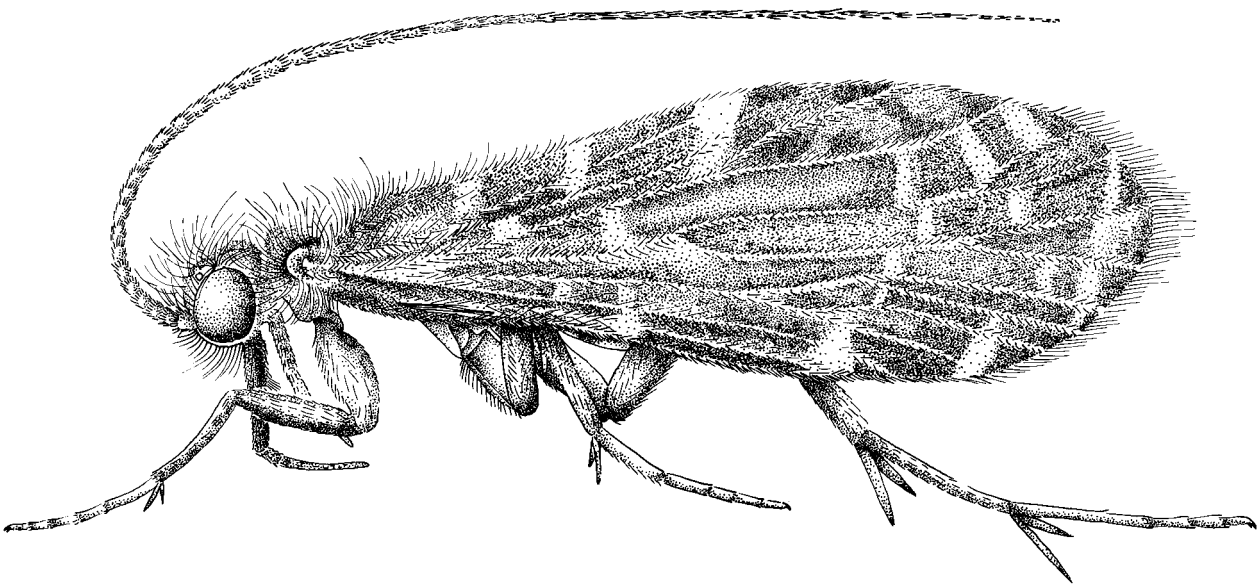


FIGURE 133. *Wormaldia moesta* (Banks), habitus, adult male, left lateral view.

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