

The Nearctic Genus *Ammonaios* Irwin and Lyneborg 1981 (Diptera: Therevidae)

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ABSTRACT The North American genus *Ammonaios* Irwin and Lyneborg is revised, and the three new species, *A. confusus* sp. n., *A. mexicanus* sp. n., and *A. sabulosus* sp. n., are described. The limits of the genus are redefined; a key to the species, descriptions of the pupae of three species, and distribution maps are provided. A cladistic analysis provides hypotheses of phylogenetic relationships within the genus, and the monophyly of *Ammonaios* was affirmed when tested with respect to species within its putatively closely related genera.

KEY WORDS *Ammonaios*, Therevidae, new species, pupal morphology

THIS ARTICLE IS PART of the effort to revise the species of the genera of Nearctic Therevidae (Irwin and Lyneborg 1981a, b; Webb and Irwin 1988, 1991a, b, c, 1995, 1999). In their revision of the Nearctic genera of Therevidae, Irwin and Lyneborg (1981a) erected the genus *Ammonaios* and designated *Thereva nivea* Kröber as the type species. They stated that there are “at least four additional, unnamed species at hand.” Since then, several private collectors and institutions made more material available for study. Like most members of the family Therevidae, the genus *Ammonaios* prefers hot sandy habitats and is distributed in the southwestern part of the United States and in northwestern Mexico. The revision undertaken in this study redefines the limits of the genus, and provides a key to the species, species descriptions with figures, descriptions of the pupae, and distribution maps. In a cladistic analysis, the internal relationships of the genus *Ammonaios* were examined, and the monophyly of *Ammonaios* was affirmed with respect to species within its putatively closely related genera.

Materials and Methods

Specimens. A unique identifying number, usually a three-letter prefix followed by a 6-digit number (MEI#####), was attached to each specimen (yellow label). If a specimen had previously been assigned a unique identifier, that number was used in preference to the MEI#. This unique identifier, together with all label information, was incorporated into Mandala, a database designed to log data about and track individual therevid specimens (Kampmeier and Holston 2002). These data are available and searchable through the Internet (<http://pherocera.inhs.uiuc.edu/index.htm>).

Specimens Examined Format. To conserve space and include as much information as possible about each specimen, the “specimens examined” section under each species was formatted to avoid redundancy. The data are reported hierarchically: country (all caps), state, county, populated place (with distance modifiers, lower case), decimal degrees of latitude and longitude [in square parentheses], altitude in meters (m), collecting date (day, month in roman numbers, 4-digit year), collecting method (if known), collector (when represented by an acronym, see Appendix 1), number and sex of specimens followed by unique identifier (all 6-digit numbers are MEI numbers if not stated otherwise), and collection depository acronym (all specimen numbers of specimens deposited in the same collection are enclosed by the same set of parentheses). Data not repeated in a series are the same as those of preceding series. In the presentation of locality data, a semicolon (;) terminates one series of specimens and signals the beginning of the next. Acronyms of museums and collections are given in Appendix 1; acronyms of collectors are in the Materials and Methods section.

Immature Stages. The immature stages of Therevidae are poorly known. Larvae are predators of immature soil-dwelling insects. The larvae and pupae of species of *Ammonaios* can be found by sifting sand. Descriptions and biologies are available for very few species of Therevidae, and most descriptions lack detail. For this study, only the pupal stage was examined. The terminology for Asiloidea pupal morphological characters is not well established. Such information in the literature is scattered and inconsistent. Therevid pupal morphology is confined to the works of DeMeijere (1916), English (1950), Hennig (1952), Brauns (1954), and Irwin (1972, 1973). Additional information comes from publications about Asilidae pupae

(Melin 1923, Musso 1978) and Bombyliidae pupae (Hull 1973), both of which are closely related to the Therevidae. Inconsistencies in terminology include the number of abdominal segments and abdominal spiracles, which vary among authors and are not included in most. In this study, an overview of the morphology of therevid pupae is provided with the aim of clarifying the use of terminology.

Description of Species. Adult terminology follows Irwin and Lyneborg (1981a, b), McAlpine et al. (1981), and Winterton et al. (1999). We use the term "pubescent" instead of "pruinescence" for the silver microtrichia on head and thorax. The term pruinescence is often used for "waxy bloom covering insects like Odonata" (Nichols 1989), while "pubescent" is defined as "clothed with soft, short, fine, loosely set hairs." This description reflects better the microtrichia covering the head and thorax. Descriptions and re-descriptions of the species are based on holotype specimens. Variation found in other specimens is recorded within that description in parentheses. The following abbreviations are used: av, anteroventral macrosetae of the femora; dc, dorsocentral macrosetae of mesonotum; np, notopleural macrosetae of mesonotum; pa, postalar macrosetae of mesonotum; sa, supra-alar macrosetae of mesonotum; sc, scutellar macrosetae. ALM = A. L. Melander, CRN = C. R. Nelson, DWW = D. W. Webb, ELS = E. L. Sleeper, EMF = E. M. Fisher, FDP = F. D. Parker, JAP = J. A. Powell, JLF = J. L. Fisher, MAC = M. A. Cazier, MEI = M. E. Irwin, RCM = R. C. Miller, DYA = D. Yanega.

Illustrations. Genitalia were macerated in 10% KOH overnight to remove soft tissue, rinsed in distilled water, and dissected under a Wild/Leica MZ8 binocular dissecting microscope. Female reproductive organs were stained with a saturated solution of Chlorazol Black in 75% ethanol. Preparations were retained in glycerin in genitalia vials mounted beneath the specimens. Images of preparations were captured electronically with a digital camera and enhanced using Adobe Photoshop 5.0. Line drawings were made by the first author using Adobe Illustrator 8.0 aided by the digital images.

Cladistic Analysis. The internal hierarchy of the Therevidae remains unclear. Lyneborg (1976) and Irwin and Lyneborg (1981a) divided the family into two subfamilies, the Phycinae and Therevinae. While the Phycinae were split into two tribes, the Phycini and the Xestomyzini (Lyneborg 1976), the highly diverse Therevinae were left with no formal tribal classification. Gaimari and Irwin (2000) erected the tribe Cyclotelini for a Laurasian group of Therevinae. These studies helped to characterize one monophyletic group of Therevinae, but left the majority of genera lacking placement in named groups. Winterton et al. (2001) described a third subfamily, Agapophytinae, for a group of Australasian genera.

The close relatives of *Ammonaios* were unknown because nothing had been published about the relationships among the therevine genera beyond the groups mentioned above. Unpublished data from an extensive phylogenetic treatment of the higher Ther-

evinae (Metz 2002) suggest a putative sister group relationship between species of *Ammonaios* Irwin and Lyneborg and *Arenigena* Irwin and Lyneborg. These two genera were also found to be closely associated with species in the genera *Brachylinga* Irwin and Lyneborg, *Chromolepida* Cole, *Lysilinga* Irwin and Lyneborg, and *Rhagioforma* Irwin and Lyneborg. The four genera were included in the morphological dataset, and *Penniverpa* Irwin and Lyneborg was used as an outgroup in the study presented in this work. To test the hypothesis of the monophyly of *Ammonaios* with respect to *Arenigena*, *Brachylinga*, *Chromolepida*, *Lysilinga*, and *Rhagioforma*, the following taxa were chosen to represent the above listed genera: *Arenigena marcida* (Coquillett), *Arenigena semitaria* (Coquillett), *Brachylinga cinerea* (Cole), *Brachylinga baccata* (Coquillett), *Chromolepida bella* (Cole), *Lysilinga aurantiaca* (Coquillett), *Rhagioforma maculipennis* (Kröber), and *Penniverpa festina* (Coquillett).

Phylogenetic analyses followed the cladistic philosophy of parsimony promoted by Hennig (1966). The outgroup was used to establish character polarities. Data were recorded in WINCLADA version 0.9.99m24 (Nixon 1999), and an exhaustive search was performed using PAUP* 4.0b10 (Swofford 2001). All multistate characters were treated as nonadditive. The character states are described in Table 1, and the data matrix is shown in Table 2.

States of characters that were not known in certain species were scored as "?". Bremer support values were calculated using SEPAL version 1.4 (Salisbury 2000) and added to the cladogram (Fig. 2).

Results and Discussion

Cladistic Analysis. Parsimony analysis to test the monophyly of *Ammonaios* with respect to its putative related genera resulted in three most parsimonious trees of 71 steps. The strict consensus tree of 74 steps had a consistency index (CI) of 0.52 and a retention index (RI) of 0.68 (Fig. 2).

The *Arenigena* + *Ammonaios* clade is supported by several synapomorphies, including the pale yellow macrosetae of the thorax and the missing hindcoxal knob. The coloration of the thoracic macrosetae is found in several other therevid genera (e.g., *Ammothereva* Lyneborg) and therefore homoplastic. The absence of the hind coxal knob (character 16) is a strong diagnostic feature of this clade, and this state is only found in two other genera: the Phycini genus *Actorthia* Kröber (which belongs in a separate subfamily and is without a doubt not closely related) and *Ammothereva* (*lepida* Lyneborg & *mesasiatica* Zaitzev), a Palaearctic genus placed in the Cyclotelini (Gaimari and Irwin 2000). *Ammonaios* and *Arenigena* are not included within the Cyclotelini; thus, the lack of a hincxal knob appears to have been derived independently at least three times. Although this structure is reduced in size in the North African genus *Acantothereva* Ségué, its presence is evident.

Table 1. Character description and states used in phylogenetic analysis

| Character description and character state | |
|---|---|
| 1 | Setae on male frons (frontal triangle) (0) absent (1) present |
| 2 | Setae color on frons (0) black (1) white |
| 3 | Lanceolate setae (Fig. 54) on occiput (0) absent (1) present |
| 4 | Setae on male frons erected (0) appressed (1) |
| 5 | Parafacial setae (0) absent (1) present (Fig. 54) |
| 6 | Area around tentorial pit (0) pubescent (Fig. 54) (1) bare, shining black (Fig. 53) |
| 7 | Setae on gena (0) darker than other facial setae (1) same color as other facial setae |
| 8 | Wings (0) maculated (Figs. 47, 48) (1) transparent (Figs. 49, 50) |
| 9 | Cell m_3 (0) open (1) close (2) petiolate (Figs. 47–50) |
| 10 | Pterostigma (0) distinct, dark (Figs. 47, 48) (1) indistinct, concolorous with membrane of wing (Figs. 49, 50) |
| 11 | Cross veins (0) darker than other veins (Figs. 47, 48) (1) same color as other veins (Figs. 49, 50) |
| 12 | Setae on metanepisternum (0) present (1) absent |
| 13 | Setae on lower katepisternum (0) present (1) absent |
| 14 | Setae on katepisternum (0) not continuous dorsoventrally (1) continuous dorsoventrally |
| 15 | Thoracic macrosetae (0) dark brown to black (1) pale yellow (Fig. 1) |
| 16 | Hind coxal knob (0) present (1) absent |
| 17 | Furca anteriorly (0) with a square anterior extension (1) straight (2) with a round anterior extension |
| 18 | Furca posteriorly (0) broad (1) constricted (Figs. 32–35) (2) narrow |
| 19 | Setae on median lobe of female tergite IX (0) present (1) absent |
| 20 | Ejaculatory apodeme dorsally (0) without ring-like structure (Figs. 19, 23) (1) with ring-like structure (Figs. 17, 21) |
| 21 | Posterior end of ejaculatory apodeme with hollow opening (0) closed (Fig. 18) (1) open |
| 22 | Posterior end of ejaculatory apodeme with hollow opening (0) round (Fig. 16) (1) narrow |
| 23 | Outer gonocoxal process (0) present (1) absent (Fig. 12) |
| 24 | Inner gonocoxal process (0) present (Fig. 12) (1) absent |
| 25 | Phallus in dorsal view (0) widest anteriorly (Fig. 16) (1) parallel sided |
| 26 | Anterior edge of epandrium border (0) straight (Fig. 24) (1) concave (Fig. 27) |
| 27 | Gonostylus tip (0) rounded (1) golf club shaped |
| 28 | Setae apically on gonostylus (0) absent (1) present |
| 29 | Epandrial flanges (0) absent (Fig. 25) (1) present, small (Fig. 26) (2) present, large |
| 30 | Hypoproct in lateral view (0) straight (1) bent ventrally |
| 31 | Tergite VIII of males medially (0) broad (1) small (2) very small |
| 32 | Female S8 (0) square (1) elongated |
| 33 | Posterior end of male S8 (0) straight (1) with incision |
| 34 | Male T8 (0) concave (1) straight |
| 35 | Setae on posterior part of midcoxa (0) absent (1) present |

The cladistic analysis supported the monophyly of *Ammonaios* with respect to its sister genus, *Arenigena*; however, the described species of *Arenigena* did not produce a monophyletic unit in this study. Several undescribed species of *Arenigena* were included in preliminary analyses, and the results supported a monophyletic *Arenigena semitaria* group (Irwin and Lyneborg 1981a); suggesting that the *Arenigena marcida* group (Irwin and Lyneborg 1981a) is paraphyletic with respect to *Ammonaios*. Although the resolution of phylogenetic relationships among the species in the genus *Arenigena* is beyond the scope of this study, future analyses that include immature characters and molecular data will hopefully clarify the relationships among those species.

The analysis hypothesizes a very distinct clade for *Ammonaios*, with a relatively high Bremer support value of 7.

Synapomorphies. The genus is supported by the following synapomorphic morphological features: lanceolate setae at least on the head (character 3), presence of parafacial setae (character 5), closed opening at the posterior end of ejaculatory apodeme (character 21), and hypoproct bent ventrally (character 30). The tentorial pit in *Ammonaios* is always modified: three of the four species show a distinct black area around each tentorial pit (Fig. 52), while the type species lacks a black area, but has elongate setae originating from the tentorial pit (Fig. 53).

It is unclear whether these two modifications have the same genetic origin. All *Arenigena* species and other outgroup genera have unmodified tentorial pits. The strong support for the *Ammonaios* clade led to the decision not to expand the concept of *Ammonaios* by including species of the *Arenigena marcida* group.

The internal relationships among the species of *Ammonaios* show a sister group relationship between *A. confusus* and *A. mexicanus*, while *A. sabulosus* and *A. niveus* are sister species and form a separate clade.

Biology and Ecology of *Ammonaios*

A. mexicanus flies late in the fall and is restricted to Baja California. *A. niveus* flies during spring and summer and has been collected only close to the Rio Grande (with one exception in northern Mexico). *A. sabulosus*, found as an adult only in the early spring, is confined to inland dune systems in California. It is remarkable that three of the *Ammonaios* species are allopatric to each other (but all are sympatric with *A. confusus*) and have flight periods that barely overlap (*A. sabulosus* and *A. niveus* overlap for only a few weeks). Perhaps these spatial and temporal patterns are a result of competitive displacement. *A. confusus*, however, is sympatric with all three aforementioned species and has the longest flight period, beginning in mid-February and ending in October. *A. confusus* seems to occupy a broader niche (including different sandy habitats; allowing a wider geographical and temporal range) and is able to outcompete other species, restricting them to much narrower niches in which they individually might be more competitive than *A. confusus*.

The vast majority of *Ammonaios* specimens are confined to sandy inland habitats of western North America; however, a few specimens of *A. confusus* were found in other habitats, including coastal dunes (114553, 114015), dry washes (133226, 133227, 133236, 113237, 109179), water seeps (114712, 114673), and inland river dunes (114754, 114784, 114801, 101038, 104506, 114751). A few specimens of *A. confusus* (072634, 072635, 072637, 072638) were collected by ethylene-glycol-filled pitfall traps set in stable dunes. *A. confusus* larvae have been sieved from vegetated inland dunes (114744, 114750, 114759, 114762, 14769, 114783, 114785, 114786, 114795) and from low, stabilized, coastal dunes (114553), while *A. sabulosus* has

Table 2. Character matrix of the data used in phylogenetic analysis

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | |
|------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|
| <i>A. confusus</i> | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 1 | 1 | |
| <i>A. mexicanus</i> | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | |
| <i>A. niveus</i> | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 1 | 1 | |
| <i>A. sabulosus</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | |
| <i>Ar. marcida</i> | 0 | ? | 0 | ? | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | | |
| <i>Ar. semitaria</i> | 0 | ? | 0 | ? | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 0 | 0 | 1 | 1 | |
| <i>R. maculipennis</i> | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | |
| <i>B. cinerea</i> | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | |
| <i>B. baccata</i> | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 1 |
| <i>C. bella</i> | 0 | ? | 0 | ? | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 0 | 1 | 0 | 0 | |
| <i>L. aurantiaca</i> | 0 | ? | 0 | ? | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 0 | 1 | 0 | 1 | |
| <i>P. festina</i> | 0 | ? | 0 | ? | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | |

been reared from larvae sieved in open, shifting inland dunes (114765, 114760). Adults of *A. confusus* are often found resting in the relative coolness of rodent burrows (114132, 114288, 114176, 109178, 109182) during the heat of the day. During the hotter part of the

summer, they are most active in the early evening hours when they can be observed flying about and alighting on shiny objects such as car hoods (122440, 122441, 122442, 122443, 122444, 122445, 122446, 122447, 122448, 122449). Adults of this species were



Fig. 1. Habitus of the male of *A. confusus* n. sp.

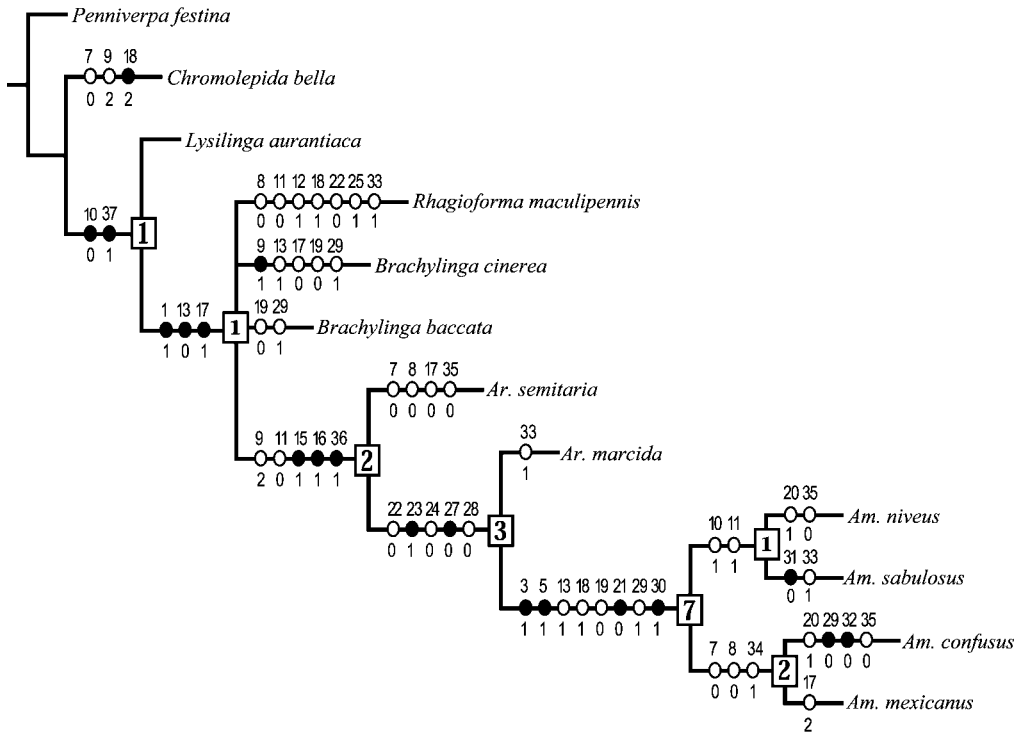


Fig. 2. Strict consensus of the three most parsimonious trees found with the exhaustive search option in PAUP. Characters are numbered as in the text and the character matrix (Table 1) with character numbers above and character states below the circles. Characters were plotted on the tree using unambiguous transformation optimization. The circles are coded as follows: black = forward change with no homoplasy; white = forward change with homoplasy or reversal. Bremer support values are given in square boxes at the nodes.

observed actively flying into a Malaise trap at dusk in the Goblin Valley, Emery County, UT (M.E.I. and Frank D. Parker, unpublished data). Some pinned adults have labels that indicate a number of plant associations. These records suggest that specimens were collected from grass, shrubs, herbs, and even low-lying tree species. A single record notes that *A. confusus* was found in a cotton field (028328), suggesting that larvae of this therevid might prey on ground-dwelling larvae of cotton pests. *A. confusus* males form the prey of at least one species of *Bembix* (Hymenoptera: Sphecidae) (114669, 114676, 114696, 114717, 114729, 114746, 114772). One of us (M.E.I.) once observed a

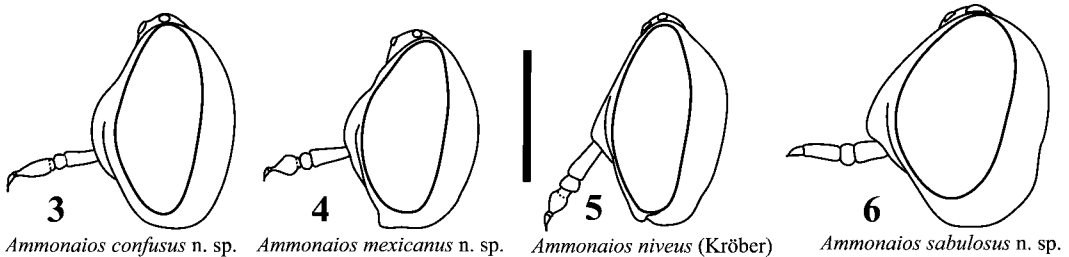
larva of *A. sabulosus* (114383) preying on a tenebrionid (Coleoptera: Tenebrionidae) larva in the field.

Taxonomy

Ammonaios Irwin and Lyneborg

Ammonaios Irwin and Lyneborg. Type species: *T. nivea* Kröber, designated by Irwin and Lyneborg (1981a).

Diagnosis of the Genus. Overall pale brown to white, moderately large, heavy-bodied species with dense, long, filiform and lanceolate setae (Fig. 1);



Figs. 3–6. Female head in profile: (3) *A. confusus* n. sp. (4) *A. mexicanus* n. sp. (5) *A. niveus* (Kröber). (6) *A. sabulosus* n. sp. Scale bar 1 mm.

setae often lanceolate, especially on head and thorax (Fig. 53); face with white filiform parafacial setae; male eyes holoptic with enlarged frontal ommatidia; flagellar style apically, two segmented, with distinct terminal spine; tentorial pits modified: in most species broadly concave, surrounded by a polished black area (Fig. 52) or, if without polished area, with long, filiform setae extending from tentorial pits (Fig. 53); maxillary palp one segmented; thoracic macrosetae pale brown; prosternal furrow with setae; costal setae beyond humeral cross vein biserially arranged; mid-coxa with white, filiform setae on posterior surface; hindfemur without coxal knob; posterior end of hypoproct bent ventrally; inner gonocoxal process present; pupa with an anterior and lateral antennal process on antennal sheath (Fig. 35), a facial process (Fig. 35), and an eye sheath process (Fig. 36); pupal cuticle light brown, translucent, and smooth.

Pupal Stage. The obtect adecticous pupae of Therevidae are similar to those of other asiloid families (Figs. 35 and 36). Morphologically, the pupa is divided into two major parts: cephalothorax and abdomen. Most of the terms used in this work for describing the pupa are self explanatory. The structures that are not sheaths are termed "processes" or "spines" and represent extensions of the cuticle. Mostly thick or knob-like on the cephalothorax, these extensions are often thin and filiform on the abdomen. To distinguish between these types of cuticular extensions, the term "process" was used for structures on the cephalothorax and "spine" for those on the abdomen. At the base of the lateral antennal process is a tubular structure that is different from all other processes in that it has an opening at its apex and is located on what appears to be a membranous area (Figs. 50 and 51). This structure is figured in nearly all pupal descriptions, but was never named until Irwin (1972) used the term "tubular sense organ" for it. Because there is no proof that this is a sensory organ, we call it in this work the "antennal sheath pore." This structure most likely provides a connection between the antenna and the environment. This structure can be found on pupae of Asilidae, Scenopinidae, Mydidae, and Bombyliidae and is under further investigation by the senior author. The number of abdominal spiracles is not mentioned in most papers, but the figures often indicate that there are only seven. Melin (1923) stated that there are eight pairs of abdominal spiracles in asilid pupae and that the last one is often overlooked by most authors. This is also true for the Therevidae (Malloch 1917). All examined pupae of Therevidae, Bombyliidae, and Asilidae possess eight spiracles. The number of abdominal segments is also in dispute: some authors (Melin 1923, Musso 1978) believe that segment VIII is secondarily segmented, while others accept that there are nine segments, with the last one lacking a spiracle. In this paper, the latter designation is followed for reasons of simplicity.

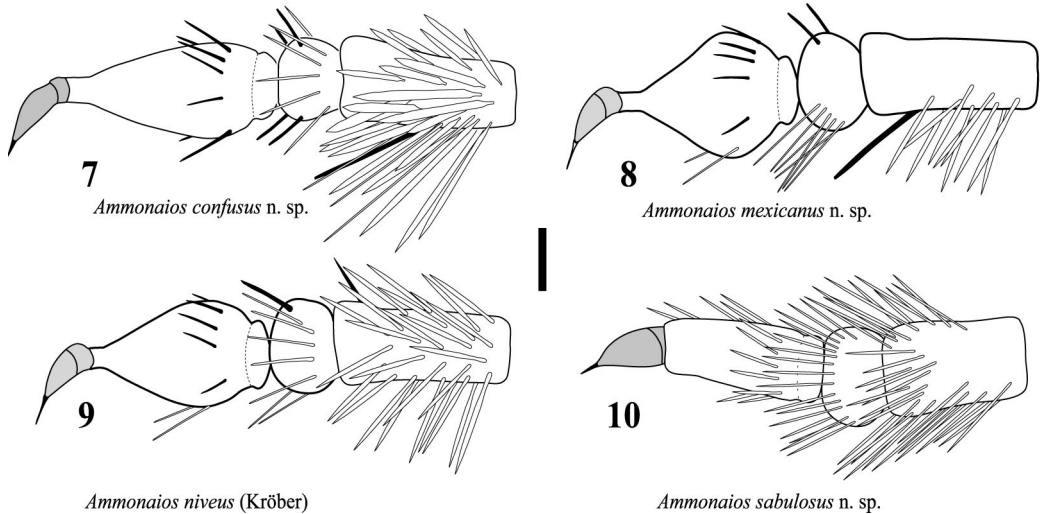
Placement of the Genus. The genus *Ammonaios* belongs within the subfamily Therevinae, as defined in Irwin and Lyneborg (1981a). *Ammonaios* may be separated from other Nearctic therevids by using the keys

to the genera of Nearctic Therevidae in Irwin and Lyneborg (1981a, b).

Arenigena is the putative sister genus of *Ammonaios*, sharing among others the following character states: absence of a hind coxal knob, cell m_3 closed, thoracic macrosetae pale yellow, pupa with a long anterior antennal process, an eye sheath process, and the smooth transparent cuticle of the pupal exuvia.

Key to the Species of *Ammonaios*

1. Long lanceolate macrosetae originating within the tentorial pit (Fig. 52); area surrounding tentorial pits white pubescent; wings without distinct pterostigma (Fig. 48); male, gonocoxite with several short, thick, black macrosetae along ventromedial margin (Fig. 13); female, tergites I-VI with appressed white setae (some lanceolate); furca with medially directed lobes extending from lateral margins (Fig. 33) *A. niveus* (Kröber)
- No lanceolate macrosetae originating within tentorial pit (Fig. 52); area surrounding tentorial pit glabrous, shining black, strongly contrasting to white pubescence on rest of face (sometimes covered by palps); wings with or without pterostigma; male, gonocoxite without such macrosetae (Figs. 11 and 12, 14); female, tergites I-IV with appressed white setae (some lanceolate); furca without such lobes, rather simple (Figs. 31, 32, and 34) . . . 2
2. Pterostigma not distinct (Fig. 49); antenna with only white macrosetae (Fig. 10); first flagellomere cylindrical (Fig. 10); female, mid- and hindtarsi with elongate white macrosetae (Fig. 45); head (lateral view) swollen (Fig. 6); furca (Fig. 34), sternite VIII (Fig. 30). *A. sabulosus* n. sp.
- Pterostigma distinct, dark brown (Figs. 46 and 47); antenna with black and white macrosetae; first flagellomere thickened basally; female, mid- and hindtarsi with normal length dark brown macrosetae (Fig. 44); head (lateral view) not significantly swollen (Figs. 3, 4, and 5) 3
3. Shining area surrounding tentorial pit forming full circle; costal cell in most specimens brown infuscated (Fig. 46); anterior margin of wing often darker than rest of wing (Fig. 46); first flagellomere more elongate (Fig. 7); male, distiphallus with lateral lobes (Fig. 15); female, ocellar tubercle with only pale yellow setae posteriorly; yellow thoracic macrosetae lighter than brown macrosetae on femur and tibia; furca widest posteriorly (Fig. 31) *A. confusus* n. sp.
- Shining area surrounding tentorial pit forming partial circle; costal cell as transparent as wing membrane (Fig. 47); first flagellomere rounder (Fig. 8); male, distiphallus without lateral lobes (Fig. 17); female, ocellar tubercle with several dark macrosetae; brown mac-



Figs. 7–10. Antenna in lateral view: (7) *A. confusus* n. sp. (8) *A. mexicanus* n. sp. (9) *A. niveus* (Kröber). (10) *A. sabulosus* n. sp. Scale bar 0.1 mm.

rosetae on thorax same color as macrosetae on femur and tibia; furca widest anteriorly (Fig. 32) *A. mexicanus* n. sp.

Description of Species

Ammonaios confusus n. sp.

(Figs. 1, 2, 3, 7, 11, 15, 16, 23, 27, 31, 35, 36, 37, 40, 44, 46, 50, 51, 52, 54)

Derivation of Name. Confusus (Lat.) = confused, mixed. Illustrations of this species were mixed with *A. niveus* in Irwin and Lyneborg (1981a). Fig. 20 (Irwin and Lyneborg 1981a) illustrates *A. confusus* n. sp. and not *A. niveus*, as stated in the legend.

Diagnosis. Body covered with long, white filiform and lanceolate setae (Fig. 1). Shining black, circular area surrounding each tentorial pit. Males and females are easily distinguished from other species by the brownish tanned costal cell (Fig. 46). The pterostigma is darkened as in *A. mexicanus* n. sp. (Fig. 47). Distiphallus with lateral wing-like extensions near apex (Fig. 15).

Description of Male Holotype (122447). Body length 8 (6–9.4) mm, wing length 6 (5–7) mm.

Head. Ocellar tubercle black with gold to silver pubescence; setae pale yellow brown. Eyes reddish brown, upper frontal ommatidia larger than lower and marginal ones. Frons ground color brown with silver pubescence; setae long, white, often lanceolate. Parafacial with erect, white, filiform setae. Genal setae brownish. Face densely silver-white pubescent; circular area around tentorial pit shiny black. Antenna (Fig. 7) pale brown, scape and pedicel with silver pubescence. Scape three times longer than wide, with long white setae, mostly lanceolate (ventrally sometimes with thickened brown macrosetae). Pedicel nearly square, filiform setae shorter than on scape, white; dorsally and ventrally with thickened brown macrosetae. First flagellomere pear shaped, with basal

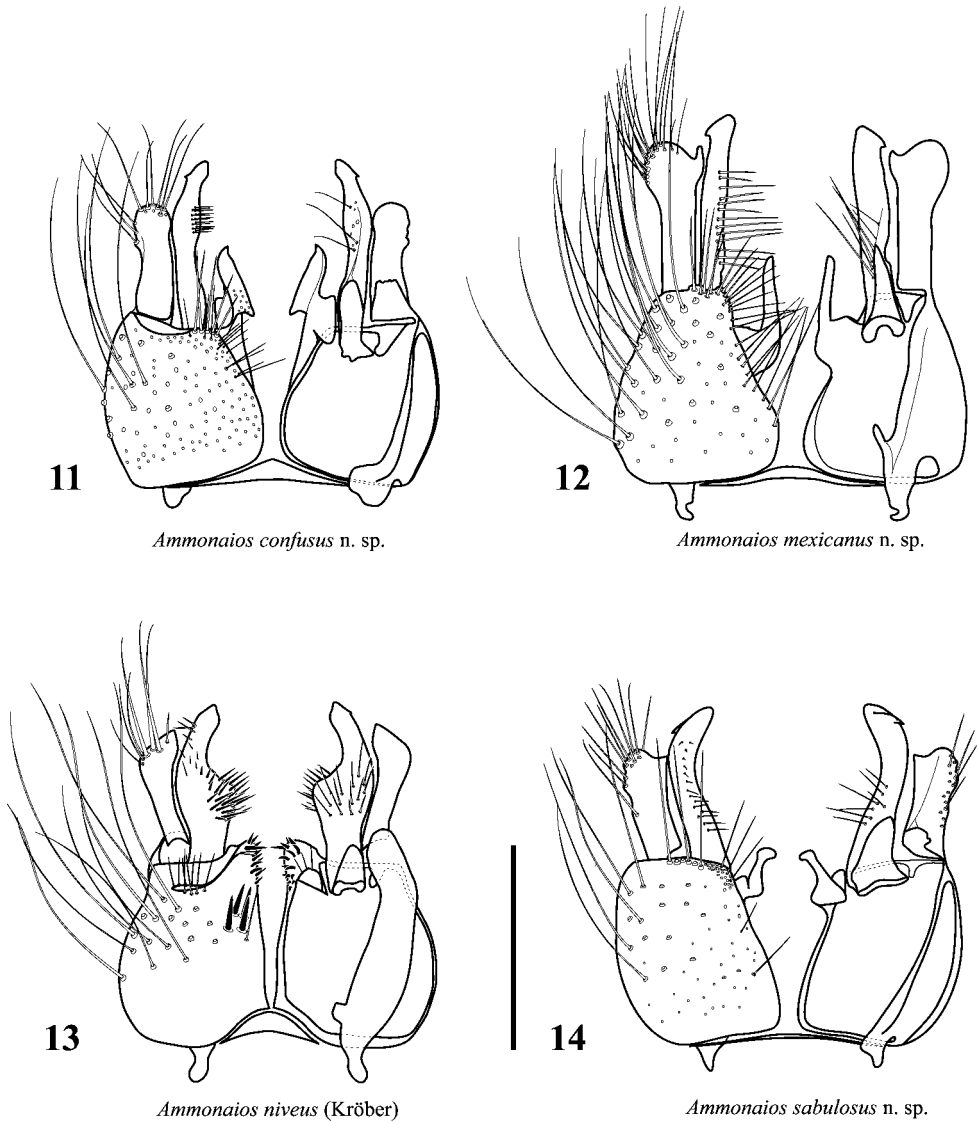
constriction; macrosetae brown, especially on inner, basal surface. Flagellar style conical, black. Maxillary palp pale yellow-brown with long white setae.

Thorax. Chaetotaxy: np 3, sa 2, pa 1, dc 2, sc 2. Macrosetae pale yellow. Mesonotal cuticle black. Postpronotum, scutellum, postalar, and supra-alar sclerites pale brown. Mesonotum and scutellum silver pubescent; setae white, semiappressed, lanceolate, intermixed with filiform, erected, yellowish setae. Pleural cuticle pale brown. Anepisternum, ventral part of katepisternum and meron black (in some specimens, pleuron nearly completely pale to nearly completely dark brown). Pleuron dense silver pubescent. Posterior anepisternum, upper katepisternum, katatergum, and metanepisternum with long, white, filiform setae.

Wing (Fig. 46). Membrane translucent whitish gray; some veins with brownish margins. Costal cell pale brown (sometimes very dark brown), with a small, lighter portion basally; pterostigma brown; cell m_3 closed, petiolate; costal setae dark brown to black. Halter knob pale brown, stalk yellowish brown.

Legs. Coxa brown (occasionally black), silver pubescent, setae long, white. Forecoxa with 3, midcoxa with 2, hindcoxa with 1 pale yellow macro setae. Forefemur dark brown (sometimes black), darker than mid- and hindfemora, which are pale brown, except basally and ventrally. Femur with two kinds of white setae: appressed, lanceolate and erect, filiform. Forefemur with 2 (2–4) anteroventral (av) macrosetae, midfemur with 4 (4–6) av, and hindfemur with 6 (6–8) av. Tibia pale brown, small portion of base and apex dark brown (occasionally foretibia completely black). Tarsi black, with first and most of second segments light brown. All macrosetae on legs, except those on coxa, brown (Fig. 44).

Abdomen. Cuticle of abdomen pale brown (sometimes dark, nearly black) with silver pubescence; filiform setae dense, long, white.



Figs. 11–14. Gonocoxite ventral (left side) and dorsal (right side) view: (11) *A. confusus* n. sp. (12) *A. mexicanus* n. sp. (13) *A. niveus* (Kröber). (14) *A. sabulosus* n. sp. Scale bar 0.5 mm.

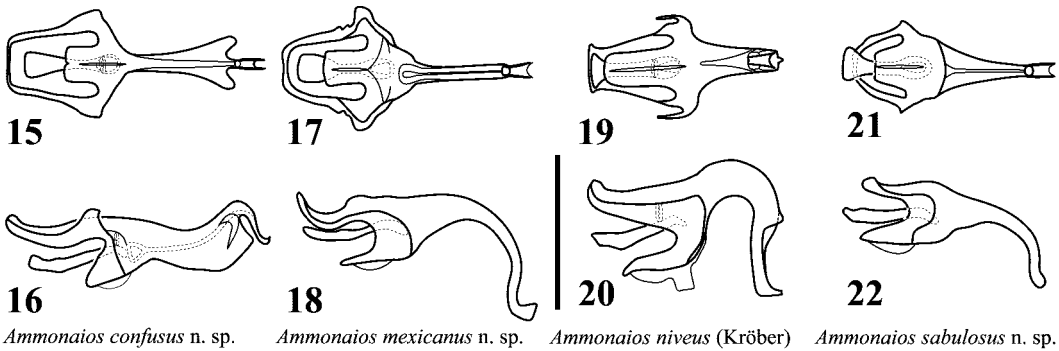
Terminalia. Most of the terminalia description is based on paratypes, because the holotype was not dissected. Epandrium quadrate (Fig. 23); hypoproct curved ventrally; posterior margin U-shaped emarginate (depth of emargination varies). Inner gonocoxal process rectangular, three times longer than wide (Fig. 11). Gonostylus long, posterolateral apex with a small, distinct, hook-shaped projection. Aedeagus with dorsal apodeme broad; ventral apodeme short. Distiphallus with wing-like, lateral extension apically (shape and size of these extensions vary) (Figs. 15 and 16). Ejaculatory apodeme with subapical posterodorsal ring.

Female Paratype (71126). Body length 9 (7.5–12) mm, wing length 7 (5.6–8) mm. Similar to male, except as follows.

Head. Frons at its widest point twice width of eye; upper frons dark brown; lower frons pale brown, golden yellow pubescent. Face ventral to antennae silver pubescent.

Wing. Membrane generally more infuscated than in males.

Abdomen. Segments I–IV with appressed setae. Segment I with filiform setae, which increasingly become lanceolate toward segment IV. Tergite III with some erect, filiform setae near margin; tergites IV to VIII completely covered with erect, filiform setae. All sternites except sternite I with erect filiform setae. Segments I–V with white or pale yellow, filiform setae; segments VI–VIII with brown filiform setae. Segments I–VI with white pubescence; segment VII with less pubescence; segment VIII shiny.



Figs. 15–22. Aedeagus in ventral (odd numbers) and lateral (even numbers) view: (15, 16) *A. confusus* n. sp. (17, 18) *A. mexicanus* n. sp. (19, 20) *A. niveus* (Kröber). (21, 22) *A. sabulosus* n. sp. Scale bar 0.5 mm.

Terminalia. Sternite VIII rectangular with straight anterior margin (Fig. 27). Furca blunt posteriorly, shape rather simple (Fig. 31). Bases of spermathecal ducts originate from common duct one furcal length distal of gonopore. Acanthophorites (T IX & X) with 9–11 brown, blunt-tipped A_1 setae and 5 elongate A_2 setae.

Variation. This species varies considerably in leg coloration, the extent of yellow cuticular coloration on the thorax, shape of distiphallus, emargination depth of hypoproct, size of ventral lobes, and amount of lanceolate setae on head and thorax. The variation is not distinct enough in specific geographical regions to erect separate species or subspecies. The overall morphological patterns are similar, and this taxon can be easily distinguished from all other species in the genus.

Immature Stages. Pupal exuviae (Figs. 35 and 36). Antennal sheath with anterior antennal process adjacent to longer, lateral antennal process. Eye sheath process present (sometimes very weakly). Thoracic spiracle, in ventral view, U-shaped at tip (Fig. 37). Labral sheath pointed at apex, shorter than proboscis sheath. Facial process present (varies from small knob to hook-like pointed projection). Alar process long, basal third nearly perpendicular to body axis, apical two-thirds curved ventrad. Abdominal segment I dorsally lacking spines, ventrally with 6 (rarely 8) long

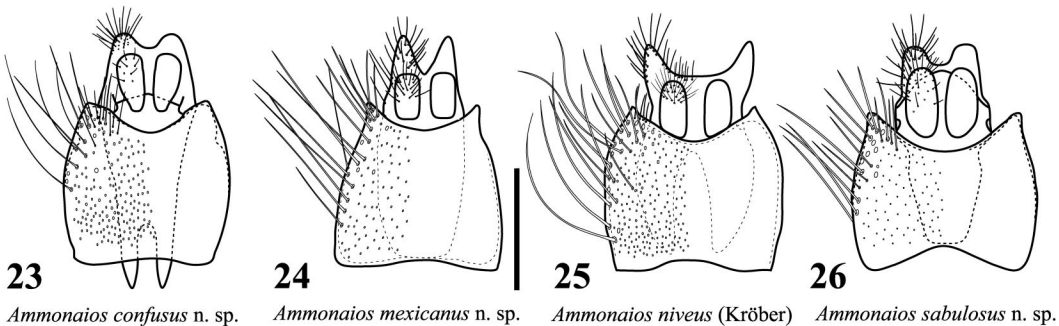
erected spines. Segments II–VII each with ventral row of 12–24 spines and dorsally on segments II–VIII with row of 14–24 spines. Segment VIII and IX without ventral and segment IX without dorsal rows of spines. Abdominal segment I with one large lateral spine; segments II–VII with 5–7 lateral spines situated on small prominence. Spiracles on segments I–VII positioned laterally on prominence anterior to spines. Spiracle VIII smaller than preceding ones and slightly more ventrally located. Sexual dimorphism on segment VIII: males possess spines that vary in number and size between 2 very small to 6 longer pointed spines (Fig. 40). Females lack spines, but possess a cushion-like structure with a longitudinal median groove (Fig. 43). Caudal spines strong, brown.

Biology. Thirty-nine specimens were caught at light. Several specimens were found as prey in nests of *Bembix* sp. (Hymenoptera, Sphecidae).

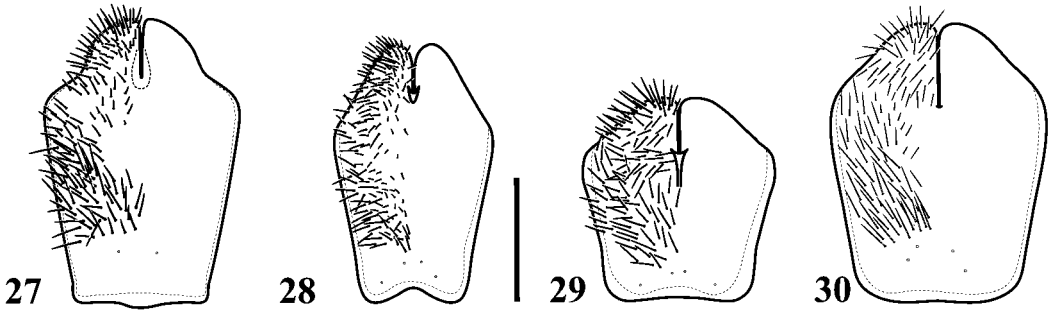
Flight Period. Adult specimens were collected between the beginning of February and the end of October.

Distribution. Widespread southwestern species, ranging from Mexico to Utah and from California to Oregon (Fig. 54).

Specimens Examined. A total of 1190 specimens was examined.

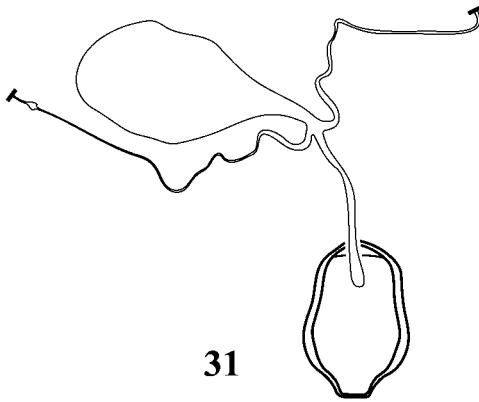


Figs. 23–26. Epandrium in dorsal view. Right side without setae: (23) *A. confusus* n. sp. (24) *A. mexicanus* n. sp. (25) *A. niveus* (Kröber). (26) *A. sabulosus* n. sp. Scale bar 0.5 mm.



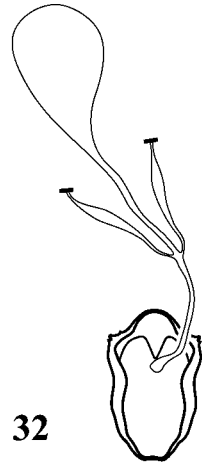
Ammonaios confusus n. sp. *Ammonaios mexicanus* n. sp. *Ammonaios niveus* (Kröber) *Ammonaios sabulosus* n. sp.

Figs. 27–30. Sternite eight of female in ventral view. Right side without setae. (27) *A. confusus* n. sp. (28) *A. mexicanus* n. sp. (29) *A. niveus* (Kröber). (30) *A. sabulosus* n. sp. Scale bar 0.5 mm.



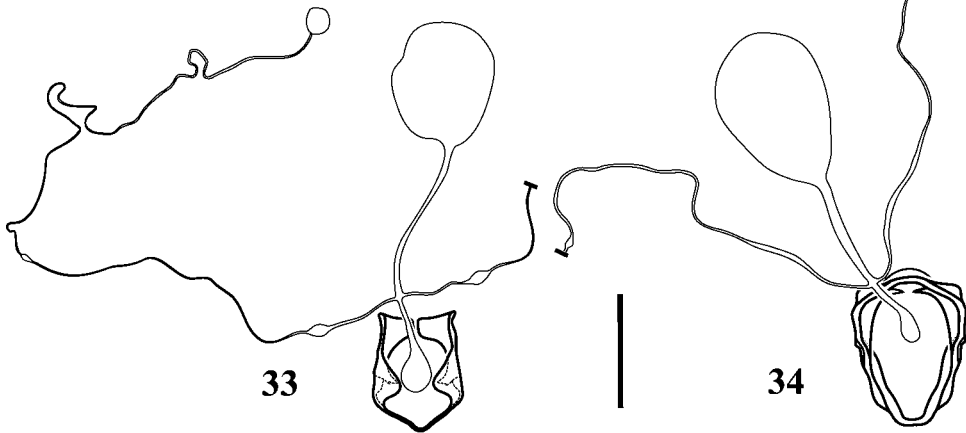
31

Ammonaios confusus n. sp.



32

Ammonaios mexicanus n. sp.



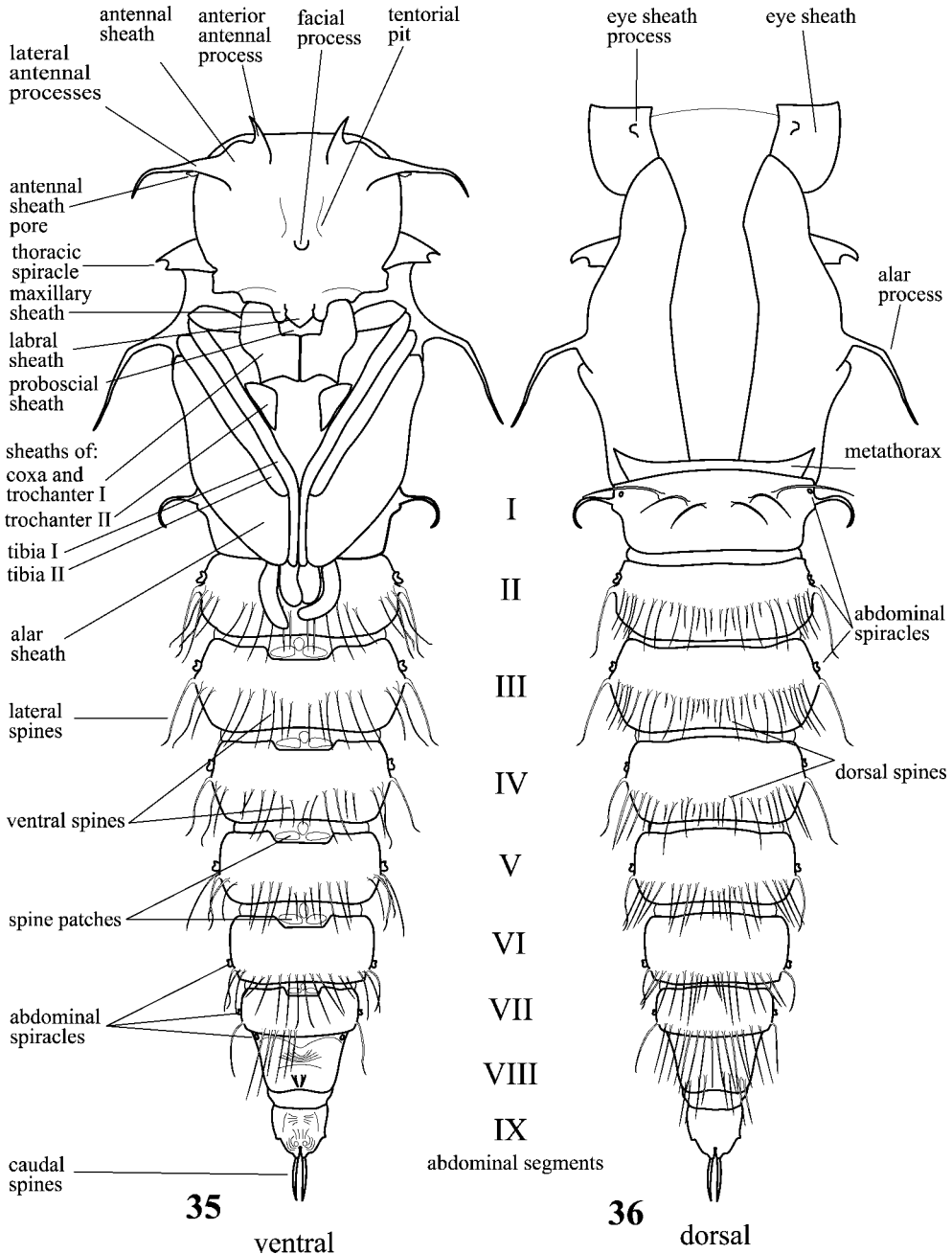
33

Ammonaios niveus (Kröber)

34

Ammonaios sabulosus n. sp.

Figs. 31–34. Furca ventral view: (31) *A. confusus* n. sp. (32) *A. mexicanus* n. sp. (33) *A. niveus* (Kröber). (34) *A. sabulosus* n. sp. Scale bar 0.5 mm.

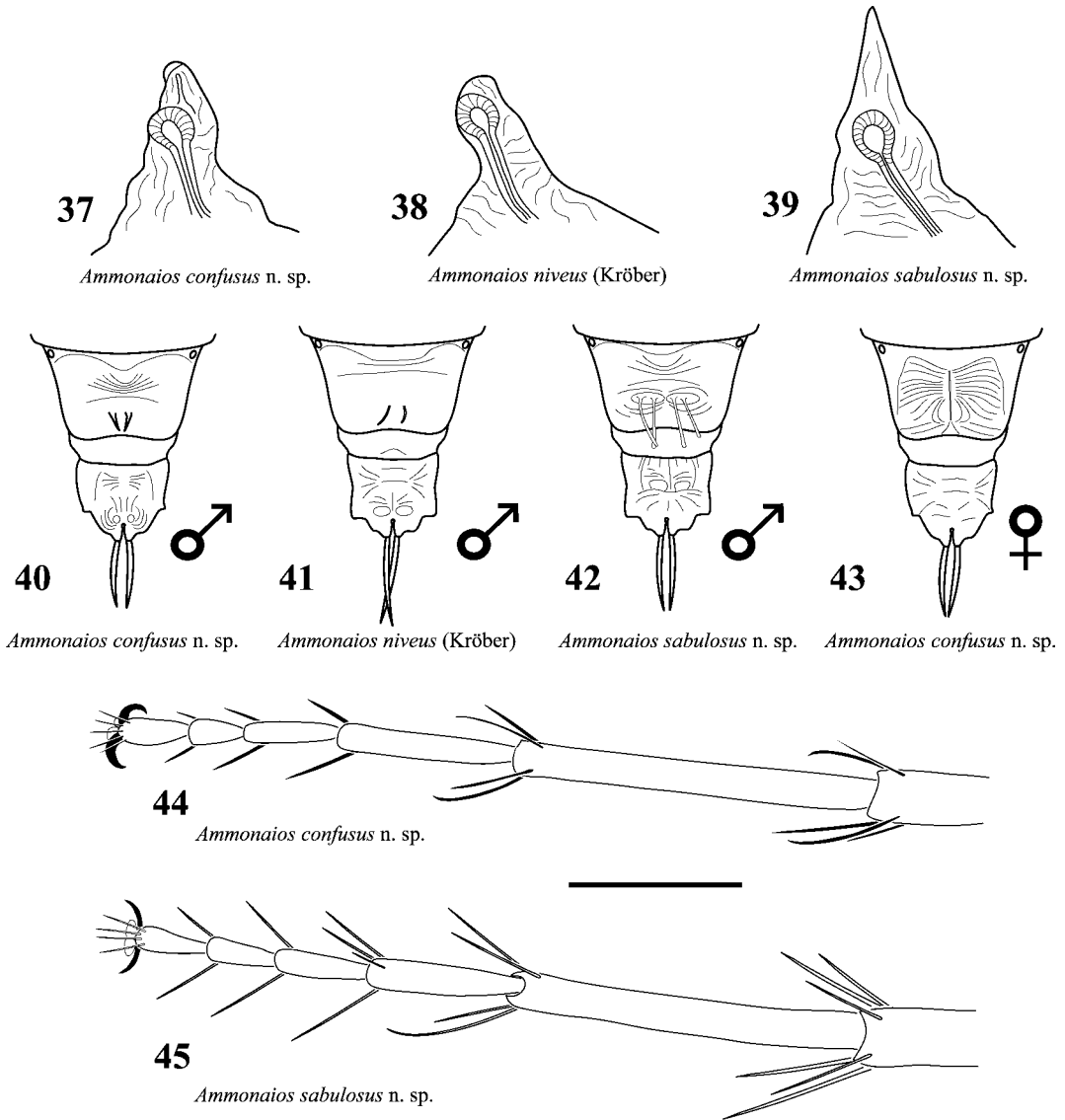


Figs. 35 and 36. Exuvia of *A. confusus* n. sp.

HOLOTYPE (δ). USA: Utah: Emery County: San Rafael Desert, 22 km NE Hanksville Flat Top Pass [38.538 -110.488], on car hood, 23.V.2000 FDP (122447, UCDC).

PARATYPES. USA: Utah: Emery County: San Rafael Desert, 22 km NE Hanksville, Flat Top Pass [38.538 -110.488], on car hood, 23.V.2000, FDP, 9 δ (122440, UNAM) (122441, LACM) (122442, EMEC) (122443, CNCI) (122446, CASC) (122449, SMNS) (122444, BMNH) (122445, ANIC) (122448, MEI);

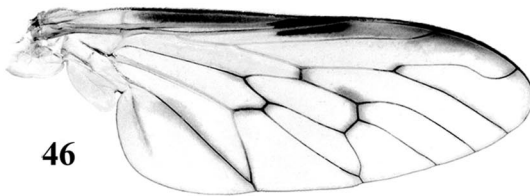
W of Goblin Valley, Wild Horse Creek [30.358 -110.422] 1,463 m, 26. to 28.VII.1982 FDP, Griswold, 1 δ (072194, EMUS); 29 km NE Hanksville, 4 km E Little Flat [38.533 -110.45] 1,615 m, Quercus dunes, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 1 δ (133228, MEI); 27 km NE Hanksville, Little Flat Top [38.533 -110.483], 1,670 m, dunes, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 1 δ (133225, MEI); 3.2 km E Little Gilson Butte [38.592 -110.574]



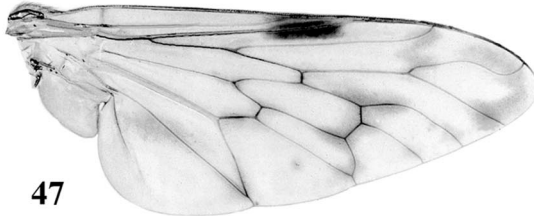
Figs. 37–45. (37–39) Thoracic spiracle of pupal exuvia: (37) *A. confusus* n. sp. (38) *A. niveus* (Kröber). (39) *A. sabulosus* n. sp.; (40–42) Terminal segments of male pupal exuvia: (40) *A. confusus* n. sp. (41) *A. niveus* (Kröber). (42) *A. sabulosus* n. sp.; (43) Terminal segments of female pupal exuvia of *A. confusus* n. sp.; (44–45) Hindtarsi of female: (44) *A. confusus* n. sp. (45) *A. sabulosus* n. sp.

1,554 m, 29.V.1981, FDP, 1 ♂ (072215, EMUS); 3.2 km E Little Gilson Butte [38.592 –110.574] 1,554 m, 24. to 26.VIII.1981, D. V. Griswold, FDP, 2 ♂♂ (072217; 072216, EMUS), 2 ♀♀ (072220; 072221, EMUS); 6.4 km N of Gilson Butte [38.639 –110.617], 1,554 m, 5. to 7.V.1981, D. V. Griswold, Bohart, 1 ♂ (072214, EMUS); W of Goblin Valley, Wild Horse Creek [30.358 –110.422] 1,463 m, 26. to 28.VII.1982, FDP, Griswold, 1 ♀ (072192, EMUS); N of Goblin Valley, Wild Horse Creek [30.358 –110.422], 1,494 m, 14.VI.1983, FDP, J. H. Parker, 1 ♀ (071135, EMUS); 4.0 km NE Big Flat Top, Dugout Spring [38.611 –110.364] 1,463 m, 28.VII.1983, FDP, A. Parker, T. Griswold, 1 ♀ (072189, EMUS); Kane County: Coral Pink Sand Dunes State

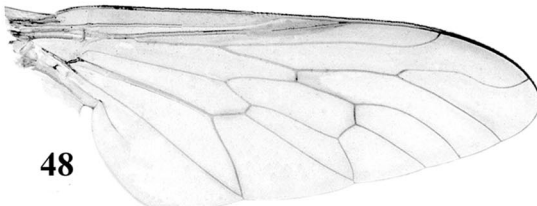
Park [37.035 –112.727] 1,786 m, near park headquarters, 11.V.2000 K. T. Huntzinger, W. N. Mendel, CRN, 4 ♂♂ (133773; 133767; 133772; 133746, BYUC), 1 ♀ (133768, BYUC); 6.VI.2000, L. Church, K. T. Huntzinger, W. N. Mendel, 1 ♂ (133770, BYUC); 22.VI.2000, R. W. Baumann, D. J. Cavan, E. C. Green, W. N. Mendel, 1 ♀ (133771, BYUC); Dance Hall Rock jct., Hole in the Rock Road [37.356 –111.101], 31.V.2000, K. T. Huntzinger, W. N. Mendel, CRN, TX Folks, 1 ♂ (133838, BYUC); Fortymile Ridge off Hole in the Rock Road to Stevens Arch Overlook [37.404 –111.988], 31.V.2000, K. T. Huntzinger, W. N. Mendel, CRN, TX Folks, 1 ♀ (133839, BYUC); Wahweap Camp Ground [37.031 –111.565], 6.IX.1978, Hanson, G. F. Knowlton,



46

Ammonaios confusus n. sp.

47

Ammonaios mexicanus n. sp.

48

Ammonaios niveus (Kröber)

49

Ammonaios sabulosus n. sp.

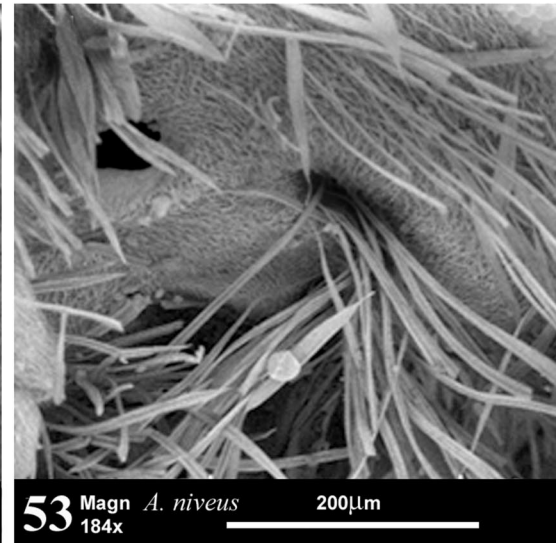
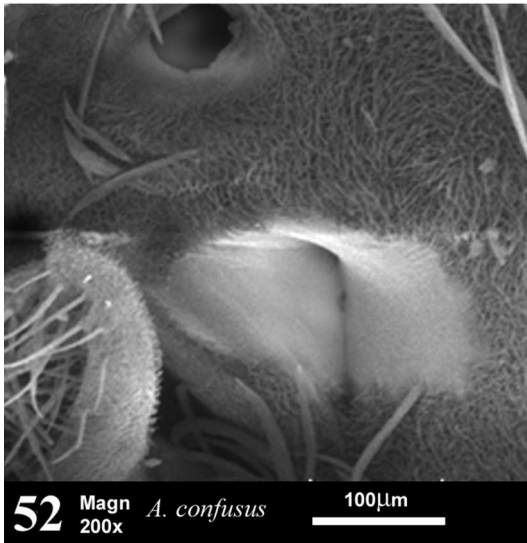
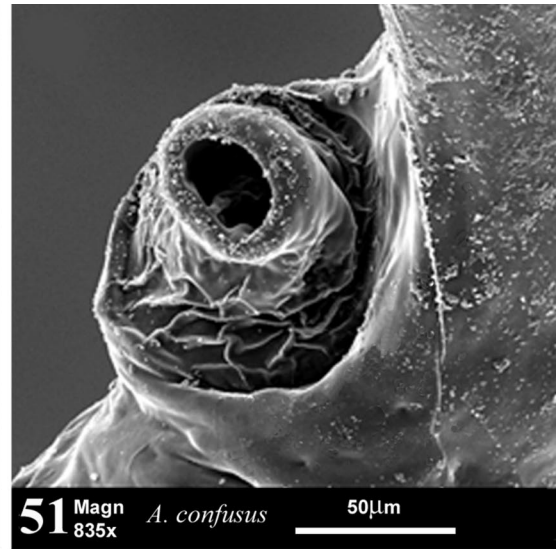
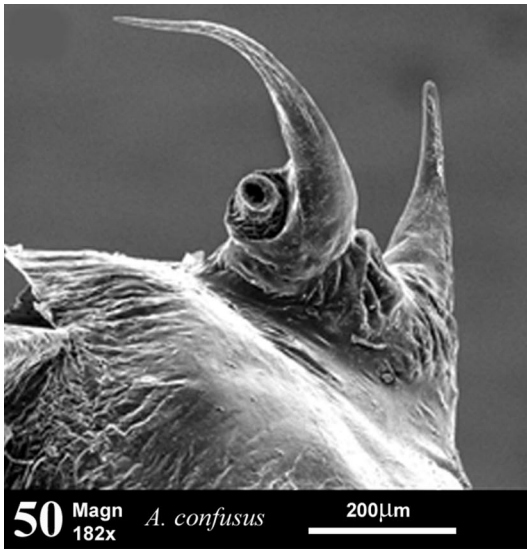
Figs. 46–49. Dorsal view of right wing: (46) *A. confusus* n. sp. (47) *A. mexicanus* n. sp. (48) *A. niveus* (Kröber). (49) *A. sabulosus* n. sp. Scale bar 1 mm.

1 ♀ (072196, EMUS); Millard County: 19.3 km NW Fillmore [39.092–112.446], 1,565 m, 20.VI.1972, FDP, D. L. Vincent, 1 ♀ (072195, EMUS); Garfield County: SE of Mount Hillers [37.888–110.697], 1,494 m, 16.VI.1983, FDP, J. H. Parker, 1 ♀ (071126, EMUS); Tooele County: 59.6 km NW Grantsville [40.979–112.843], 21.IV.1990, sifted, DWW, MEI, 7 ♂♂ (113995, UCMC) (114222; 114100; 114211, INHS) (113996, CICESE) (114044, WSUC) (114047, MEI), 11 ♀♀ (114175, UCMC) (114049; 114000; 114170, INHS) (114017, CICESE) (114200, WSUC) (113992; 113998; 114164; 114183; 114290, MEI); Washington County: Paradise Canyon [37.133–113.567], 3. to 20.IX.1982, CRN, 1 ♀ (075309, EMUS); 13. to 19.V.1983, malaise trap, D. Beck, 1 ♀ (072191, EMUS).

Additional Material

MEXICO: Baja California Norte: 20.9 km SW Gonzaga Bay, [29.667, –114.516], in wash, 12.IV.1968,

MEI, 1 ♂ (109179, MEI); 11.3 km N San Felipe, [31.13, –114.853], 8.X.1973, EMF, 1 ♂ (109185, MEI), 1 ♀ (114150, MEI); 16.1 km S San Felipe [30.883–114.853], 25.III.1961, ELS, 1 ♂ (111989, CASC); 23.2 km S Campo Alfonsina [Alfonsina] [29.591–114.383], 20. to 26.X.1987, N. Bloomfield, 8 ♂♂ (109213; 109222; 109228; 109229; 109230; MEI) (109223, CICESE) (119432, 109231, SDMC), 4 ♀♀ (109224; 109225; 109226, MEI) (109227, CICESE); 35.4 km NW Bahia de los Angeles [29.195–113.785], 305 m, 14.IV.1969, S. C. Williams, 1 ♀ (131797, CASC); 37 km E San Luis [28.43–113.417], 122 m, sand dunes association in rodent hole, 24.IV.1968, MEI, 1 ♂ (109178, MEI), 1 ♀ (109182, MEI); 38 km N Punta Prieta [29.272–114.16], 10.IV.1977, EMF, JLF, 1 ♀ (109191, MEI); 14.IV.1977, EMF, JLF, 1 ♀ (109189, MEI); 4.8 km N San Felipe, [31.071, –114.853], sand dune, 26.III.1964 sifted, MEI, 1 ♀ (114365, MEI); 6.4 km S Las Arrastras [29.55–114.333], 9.VI.1967, ELS, EMF, 1 ♂ (112011, CASC), 1 ♀ (112037, CASC); 8.1 km N Oakie Landing [30.09–114.561], 8 m, 11.IV.1968, MEI, 1 ♀ (109183, MEI); 8.1 km N Mulege, [26.969, –111.959], 1 ♀ (109232, MEI); 85.3 km S Catavina [29.79–114.95], 7.IV.1982, Faulkner, Brown, 1 ♂ (114011, SDMC); Bahia de los Angeles [28.97–113.56], 1.IV.1973, J. T. Doyen, JAP, 1 ♀ (109176, EMEC); 6.4 km N Bahia de los Angeles [28.973–113.511], 23.III.1970, EMF, JLF, 4 ♂♂ (109171; 109172; 109173; 109180, MEI), 1 ♀ (109181, CICESE); 2 km S. Bahia de Los Angeles [28.952–113.56], 27.III.1979, E. M. Fisher, 1 ♀ (146351, CDAE); Bahia San Luis Gonzaga [29.767–114.3], 17.VI.1970, A. T. Lzer, 1 ♀ (112034, CASC); El Crucero [29.214–114.219], 4.IV.1976, P. A. Rude, 1 ♂ (109194, MEI), 2 ♀♀ (109174; 109184, MEI); El Crucero [29.214–114.219], on sand, 3.IV.1976, J. Doyen, 4 ♂♂ (109177; 109193; 109195, MEI) (114109, EMEC); 4.IV.1976, sifted, J. Doyen, 1 ♂ (109186, MEI); La Zapopita, 30.VIII.1960, ELS, 1 ♂ (111988, CASC); Laguna Salada, 20.II.1959, ELS, 1 ♂ (112003, CASC); Punta San Fermin [30.483–114.617], 7. to 10.VI.1971, black light (UV), ELS, 2 ♂♂ (112030; 112029, CASC); San Felipe [31.028–114.853], 24.III.1971, R. A. Cunningham, 1 ♂ (114066, UCRC); 5.III.1963, P. H. Arnaud Jr., 1 ♀ (131800, CASC); 19.II.1954, P. H. Arnaud, 1 ♂ (131825, CASC); San Felipe Valley S end of Diablo Dry Lake [31.017–114.85], 6.IV.1973, JAP, 1 ♂ (109170, EMEC); San Felipe Valley S end of Diablo Dry Lake [31.017–114.85] sand dunes, 6.IV.1973, J. Doyen, 1 ♂ (109187, MEI), 1 ♀ (109175, MEI); Valle la Trinidad [31.4–115.783], ELS, M. L. West, 1 ♂ (112000, CASC); Baja California Sur: 29 km W La Paz [24.14–110.571], 20.X.1944, F. F. Gander, 1 ♂ (109241, SDMC); Chihuahua: 24.2 km S Juarez [31.533–106.467], 1,195 m, low dunes, 16.IV.1969, MEI, 3 ♂♂ (113915; 113921; 113945, MEI); Sonora: 38 km S Sonoyta, [31.518, –112.851], 5.X.1953, MAC, 1 ♂ (114412, USNM); Bahia San Jorge near La Salina [La Salina Punta] [31.067–113.117], coastal sand dunes, 18. to 20.IV.1975, EMF, 1 ♂ (114015, UCRC); El Desemboque [29.51–112.39], 18.IV.1975, EMF, 1 ♂ (113989, UCRC), 1 ♀ (114196, UCRC); Pt.



Figs. 50–53. ESEM pictures: (50) *A. sabulosus* n. sp. pupal exuvia, antennal sheath with “antennal sheath pore.” (51) Detail of “antennal sheath pore.” (52) *A. confusus* n. sp. tentorial pit. (53) *A. niveus* (Kröber), tentorial pit.

[Puerto] Penasco [31.319 –113.542], 21.IV.1948, ALM, 1 ♀ (113813, USNM); Huatabampito [26.79 –109.63], sand dunes, 22.IV.1974, D. Giuliani, 1 ♂ (072470, CDAE); 83 km S. Organ Pipe Cactus National Monument [Arizona, Pima County], [31.295, –112.875], 21.IV.1947, ALM, 1 ♂ (113799, USNM).

USA: Arizona: Coconino County: 11.3–14.5 km W Page [36.909 –111.589], 8.V.1988, EMF, 2 ♂♂ (072371; 072372, CDAE), 1 ♀ (072373, CDAE); 24.2 km NE Tuba City [36.289 –111.085], on grass stems, 27.VI.1967, J. M. Davidson, MAC, 1 ♂ (114232, ASUT); 32.2 km W Marble Canyon [36.816 –111.927], 1,372 m, 10.VIII.1950, T. Cohn, P. Boone, MAC, 1 ♂ (114440, AMNH); 7.2 km E Moenkopi [36.111 –111.157], 21.VI.1967, J. H. Davidson, J. M. Davidson, MAC, 1 ♂ (114251, ASUT), 2 ♀♀ (114027; 114036,

ASUT); Cameron [35.876 –111.412], 2.V.1977, RCM, 1 ♂ (114433, UCDC), 2 ♀♀ (114561; 114518, UCDC); 3.V.1977, RCM, 1 ♂ (114446, UCDC), 1 ♀ (114585, UCDC); 9.VI.1977, RCM, 1 ♀ (114564, UCDC); 19.V.1977, RCM, 1 ♀ (114963, UCDC); Moenave [36.139 –111.337], 1,461 m, 25.VI.1967, J. H. Davidson, J. M. Davidson, MAC, 2 ♀♀ (114079; 114166, ASUT); Page [36.909 –111.473], 25.IX.1980, A. Freidberg, 1 ♀ (011309, TAUI); Gila County: Globe [33.394 –110.786], 4.IV.1937, F. H. Parker, 1 ♂ (113826, USNM); Hayden [33.005 –110.785], 18.IV.1937, F. H. Parker, 8 ♂♂ (078512, UAIC) (113812; 113821; 113822; 113824; 113827; 113828; 113829, USNM); San Carlos [33.345 –110.453], 803 m, 3.X.1938, F. H. Parker, 1 ♀ (078505, UAIC); 15.III.1938, F. H. Parker 1 ♂ (078510, UAIC); La Paz County: Ehrenberg [33.604 –114.524],

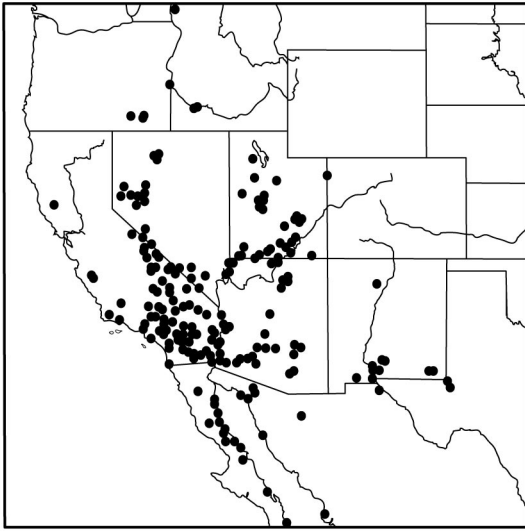


Fig. 54. Distribution map of *A. confusus* n. sp.

88 m, 23.III.1939, F. H. Parker, 2 ♂♂ (113823; 113825, USNM), 1 ♀ (113814, USNM); Maricopa County: 16.1–32.2 km SW Phoenix [33.328 –112.22], 1. to 7.V.1974, H. E. Evans, 1 ♀ (114302, MEI); 16.1 km W. New River Lake Pleasant [33.916 –112.28], 23.V.1965, R. Matthews, J. Matthews, 1 ♀ (113932, MEI); 29 km S Gila Bend [32.687 –112.716], 12.V.1968, J. Wilcox, 1 ♀ (113946, MEI); 18.IV.1965, S. A. Gorodenski, 1 ♀ (114092, ASUT); 8.V.1965, M. A. Mortenson, J. M. Davidson, MAC, 1 ♀ (114082, ASUT); 7.IV.1966, J. H. Davidson, J. M. Davidson, MAC, 1 ♂ (114107, MEI), 1 ♂ (MEI, 114126 MEI); 3.2 km S Palo Verde [33.348 –112.677], 21.III.1967, R. H. Gonzalez, 1 ♀ (104575, MEUC); 32.2 km S Gila Bend [32.658 –112.716], 305 m, 13.IV.1961, R. H. Painter, E. M. Painter, 1 ♀ (113914, MEI); Higley [33.307 –111.72], 2.VI.1943, F. H. Parker, 1 ♀ (078506, UAIC); 396 m, 1.VI.1943, F. H. Parker, 1 ♂ (078508, UAIC); Sentinel [32.858 –113.213], 19.III.1954, T. R. Haig, 1 ♀ (114136, MEI); Theba [32.919 –112.894], 28.V.1955, G. D. Butler, 1 ♂ (078456, UAIC); Mohave County: Mohave Valley, 15.IV.1980, flight trap, P. Artz, G. D. Butler, 1 ♀ (078507, UAIC); Topock [34.718 –114.486], 13.IV.1958, E. G. Linsley, 1 ♂ (114034, MEI); Littlefield [36.887 –113.929], 12.IV.1979, FDP, 1 ♂ (072745, EMUS); Pima County: Santa Catalina Mountains, Sabino Canyon [32.328 –110.801], IV.1963, Goldbaut, 1 ♀ (113927, UAIC); Tuscon [32.222, –110.926], 22.III.1924, A. A. Nichol, 1 ♂ (114254, UMSP), 1 ♀ (114286 UMSP); University of Arizona, West Campus Agricultural Center, [32.283, –111.003], 698 m, 20.V.1930, *L. alyssoides*, V. E. Romnoy, 1 ♂ (113830, USNM); Pinal County: 26.6 km E Tacna [32.765 –113.643], 10.IV.1990, DWW, MEI, 2 ♂♂ (114026; 114073, INHS); Yavapai County: Cottonwood [34.739 –112.009], 20.III.1978, RCM, 1 ♂ (116893, UCDC); Yuma County: 16.1 km E Yuma [32.723 –114.482], *Larrea tridentata*, 7:30–7:59, 5.IV.1974, P. D. Hurd,

E. G. Linsley, A. E. Michelbacher, M. M. Michelbacher, 1 ♂ (113832, USNM); 19.3 km E Tacna Mohawk Dunes [32.698 –113.779], 6.III.1988, black light trap, R. E. Woodruff, 1 ♂ (128431, FSCA); 6.4 km SE Parker [34.109 –114.248], 16.IV.1965, S. A. Gorodenski, J. M. Davidson, MAC, 1 ♂ (114040, MEI); 9.7 km E Parker [34.15 –114.201], 6.IV.1969, MAC, J. Bigelow, K. Boetzer, L. Welch, 1 ♂ (114248, ASUT), 1 ♀ (113990, MEI); 9.7 km SE Parker [34.235 –114.077], sand dune, 13.IV.1965, MEI, 10 ♂♂ (113909, CNCI) (113937; 113943; 114356; 114357; 114361; 114364; 114366; 114370; 114382, MEI); Date-land [32.796 –113.54], 12.IV.1955, Butler, Werner, 1 ♀ (078448, UAIC); 6.V.1948, ALM, 1 ♀ (113801, USNM); Ligurta [32.674 –114.294], 71 m, 20.IV.1973, J. G. Rozen, K. C. Rozen, 1 ♂ (114465, AMNH); Martinez Lake near McAllister Wash [33.017 –114.483], 27.III.1961, C. A. Toschi, 1 ♀ (114638, MEI); Yuma [32.723 –114.627], 2.V.1959, at light, D. Muse, 1 ♀ (078511, MEI); 15.X.1955, V. D. Roth, 1 ♂ (078513, UAIC), 1 ♀ (078514, UAIC); 29.IV.1959, at light, D. Muse, 1 ♀ (078515, UAIC); *Larrea tridentata*, 6.IV.1974, P. D. Hurd, E. G. Linsley, Michelbachers, 1 ♂ (082073, EMEC); *Olneya testota*, 24.V.1976, E. G. & J. M. Linsley, 1 ♂ (082075, EMEC); 16.III.1960, sweep net, D. Muse, 1 ♂ (113954, UAIC).

California: 3.2 km N Plaster City [32.821, –115.858], on *Salix*, 6.V.1952, Timberlake, 1 ♀ (114352, MEI); Death Valley, IV.1891, 1 ♂ (113239, USNM); Death Valley, Furnace Creek [37.589 –118.004], 17.IV.1973, G. R. Ballmer, J. D. Pinto, 1 ♂ (114279, MEI); 31.III.1951, E. G. Linsley, 1 ♀ (114639, MEI); 1.IV.1951, P. D. Hurd, 1 ♂ (114675, MEI); Joshua Tree National Park, Outlaw Mine [33.917 –115.917], 13.III.1965, D. G. Rainey, 1 ♀ (112068, CASC); Joshua Tree National Park, Pinto Wash Well [33.9 –115.75], 25.V.1963, black light-20 watt, ELS, 2 ♂♂ (112058; 112069, CASC), 2 ♀♀ (112060; 112062, CASC); Kraun Hills 1.VIII.1953 P. D. Hurd, 2 ♂♂ (114228; 114240, MEI); Mojave Desert Piute Butte [34.658 –117.85], 12.V.1944, ALM, 1 ♀ (113237, USNM); Signal Mountain, 31.IV.1949, R. A. Flock, 1 ♀ (113962, MEI); Imperial County: S Ruthven, Algodones Dunes, [32.925, –114.993], 28.IV.2001, Hawks, DYA, 1 ♀ (UCRC 51026, UCRC); S Ruthven, Algodones Dunes, [32.903, –115.004], at light, 16-IV-1999, DYA, 1 ♂ (UCRC 27868, UCRC); Gordon's Well, [32.709, –114.964], 15.III.60, J. W. MacSwain, 1 ♂ (114192, MEI); 1.6 km W Glamis [32.997 –115.088], 17.IV.1969, F. G. Andrews, 2 ♂♂ (146367; 146368, CDAE); sand dune, 19.IV.1964, E. I. Schlinger, 2 ♂♂ (113939; 114002, MEI), 1 ♀ (114029, CNCI); 1.X.1965, MEI, 1 ♀ (114707, MEI); 105 m, sand dune, 19.IV.1964, MEI, 1 ♀ (114009, MEI); 7.IV.1971, EMF, P. H. Sullivan, 2 ♂♂ (114057; 114237, UCRC), 1 ♀ (114097, UCRC); 4.8 km NW Glamis [33.018 –115.091], 15.–16.IX.1972, Black-light trap, M. Wasbauer & A. Hardy, 1 ♂ (146366, CDAE); 10 km N Glamis [33.042 –115.163], 21.V.1967, MEI, 21 ♂♂ (113976; 114007; 114045; 114048; 114050; 114055; 114095; 114121; 114138; 114147; 114152; 114162; 114221; 114261; 114276; 114281; 114293; 114297; 114301; 114307; 114316, MEI), 8 ♀♀ (114104;

114114; 114119; 114124; 114154; 114155; 114216; 114326, MEI); in rodent holes, 21.V.1967, MEI, 3 ♂♂ (114176; 114132; 114288, MEI); sand dune, 2.III.1968, MEI, P. A. Rauch, 1 ♂ (114242, MEI), 1 ♀ (028329, MEI); 11.3 km SE Glamis, Algodones Dunes [32.922 -114.987], 25.III. to 8.IV.1979, 1 ♂ (072444, CDAE); 11.3 km W Glamis, [32.998, -115.173], 21.III.1975, John D. Pinto, (114178, UCRC); 12.9 km NW Glamis Algodones Dunes [33.053 -115.191], 11.IV.1990, DWW, MEI, 5 ♂♂ (114013; 114071; 114158; 114168; 114218, MEI); 32.2 km E. Glamis, [32.498, -114.782], 8.IV.1964, FDP, 1 ♀ (114239, MEI); 2.1 km SW Glamis near Highway 78 [32.995 -115.099], 105 m, 26.IX.1991, R. A. Cunningham, 5 ♂♂ (078701; 078702, CAES) (114775; 114756; 114800, MEI), 1 ♀ (114796, MEI); 27.4 km NW Glamis [33.172 -115.245], 27.VI.1978, black light (UV), P. A. Rude, 1 ♂ (082077, EMEC); 1.6 km W. Harpers Well San Felipe Creek [33.096 -115.891], dune, 7.II.1968, sifted, MEI, P. A. Rauch, 1 ♂ (114230, MEI); 33.8 km W. Winterhaven [32.739 -114.938], on ground at night, 13.IV.1965, L. O'Brien, C. W. O'Brien, 1 ♂ (113967, MEI), 1 ♀ (113910, MEI); 4 km W Ogilby Algodones Dunes [32.8 -114.883], 16.III.1999, MEI, 1 ♂ (111097, MEI); 17.III.1999, MEI, 1 ♂ (111100, MEI); 16.III.1999, M. Hauser, 1 ♂ (111102, MEI), 1 ♀ (111103, MEI); 4.8 km NW Glamis [33.028 -115.102], 9.IV.1972, A. R. Hardy, 1 ♂ (UCRC 64604, UCRC); 15. to 16.IX.1972, black light (UV), M. Wasbauer, A. Hardy, 1 ♂ (072398, CDAE), 1 ♀ (072625, CDAE); 5.6 km NW Glamis [33.033 -115.107], 13.IV.1968, E. M. Bellet, 1 ♀ (114331, MEI); 9.7 km NE Ogilby Glamis Dunes [32.879 -114.776], 19.III.1980, Werner, Olson, Metz, MacLachlan, 1 ♂ (078500, UAIC), 3 ♀♀ (078502; 078503; 078504, UAIC); Algodones Dunes 11.3 km W Ogilby Road I-8 [32.75 -114.968], 5.III.1988, black light trap, R. E. Woodruff, 2 ♂♂ (128425; 128427, FSCA); Algodones Dunes 3.2 km W Sand Hills Rest Area [33.147 -115.324], 26.IV.1980, D. K. Faulkner, 1 ♂ (114146, SDMC); at base of Mount Signal, 21.III.1974, J. D. Pinto, 1 ♂ (114151, UCRC); Glamis [32.998 -115.071], 28.III.1964, L. D. Anderson, 2 ♂♂ (113911; 113949, MEI); 11.II.1972, sieved, A. R. Hardy, 1 ♂ (114338, MEI); 19.IX.1980, K. A. Smith, 5 ♂♂ (125681; 125682; 125683; 125684; 125685, UCDC); Imperial Valley [33.058 -115.558], IV.1964, D. A. Ward, 1 ♀ (114313, MEI); NE Glamis Algodones Dunes [33.1 -115.25], 15.III.1999, K. Holston, 1 ♀ (114580, MEI); Ogilby Algodones Dunes [32.8 -114.883], 16.III.1999, S. Winterton, 1 ♂ (111101, MEI), 1 ♀ (111110, MEI); Palo Verde [33.433 -114.731], 7.IV.1949, W. W. Wirth, 1 ♂ (113225, USNM); 5.IV.1964, MEI, 1 ♂ (113918, MEI); 1.IV.1968, R. O. Schuster, 1 ♀ (116878, UCDC); 2.IV.1968, R. O. Schuster, 1 ♂ (116892, UCDC), 1 ♀ (116880, UCDC); Inyo County: Death Valley, Sand Spring; 25 km NW Scottys Castle [37.188 -117.553 960], 940 m, VIII.1989 to III.1990, D. Giulian, antifr. pit trap 15 ♀♀ (146316; 146319; 146320; 146321; 146322; 146323; 146324; 146325; 146326; 146327; 146328; 146329; 146330; 146333; 146334, CDAE); II.1987 to IX.1987, 1 ♀ (146353, CDAE); Eureka Dunes, [37.096, -117.674], 1.V.1982, black light (UV), L. G. Bezark, 1 ♂ (114778, MEI), 1 ♀ (114747, MEI); 1.6 km NW Keeler, [36.497, -117.883], 11.V.1969, J. Doyen, 1 ♂ (114379, MEI); 22.5 km S 6.4 km E Ballarat [35.845 -117.165], sand dune, 4.IV.1983, D. Giuliani, 1 ♂ (072517, CDAE); 24.2 km S. Panamint Springs [36.122 -117.467], 28.IV.1953, R. O. Schuster, 1 ♀ (114644, MEI); 3 miles. W. Brown [37.346 -118.44], 14.IV.1962, R. M. Bohart, 1 ♂ (114274, MEI); 4 km E Jct Hwy 190 Death Valley National Monument, Stovepipe Wells [36.606 -117.146], 1.IV.1980, T. W. Schoener, C. A. Toft, 6 ♂♂ (114684; 114678; 114692; 114704; 114767; 114798, UCDC); 4.8 km N Lone Pine [36.649 -118.062], sand dunes, 8.V. to 4.IX.1980, Giuliani, 3 ♀♀ (072589; 072590; 072591, CDAE); 8.1 km N Lone Pine [36.679 -118.062], 7.VI.1964, J. D. Birchim, 1 ♀ (131730, CASC); Death Valley, Furnace Creek [37.589 -118.004], 27.III.1961, MEI, 1 ♂ (114236, MEI); 27.III.1961, D. R. Miller, 1 ♂ (114287, MEI), MEI 1 ♀ (114278, MEI); Death Valley National Monument, Death Valley Jct Hwy 178-Saratoga Spr. Rd. ex *Bembix* nest 02, 20.III.1980, L. S. Kimsey, R. B. Kimsey, 4 ♂♂ (114669; 114717; 114746; 114772, UCDC); 20.III.1980, L. S. Kimsey, R. B. Kimsey, 3 ♂♂ (114696; 114729; 114676, UCDC); 22.IV.1980, L. S. Kimsey, R. B. Kimsey, 2 ♂♂ (114723; 114738, UCDC), 1 ♀ (114667, UCDC); Death Valley National Monument, Mesquite Spring [36.451 -116.866], 549 m, 7.IV.1977, D. Giuliani, 1 ♂ (131744, CASC); Death Valley National Park, Stovepipe Wells [36.659 -117.079], 9.IV.1977, D. D. Wilder, 1 ♂ (131735, CASC), 1 ♀ (131727, CASC); Eureka Dunes [37.096 -117.674] 1.V.1987, R. W. Rust, 2 ♂♂ (073752; 073753, EMUS); 24.IV.1986, R. W. Rust, 1 ♂ (073737, EMUS); 2.V.1987, R. W. Rust, 4 ♂♂ (073746; 073747; 073749; 073750, EMUS), 2 ♀♀ (073748; 073751, EMUS); Eureka Valley [37.111 -117.707], 4.IX.1975, D. Giuliani, 2 ♂♂ (146354; 146355, CDAE); IV.1978, pitfall trap, Giuliani, Hardy, Andrews, 2 ♂♂ (114203; 114087, CDAE), 1 ♀ (114084, MEI), 13 ♀♀ (114038; 114135; 114145; 113994; 114085; 114089; 114137; 114321; 113977; 114325; 114096; 114327; 114144, CDAE); 15.V.1979, L. D. French, N. J. Smith, 1 ♂ (116894, UCDC); 17.IV.1978, pitfall trap, Giuliani, Hardy, Andrews, 1 ♀ (114076, CDAE); IV.1978, pitfall trap 2, Giuliani, Hardy, Andrews, 2 ♀♀ (114300; 114106, CDAE); 30.V.1972, D. Giuliani, 1 ♂ (131748, CASC); 4.V.1977, S. I. Frommer, 2 ♂♂ (104512; 104578, UCRC); 4.V.1977, J. C. Hall, 9 ♂♂ (104556; 114101; 114140; 114018; 114004; 113981; 114113; 114128; 114024, UCRC), 3 ♀♀ (104558; 113985; 114156, UCRC); 4.V.1977, A. J. Mayer, 2 ♂♂ (114180; 114108, MEI); 5.IV.1978, pitfall trap, Giuliani, Hardy, Andrews, 1 ♂ (114103, CDAE), 2 ♀♀ (113984; 114134, CDAE); 7.IX.1972, D. Giuliani, 2 ♂♂ (131720; 131728, CASC), 1 ♀ (131729, CASC); 881 m, dunes, 21. to 24.VI.1992, MEI, D. K. Yeates, 8 ♂♂ (114003; 114054; 114090; 114094; 114127; 114131; 114157; 114188; MEI), 3 ♀♀ (114001; 114194; 114215; MEI); dunes, 1.VII.1978, C. A. Toft, 1 ♀ (114671, UCDC); east edge of dunes at dusk, 4.V.1977, J. D. Pinto, 5 ♂♂ (104576; 104504; 114068; 104573; 104581, UCRC), 2 ♀♀ (104587; 114067, UCRC); Marble Canyon [37.209 -117.802], sand dunes, 6.IV.1972, D. Giuliani,

- 1 ♂ (131736, CASC); Golden Canyon, Death Valley National Monument, [36.421 -116.846], 31.III.1980, T. W. Schoener, C. A. Toft, 1 ♀ (114657, UCDC); Owens Valley E of Tinemaha Reservoir [37.063 -118.21], sand dunes, 30.V. to 28.VI.1980, pitfall trap, D. Giuliani, 1 ♀ (114515, MEI); Panamint Valley [35.684 -117.089], sand dunes, 27.IV.1972, D. Giuliani, 1 ♂ (131745, CASC); 525 m, 27. to 28.IV.1974, ELS, 1 ♂ (112041, CASC); Saline Valley [36.703 -117.815], 27.IV.1974, A. R. Hardy, T. Eichlin, 1 ♀ (072464, CDAE); 1.V.1977, malaise trap, D. Giuliani, 1 ♀ (072603, CDAE); Panamint Valley, sand dunes, 25.IV.1973, D. Giuliani, 1 ♀ (072447, CDAE); Kern County: 4.8 km W Brown Sand Canyon [35.77 -117.893], 7.IV.1966, R. O. Schuster, 1 ♂ (114343, UCDC); 6.4 km NE Inyokern [35.688 -117.771], 24.IV.1960, D. D. Linsdale, 1 ♀ (114635, MEI); Boron [34.999 -117.649], 6.V.1960, J. W. MacSwain, 1 ♀ (113933, MEI); Fellows [35.18 -119.542], 27.X.1957, W. R. Bauer, J. S. Buckett, 1 ♂ (116903, UCDC); Mojave [35.057 -118.17], 1976, J. E. Slansky, 3 ♂♂ (116901; 116902; 116897, UCDC), 4 ♀♀ (116883; 116888; 116889; 116890, UCDC); Los Angeles County: 7 ♂♂ (113214; 113216; 113217; 113218; 113220; 113220; 113223, USNM), 4 ♀♀ (113215; 113221; 113231; 113240, USNM); Frenchmans Flat. [34.617 -118.746], 7.IV.1951, R. L. Usinger, 1 ♂ (147685, CNCI), 1 ♀ (147916, CNCI); 19.3 km E Lancaster [34.697 -117.955], 2.V.1961, Rozen, R. Schrammel, 1 ♂ (114478, AMNH), 1 ♀ (114473, AMNH); 6.4 km E Lancaster [34.65 -118.082], 30.IV.1968, J. C. Hall, 1 ♂ (114238, MEI); Piute Butte [34.658 -117.85], 968 m, 12.V.1944, ALM, 1 ♂ (113800, USNM); Whitewater Canyon [34.356 -118.353], 18.III.1976, E. L. Klee, 1 ♀ (131737, CASC); Mono County: 14.5 km N Bishop [Inyo County] at Fish Slough [37.494 -118.394], 1,280 m, sand dunes Antifreeze pit trap, 19.V. to 29.VII.1980, D. Giuliani, 4 ♀♀ (072634; 072635; 072637; 072638, CDAE); 12.V.1982, D. Giuliani, 1 ♀ (146347, CDAE); Mono Basin, 16.1 km S Highway 167, Sulfur Spring Rd., [37.954, -118.942], 30.VII.1980, L. S. Kimsey, 1 ♀ (114739, UCDC); 6.4 km N Benton [37.877 -118.476], 1,707 m, on sandy substrate, 12.VI. to 31.VIII.1980, pitfall trap, D. Giuliani, 2 ♀♀ (114410; 114424, MEI); Benton (Station) [37.819 -118.476], 15.VII.1965, 1 ♂ (114380, UCDC); Mono Basin 16.1 km S Highway 167 Sulfur Spring Rd. [37.954 -118.942], 26.VI.1980, T. W. Schoener, C. A. Toft, 2 ♀♀ (114656, 114666, UCDC); 30.VII.1979, C. A. Toft, 1 ♂ (114698, NVDA), 29.VII.1980, C. A. Toft, 1 ♂ (114773, NVDA), 2 ♀♀ (114716; 114726, UCDC); Mono Lake Park Sand Dunes at Mono Lake [38.017 -119.008], 21.VII.1977, D. Giuliani, 1 ♀ (131733, CASC); Monterey County: 9.7-11.3 km SE King City floodplain of Salinas River [36.199 -121.146], 18.VI.1997, MEI, 1 ♂ (101038, MEI); Salinas River at King City [and Salinas River] [36.209 -121.145], dunes, 28.V.1991, MEI, 3 ♂♂ (114754; 114784; 114801; MEI), 3 ♀♀ (104506; 114774; 114751, MEI); Orange County: Bolsa Chica Beach State Park [33.7 -118.05], 23.XII.1998, sifted, MEI, 2 ♂♂ (114599; 114520, MEI), 1 ♀ (114589, MEI); Seal Beach [33.741 -118.104] sifted from beach sand, 23.XII.1998, MEI, 1 ♂ (114567, MEI), 2 ♀♀ (114553; 114495, MEI); Seal Beach [33.749 -118.086], 5 m, 15.IV.1990, sifted, DWW, MEI, 1 ♂ (114118, MEI), 1 ♀ (114051, MEI); Riverside County: 4 km S Martinez, 72nd Ave., [33.517, -116.15], MV light, 28.IV.2000, DYA, 2 ♂♂ (UCRC 40251; UCRC 40250, UCRC); Wiley's Well Road at I-10, [33.606, -114.908], 24.III.2001, DYA, 2 ♂♂ (UCRC 48672; UCRC 48673, UCRC); 28.III.2001, 3 ♂♂ (UCRC 49588; UCRC 49589; UCRC 49587, UCRC); 1.8 km W Wiley's Well Road, [33.603, -114.921], 140 m, on *Laurea tridentata*, 7.IV.2000, DYA, 1 ♂ (UCRC 39940, UCRC); Slover Ave., [34.066, -117.359], 315 m, 24.IV.2001, Hawks, DYA, 1 ♂ (UCRC 50259, UCRC); 1.6 km N Mira Loma, [34.007, -117.516] Dune Assoc., 18.VI.1967, MEI, 1 ♀ (114272, ZMUC); sand dune, 20.VI.1967, MEI, 1 ♂ (114125, MEI), 3 ♀♀ (114257; 114263; 114033, MEI); 4.8 km S Rice, [34.04, -114.849], 2.IV.1978, JAP, R. E. Dietz, 1 ♂ (082074, EMEC); Coachella [33.68 -116.173], 25.V.1928, E. C. Van Dyke, 1 ♂ (114074, MEI); 1.6 km N. Snow Creek, [33.904, -116.683], 25.IX.1965, R. C. Dickson, 4 ♂♂ (113975; 114204; 114064; 114315, MEI), 1 ♀ (114223, MEI); 7. to 13.IX.1965, yellow sticky, R. C. Dickson, 3 ♂♂ (113919; 113956; 113970, MEI), 3 ♀♀ (113957; 113969; 113971, MEI); 1.6 km S North Palm Springs [33.908 -116.542], 30.III.1975, T. Griswold, 1 ♂ (071130, EMUS); 6.4 km E Indio, [33.721, -116.157], 10.X.58, at light, J. W. MacSwain, 1 ♂ (114198, MEI); 12.9 km N Indio [33.837 -116.215], 28.III.1978, EMF, 4 ♂♂ (072346; 072347; 072350; 072351, CDAE); 14 miles. W. Indio [33.721 -116.417], 19.III.1966, P. D. Hurd, 1 ♀ (114613, MEI); 2 miles. E. Palm Springs [33.83 -116.516], 4.IX.1968, J. Wilcox, 1 ♂ (114253, MEI); 3.2 km NW Palm Springs, [33.851, -116.565], 25.III.1969, J. Wilcox, 1 ♀ (114289, MEI); Blythe [33.61 -114.596 960] 22.VI.1962, R.M.Hardman, 1 ♂ (146365, CDAE); 29 km W Blythe [33.61 -114.856], 20.II.1965, 120 m MEI & E. I. Schlinger, 1 ♂ (114744, MEI); dunes, 31.III.1968, MEI, 1 ♂ (114241, MEI), 1 ♀ (114224, MEI); 22.III.1967, R. O. Schuster, 1 ♂ (114285, UCDC); 24.IV.1963, FDP, L.A. Stange, 1 ♂ (114291, MEI); 25.IV.1961, Rozen, R. Schrammel, 1 ♂ (114477, AMNH); 120 m, 29.I.1965, sieved in inland dunes, MEI, FDP, D. R. Miller, 2 ♂♂ (114750; 114762, MEI), 3 ♀♀ (114783; 114786; 114795, MEI); 20.II.1965, sieved, MEI, E. I. Schlinger, 1 ♂ (114785, MEI), 1 ♀ (114769, MEI); 22.III.1967, D. S. Horning Jr., 1 ♀ (114349, UCDC); 3.2 km S Mira Loma [33.964, -117.516], 14.VII.1958, H. R. Moffitt, 1 ♀ (113968, MEI); 3.2 km W Hopkins Well [33.612 -115.023], 30.III.1959, J. W. MacSwain, 1 ♂ (114081, MEI); 109 m, 1.IV.1959, J. W. MacSwain, 1 ♂ (114693, MEI); 30.6 km W Blythe [33.61 -114.871], 3.IV.1966, R. M. Bohart, 1 ♀ (114341, UCDC); 35.4 km W Blythe [33.61 -114.914], 9.IV.1963, E. I. Schlinger, 2 ♂♂ (113929; 113947, MEI), 2 ♀♀ (113944; 113959, MEI); 4 miles. E. Indio [33.721 -116.157], 10.X.1958, at light, J. W. MacSwain, 1 ♀ (114197, MEI); 10.X.1958, at light, W. E. Ferguson, 1 ♀ (114616, MEI); 4.8 km E North Palm Springs [33.918 -116.458], dunes, 5.III.1968, MEI, 7 ♂♂ (028315; 028327; 114282; 114283; 114294; 114304; 114355, MEI);

- 4.8 km N North Palm Springs [33.973 -116.54], sand dune, 25.II.1968, MEI, 1 ♂ (114269, MEI); 4.8 km S Whitewater Windy Point [33.897 -116.621], 25, to 26.I.1977, sifted, J. T. Doyen, 1 ♂ (114102, MEI), 3 ♀♀ (114112; 114165; 114214, MEI); 4.8 km S. Indio [33.677 -116.215], 28.III.1958, H. R. Moffitt, 1 ♀ (113931, MEI); 5.6 km S Palm Desert Des. Res. Center [33.672 -116.374], 17.-25.IV.1970, malaise trap, P. L. Boyd, 1 ♀ (CIS 307918, EMEC); 18. to 23.V.1970, malaise trap, S. I. Frommer, 1 ♂ (114172, UCRC), 1 ♀ (114072, UCRC); 8.1 km E Mecca [33.572, -116.004], 13.IV.1965, D. Veirs, 1 ♀ (114086, MEI); 6.4 km E Mecca, [33.572, -116.019], 13.IV.1965, R. L. Langston, 1 ♀ (114116, MEI); 6.4 km S Palm Desert Deep Canyon, Desert Research Center [33.665 -116.374], 24.V.1969, malaise trap, MEI, S. I. Frommer, 1 ♀ (UCRC 019006, MEI); 8.1 km E Anza [33.568 -116.595], 27.X.1978, J. C. Mall, 1 ♀ (114737, UCRC); 8.1 km S Rice [34.011 -114.85], 20.III.1976, E. L. Lee, 2 ♂♂ (131734; 131741, CASC), 1 ♀ (131740, CASC); 9.7 km W. Indio [33.721 -116.302], Melilotus, 30.IV.1949, E. G. Linsley, J. W. MacSwain, R. F. Smith, 2 ♀♀ (114111; 114205, MEI); Blythe [33.61 -114.865], 2.IV.1963, MEI, 2 ♂♂ (114271; 114335, MEI), 1 ♀ (114296, MEI); 14.IX.1962, R. M. Hardman, 2 ♂♂ (072235; 072430, CDAE), 2 ♀♀ (072431; 072641, CDAE); 9.IV.1939, F. H. Parker, 1 ♂ (078509, UAIC); 22.IV.1978, N. J. Smith, 1 ♀ (116881, UCDC); Cathedral City [33.78 -116.464], 122 m, 18.VIII.1950, L. W. Isaak, 1 ♂ (114043, MEI); 5.IX.1950, L. W. Isaak, 1 ♂ (114069, MEI); 10.VIII.1950, L. W. Isaak, 2 ♀♀ (114359; 114387, MEI); Deep Canyon [33.944 -116.782], 19.V.1964, MEI, 1 ♀ (113912, MEI); Desert Hot Springs [33.961 -116.499], 335 m, 4.IV.1945, ALM, 1 ♀ (113820, USNM); Hopkins Well [33.612 -114.995], 16.IV.1958, JAP, 1 ♀ (114117, EMEC); 14.IV.1958, JAP, 1 ♂ (114208, EMEC); Indian Wells [33.719 -116.308], 30 m, 21.III.1979, G. C. Eickwort, 1 ♂ (114039, CUIC), 1 ♀ (114207, CUIC); Indio [33.721 -116.215], 5.IV.1951, P. D. Hurd, 1 ♂ (147677, CNCI); 5.VI.1969, R. P. Allen, 1 ♂ (072389, CDAE); 2.V.1945, ALM, 1 ♂ (113818, USNM); 18.X.1961, 1 ♂ (113964, MEI); 25.III.1937, G. E. & R. M. Bohart, 1 ♂ (114190, MEI); 5.IV.1951, E. G. Linsley, 1 ♂ (114621, MEI); 18.IX.1977, E. G. Linsley, J. M. Linsley, 1 ♀ (115632, USNM); Keosegan Ranch [33.721 -116.215], in cotton, 19. to 22.VI.1970, malaise trap, 1 ♀ (028328, MEI); La Quinta [33.663 -116.309], 37 m, 27.VI.1957, E. I. Schlinger, 1 ♂ (113966, MEI); Lake Hemet [33.661 -116.705], 1,321 m, 25.III.1971, 1 ♀ (071125, EMUS); Mecca [33.572 -116.076], 30.III.1958, F. Colley, 1 ♂ (UCRC 64606, UCRC); 18.IX.1942, C. L. Remington, 1 ♀ (YPM 105210, PMNH); Mira Loma [33.993 -117.516], 213 m, 29.IV.1957, H. R. Moffitt, 1 ♂ (114687, MEI); Whitewater Wash near Snow Creek Village [33.89 -116.683], 3.IV.1985, D. Woodward, 1 ♂ (114202, MEI); Onehundred Palms [33.55 -116.167], 9.IV.1964, R. M. Bohart, 1 ♀ (114275, MEI); Palm Springs [33.83 -116.544], 18.VI.1936, A. W. Levi, 1 ♂ (070783, EMUS); 4.IV.1935, ALM, 2 ♂♂ (113797; 113798, USNM); 3.II.1946, 1 ♀, (114185, MEI); Windy Point [33.897 -116.625], 15.VIII.1968, sifted, MEI, P. A. Rauch, 1 ♀ (113950, MEI); dunes, 8.IV.1968, sifted, P. A. Rauch, 1 ♀ (114249, MEI); Palm Springs Station [33.906 -116.647], 26.III.1960, M. Wasbauer, 1 ♂ (072422, CDAE); Rice Dunes, 19.IX.1977, A. R. Hardy, F. G. Andrews, 1 ♂ (073038, CDAE); Riverside [33.94 -117.397], 20.IX.1963, MEI, 1 ♀ (113948, MEI); San Gorgonio Pass, 24.III.1987, L. G. Bezark, 1 ♂ (114757, MEI); Snow Creek Rd. (off Hwy 111) [33.913 -116.666], At water seep, 26.V.1976, L. G. Bezark, 1 ♂ (114712, UCRC), 1 ♀ (114673, UCRC); Thermal [33.64 -116.139], 23.VI.1956, at light, M. S. Wasbauer, 1 ♀ (114005, MEI); 15.X.1959, C. E. James, 1 ♂ (146356, CDAE), 1 ♀ (146317, CDAE); 18.IX.1962, VAMarken, 1 ♂ (146360, CDAE), 1 ♀ (146318, CDAE); Thousand Palms [33.82 -116.389], 28.III.1955, W. R. Richards, 1 ♀ (147675, CNCI); 12.IV.1955, W. R. Richards, 1 ♀ (147680, CNCI); 15.IV.1955, W. R. Richards, 1 ♀ (147674, CNCI); 30.III.1958, D. D. Linsdale, 1 ♀ (114091, MEI); 25.III.1955, W. R. Richards, 1 ♀ (147684, CDAE); 23.III.1955, J. E. H. Martin, 1 ♂ (147665, CNCI); 26.III.1955, J. E. H. Martin, 1 ♂ (147664, CNCI); 27.III.1955, J. E. H. Martin, 1 ♂ (147663, CNCI); 3.IV.1955, J. E. H. Martin, 1 ♂ (147667, CNCI); 30.III.1955, J. E. H. Martin, 1 ♀ (147690, CDAE); 8.IV.1969, E. E. Grissell, 1 ♂ (116891, UCDC), 1 ♀ (116882, UCDC); 2.X.1977, N. J. Smith, 1 ♂ (116895, UCDC); Valerie [33.569 -116.179], -27 m, 5.II.1945, ALM, 1 ♂ (113817, USNM); San Benito County: 3.2 km NE New Idria [36.4 -120.675], night, 3.IV.1966, sweep net, P. A. Opler, 3 ♂♂ (114060; 114088; 114219, MEI); San Bernardino County: Panamint Valley, 1.6 km W Wingate Pass [35.738 -117.073], 13.III.1984, D. Giuliani, 1 ♀ (146352, CDAE); 19.3 km ESE Tecopa [35.78 -116.067 960], 13.-14. IV.1978, M. Wasbauer, T. Eichlin, 1 ♀ (146348, CDAE); Cadiz Dunes, [34.348 -115.377], 18.IX.1977, F. G. Andrews & A. R. Hardy, Blacklight 2 ♂♂ (146332; 146331, CDAE); 25.IV.1978, Alan R. Hardy, F. G. Andrews, blacklight, 1 ♀ (146337, CDAE); 18.IX.1977, Fred G. Andrews & A.R. Hardy, Blacklight, 1 ♀ (146338, CDAE); Twentynine Palms, [34.146, -116.036], 5.V.1962, M. Hain, 1 ♀ (UCRC 64607, UCRC); Morongo Valley, [34.047, -116.566], 5.VI.1946, D. J. & J. N. Knull, 1 ♂ (114487, OSUC); Rialto, Industrial Drive, [34.106, -117.369], 4.IX.1999, G. R. Ballmer, D. C. Hawks, 1 ♂ (UCRC 46918, UCRC); MNP [Mojave National Preserve], Kelso Dunes, [34.889, -115.717], 770 m, 19.V.2001 DYA, 2 ♂♂ (UCRC 52014; UCRC 52013, UCRC), 1 ♀ (UCRC 52015, UCRC); 3.2 km S Kelso [34.982 -115.649], 21.IV.1977, J. T. Doyen, 1 ♀ (114020, EMEC); 26.IV.1977, JAP, 1 ♂ (114070, EMEC); 10 miles. N. Earp [34.31 -114.3], 23.IV.1960, JAP, 1 ♂ (114615, EMEC); 11.3 km SW Kelso [34.941 -115.725], sand dunes, 20. to 21.IV.1969, R. R. Pinger, 1 ♀ (113831, USNM); 20.-21.IV.1969, M. S. & J. S. Wasbauer, 6 ♂♂ (146357; 146358; 146359; 146362; 146363; 146364, CDAE), 2 ♀♀ (146343; 146344, CDAE); 12.9 km SW Kelso, Kelso Dunes [34.93 -115.733], 4.IV.1966, R. M. Brown, 1 ♂ (131726, CASC); 14.5 air km S Baker Zzyzx Springs [35.136 -116.103], 27.IV.1977, JAP, 1 ♂ (114028, EMEC); 14.5

- km SW Kelso, Kelso Dunes [34.911 -115.73], 11.IX.1999; at MV light; Ballmer, Crump, Pratt, 3 ♂♂ (UCRC 63585 UCRC 63586 UCRC 63587, UCRC); 19.VI.1999; Ballmer, Hawks, Powells, DYA, at mercury vapor light, 2 ♂♂ (UCRC 63584; UCRC 63583, UCRC), 1 ♀ (UCRC 63420, UCRC); 1.V.1966, R. Dickson, 1 ♂ (114056, MEI); 3.IV.1978, JAP, 1 ♂ (114035, EMEC); 16.1 km W Victorville [34.536 -117.435], sand dunes, 24.IV.1977, G. Ulrich, 1 ♂ (114206, EMEC); 24.2 km W Baker [35.107 -116.26], 6.V.1977, N. J. Smith, 1 ♂ (116896, UCDC); 3 miles. S Kramer Junction [34.949 -117.541], 10.VI.1961, MEI, 1 ♀ (114310, MEI); 37 km SW Baker at Afton Road [35.072 -116.41], 20.IV.1977, C. Kitayama, 1 ♀ (114099, EMEC); 4.8 km S Colton [34.027 -117.32], 20.IV.1962, J. A. Litsinger, 1 ♂ (077026, IRCW); 9.7 air km W Rice [34.084 -114.936], 1.IV.1978, JAP, R. Dietz, 1 ♀ (114167, EMEC); 9.7 km N Yucca Valley [34.201 -116.431], 11.IV.1960, H. K. Court, 1 ♂ (114367, UCDC), 2 ♀♀ (113963; 114247, MEI); Cajon Pass [34.326 -117.428], 16.VI.1946, W. F. Barr, 1 ♂ (113913, MEI); Colton South side of San Bernardino Ave. between Indigo and Wildrose Aves. [34.074 -117.313], 20.VIII.1989, G. R. Ballmer, 1 ♂ (078125, UCRC); Cottonwood Wash [34.9 -115.702], 768 m, 4.IV.1983, T. Griswold, R. Griswold, 1 ♀ (075363, EMUS); Cronise Valley [35.103 -116.293], 29.IV.1956, P. D. Hurd, 3 ♂♂ (113987; 114308; 114643, MEI), 1 ♀ (114617, MEI); Cronise Valley [35.103 -116.293], 29.IV.1956, JAP, 1 ♂ (114149, EMEC); 29.IV.1956, M. Wasbauer, 1 ♀ (114369, MEI); Slover Ave. and Pepper St. [34.063 -117.352], dunes, 29.V.1990, G. R. Ballmer, 1 ♂ (078126, UCRC); Essex [34.734 -115.244], 518 m, 5.IV.1966, P. A. Opler, 2 ♂♂ (114077; 114199, MEI), 2 ♀♀ (114065; 114637, MEI); 5.IV.1966, R. M. Brown, 3 ♂♂ (131743; 131721; 131747, CASC), 2 ♀♀ (131725; 131731, CASC); 3.2 km N Essex, [34.762, -115.244], 518 m, 1 ♂ (114053, MEI); Goldstone [35.374, -116.9], 25.IV.1953, G. A. Marsh, R. O. Schuster, 2 ♂♂ (114633; 114683, MEI); Kelso [35.013 -115.653], 14.IV.1962, C. A. Toschi, 1 ♀ (114614, MEI); Kelso Dune [34.911 -115.73], 16.IV.1974, Ernest Anderson, 1 ♀ (131739, CASC); 22.V.1987, D. E. Russell, 1 ♂ (078703, CAES), 1 ♀ (114764, MEI); Kramer Hills [34.921 -117.468], 1.V.1953, G. A. Marsh, 4 ♂♂ (147693; 147668; 147670; 147673, CNCI); 6.IV.1966, R. O. Schuster, 1 ♀ (114340, UCDC); 1.V.1953, R. O. Schuster 1 ♂ (011312, MEI); 2.VII.1965, MEI, 1 ♀ (113961, MEI); *Malacothrix* sp., 1.V.1953, P. D. Hurd, 6 ♂♂ (114059; 114042; 114008; 114794; 114193; 114142, EMEC), 2 ♂♂ (147666; 147662, CNCI), 1 ♀ (147671, CNCI), 1 ♀ (147671, CDAE); 4.V.1966, J. Wilcox, 1 ♀ (114189, MEI); 11.IV.1964, P. M. Marsh, 1 ♂ (114229, MEI); 1.V.1953, P. D. Hurd, 9 ♂♂ (113978; 114650; 114654; 114661; 114691; 114695; 114714; 114718; 114732, MEI), 3 ♀♀ (114032; 114309; 114318, EMEC); Landers [34.266 -116.391], 940 m, 1.IX.1960, T. M. Peters, 2 ♀♀ (078291; 078292, UMSP); Lucerne Valley [34.444 -116.967], 1.V.1987, G. H. Nelson, 1 ♂ (128421, FSCA); Mira Loma [34.02 -117.54], 29.IV.1957, H. R. Moffitt, 4 ♂♂ (113916; 113925; 113965; 114381, MEI), 2 ♀♀ (113926; 114360, MEI); Mohave River Afton Canyon Campground [35.039 -116.382], 21.IX.1981, black light (UV), R. Hardy, 1 ♀ (072568, CDAE); Ontario [34.063 -117.65], 12.IX.1964, R. D. Sjogren, 1 ♂ (114731, MEI); Saratoga Springs [39.175 -122.98], 433 m, 22.IV. to 23.V.1977, J. T. Doyen, 1 ♂ (104577, EMEC); Yermo [34.91 -116.82], 12.IV.1966, J. Wilcox, 2 ♀♀ (113999; 114171, MEI); 6.IX.1939, W. M. Pearce, 1 ♂ (114448, AMNH); San Diego County: 1 ♂ (113230, USNM); 1.5 miles. NW Ocotillo Wells [33.16 -116.149], 4.X.1965, R. C. Dickson, 1 ♂ (114324, MEI), 1 ♀ (114319, MEI); 5.4 miles. E. Borrego Springs [33.237 -116.295], G. R. Noonan, 2 ♂♂ (113979; 114093, MEI); 6.4 km N. Anza Borrego St. Pk., Junction of Borrego Springs Rd. and DiGiorgio Rd. [33.249 -116.276], vic. of creek, 4.IV.1968, S. I. Frommer, S. L. Frommer, 1 ♂ (114212, MEI); 7.2 km E Borrego Springs [33.219 -116.262], 12.IV.1990, DWW, MEI, 5 ♂♂ (113997; 114120; 114139; 114201; 114213; MEI), 1 ♀ (114030, MEI); sand dunes, 10.II.1968, sifted, R. & A. R. Hardy, 1 ♀ (114234, MEI); Borrego Springs [33.26 -116.38], 180 m, 30.XI.1960, M. S. Wasbauer, 2 ♂♂ (072233; 072236, CDAE); Coyote Creek [33.223 -116.297], 183 m, Larva sieved in Inland dunes, 27.I.1965, MEI, 1 ♂ (114759, MEI); Borrego State Park, Clark Dry Lake [33.337 -116.278], 31.III.1977, malaise trap, M. S. Wasbauer, J. E. Slansky, 1 ♀ (072664, CDAE); Anza-Borrego Desert State Park, 7.VI.1969, A. R. Hardy, 1 ♂ (113936, MEI); sand dunes, 27.IX.1980, black light (UV), A. R. Hardy, 1 ♀ (114460, MEI); Borrego State Park, 1.IV.1967, J. E. Slansky, 1 ♀ (116877, UCDC); Borrego State Park, 17.-20.IV.1969 M. S. & J. S. Wasbauer, 1 ♀ (146350, CDAE); Borrego [33.221, -116.333], 20.IV.1951, C. D. MacNeill, 3 ♂♂ (114153; 114161; 114227, MEI); 3.V.56, B. J. Adelson, 1 ♂ (114191, MEI); 11.IV.1962, R. M. Bohart, 4 ♂♂ (114246; 114284; 114298; 114320, MEI); 3 ♀♀ (114266; 114268; 114292, MEI); 2.V.1952, Timberlake, 1 ♂ (114295, MEI); 21.IV.1960, JAP, 1 ♂ (114612, EMEC); 27.IV.1955, M. Wasbauer, 2 ♂♂ (114628; 114660, MEI), 1 ♀ (114694, MEI); 24.IV.1947, L. W. Quate, 1 ♂ (114632, MEI); 25.IV.1954, P. D. Hurd, 2 ♂♂ (114651; 114677, MEI), 2 ♀♀ (114699; 114788, MEI); 3.V.1956, M. Wasbauer, 2 ♀♀ (114728; 114659, MEI); 2.IV.1953, P. D. Hurd, 1 ♂ (114664, MEI); 1.IV.1953, P. D. Hurd, 1 ♀ (114665, MEI); 2.IV.1952, P. D. Hurd, 1 ♂ (114210, MEI); 3.V.1956, JAP, 3 ♀♀ (114686; 114733; 114706, EMEC); 24.IV.1954, J. G. Rozen, 2 ♂♂ (114735; 114720, MEI); 23.IV.1955, F. X. Williams, 1 ♀ (131718, CASC); Borrego Valley, [33.283, -116.333], 23.V.1964, J. E. Slansky, 1 ♂ (072426, CDAE); 18.IV.1957, R. M. Bohart, 2 ♀♀ (113908; 114187, MEI); 5.IV.1964, MEI, 1 ♂ (114668, MEI), 2 ♀♀ (113924; 114761, MEI); dunes, 18.IV.1957, R. M. Bohart, 2 ♀♀ (113941; 113960, MEI); 18.II.1967, M. W. Stone, 1 ♂ (114098, MEI); 28.II.1967, J. Wilcox, 1 ♂ (114115, MEI), 1 ♀ (114225, MEI); 1.V.1952, Timberlake, 1 ♂ (114332, MEI); 24.III.1967, C. R. Kovacic, 1 ♀ (114350, UCDC); 11.III.1958, E. I. Schlinger, 1 ♂ (114799, MEI); 15.IV.1957, H. R. Moffitt, 1 ♂ (114372, MEI); mouth of Tijuana River [32.555 -117.128], 23.VIII.1976, sifted, P. A. Rude, J. Doyen, 1 ♂ (114195,

MEI), 26.XII.1976, P. Rude, J. Doyen, 3 ♀♀ (114122; 114181; 114123, MEI); near Borrego North end of Clark Lake [33.346 – 116.28], 23.III.1978, malaise trap, Wasbauer, J. E. Slansky, Adams, 1 ♂ (073053, CDAE); Pala [33.365 – 117.076], 122 m, 6.VI.1945, ALM, 1 ♂ (113819, USNM); Borrego-Clark [33.403 – 116.321], 23.III.1978, Wasbauer, Slansky, Adams, 8 ♀♀ (146335; 146336; 146339; 146340; 146341; 146342; 146345; 146346, CDAE); Santa Barbara County: 3.22 km E Solvang, [34.596, –120.108], 151 m, 28.VI.1965, M. R. Gardner, 1 ♂ (114358, MEI); Los Prietos [34.535 – 119.648], 23.VI.1965, JAP, 1 ♂ (114184, EMEC); 12.VII.1965, JAP, 1 ♂ (114368, EMEC); 20.VI.1965, sifted, J. S. Buckett, 1 ♂ (114736, UCDC); Santa Ynez Mountain [34.493 – 119.686], 24.VI.1959, A. E. Menke, 1 ♂ (113928, MEI).

Colorado: Moffatt County: K Ranch [40.297 – 109.046], 11.VI.1933, G. F. Knowlton, 1 ♂ (114413, AMNH).

Idaho: Latah County: Moscow Mt. [46.804 – 116.868], F. M. Hull, 3 ♂♂ (147691; 147682; 147669, CNCI); Owyhee County: Bruneau [42.881 – 115.796], 770 m, Low spots in gray dunes, 7.VIII.1969, J. Bigelow, M. A. Mortenson, MAC, 1 ♀ (114062, ASUT); Bruneau Dunes State Park [42.885 – 115.702], 24.VI.1993, W. Cranshaw, 1 ♂ (075523, CSUC); 762 m, 16.VI.1991, G. M. Stephens, 1 ♀ (100225, CIDA).

Nevada: Churchill County: 35.4 km S Fallon [39.155 – 118.776], 29.V.1995, FDP, 1 ♀ (073718, EMUS); *Astragulus*, 8.V.1996, FDP, 1 ♀ (101339, EMUS); 10.VI.1995, FDP, 1 ♀ (073721, EMUS); 8.1 km NE Fallon [39.525 – 118.725], 18.VII.1978, R. C. Bechtel, D. M. Martinelli, 1 ♂ (076981, NVDA); 19.3 km NE Stillwater [39.627 – 118.356], 3.VI.1961, FDP, 4 ♂♂ (114384; 114625; 114658; 114703, UCDC), 4 ♀♀ (114374; 114649; 114702; 116879, UCDC); 19.3 km NE Stillwater, [39.627, –118.356], 3.VI.1961, FDP, 2 ♀♀ (114711; 114715, UCDC); 2.5 miles. W. Hazen [39.565 – 119.081], 9.VI.1960, FDP, 1 ♂ (114725, UCDC); 6.4 km E. Hazen [39.565 – 118.988], 30.VI.1965, MEI, 1 ♂ (113952, MEI); Blow Sand Mountains [39.177 – 118.649], 25.VIII.1979, R. C. Bechtel, R. W. Rust, 1 ♂ (114663, NVDA); 28.VII.1979, R. C. Bechtel, D. L. Horton, D. M. Martinelli, 1 ♂ (114670, NVDA); 2.VIII.1979, black light (UV), R. C. Bechtel, L. M. Hanks, D. L. Horton, R. W. Rust, 1 ♂ (114689, NVDA); 28 Mi SSE Fallon [39.474 – 118.371], 3.VIII.1979, R. W. Rust, 1 ♀ (114653, NVDA); Carson Sink [39.934 – 118.313], sand dune, 30.V.1965, sifted, FDP, 1 ♂ (114401, MEI); Fallon [39.474 – 118.776], 8.V.1966, J. D. Birchim, 1 ♀ (131724, CASC); Sand Mountain [39.309 – 118.396], 23.VIII.1979, R. W. Rust, R. C. Bechtel, 1 ♀ (114645, NVDA); 27.VI.1979, R. C. Bechtel, D. M. Martinelli, 1 ♀ (114647, NVDA); 23.V.1979, R. W. Rust, R. C. Bechtel, 1 ♂ (114672, NVDA); 24.VIII.1979, R. W. Rust, 1 ♀ (125687, UCDC); Clark County: 35.4 air km S Mesquite Grand Gulch Road [36.487 – 114.066], 11.V.1983–21.V.1983, FDP, J. H. Parker, 1 ♂ (071127, EMUS); 1 ♀ (071128, EMUS); Mesquite [36.806 – 114.066], 23.IX.1980, A. Freidberg, 1 ♂ (104586, TAUI); Saint Thomas Gap [36.408 – 114.125], 11.IV.1983, R. C. Bechtel, J. B. Knight, 1 ♀

(077024, NVDA); Sandy [Sandy Mill] [35.804 – 115.604], 14.V.1970, R. C. Bechtel, D. F. Zoller, 1 ♂ (076878, NVDA), 3 ♀♀ (076875; 076876; 076877, NVDA); Tule Springs [36.317 – 115.28], 24.V.1940, 1 ♂ (114450, AMNH); Humboldt County: 16.1 km N Winnemucca [41.118 – 117.735], 1,310 m, 19.VI.1985, D. Veirs, 1 ♀ (072224, EMUS); 16.1 km N Winnemucca W on Sand Pass Road [41.126 – 117.695], 22.VI.1993 liters. G. Bezark, D. E. Russell, 1 ♀ (114742, MEI); N Winnemucca [40.973 – 117.735], sand dunes, 23.VI.1995, Baumann, Peterson, 1 ♂ (079107, BYUC); 27.VI.1959, T. R. Haig, 1 ♀ (113917, MEI); 19 km NW Winnemucca [41.094 – 117.856], sand dunes, 18.VII.1977, Derham Giuliani, 1 ♀ (131742, CASC); Lyon County: Fernley [39.608 – 119.258], 9.VI.1994, FDP, 4 ♂♂ (075120; 075122; 075123; 075126, EMUS), 3 ♀♀ (075121; 075124; 075125, EMUS); 12.VII.1996, FDP, 1 ♂ (101268, EMUS), 1 ♀ (101363, EMUS); 27.V.1960, T. R. Haig, 2 ♂♂ (114256; 114260, MEI), 6 ♀♀ (113923; 113973; 114010; 114016; 114058, MEI) (114262, ZMUC); Mineral County: Teels Marsh [38.206 – 118.355], sand dunes, 16.VIII. to 22.XI.1979, pitfall trap, D. Giuliani, 1 ♀ (114353, MEI); Teels Marsh [38.206 – 118.355], sand dunes, 7.VI. to 31.VIII.1980, pitfall trap, D. Giuliani, 7 ♀♀ (114391; 114397; 114404; 114405; 114419; 114452; 114538, MEI); Nye County, Amargosa Desert Big Dune [36.647 – 116.58], 762 m, 29.IV.1974, at light, Hardy, Eichlin, 2 ♂♂ (072388; 072396, CDAE); 29.IV.1982, black light (UV), R. C. Bechtel, R. W. Rust, 1 ♀ (077007, NVDA); 29. to 30.IV.1982, black light (UV), L. G. Bezark, 1 ♂ (114770, MEI), 1 ♀ (114758, MEI); 19. IX.1974, F. G. Andrews, A. R. Hardy, 1 ♂ (146361, CDAE), 1 ♀ (146349, CDAE); Lava Dune, 30.IV.1982, black light (UV), R. C. Bechtel, R. W. Rust, 4 ♂♂ (077011; 077012; 077015; 077018, NVDA), 3 ♀♀ (077008; 077009; 077010, NVDA); Mercury [36.661 – 115.994], 26.VIII.1965, 1 ♂ (113796, USNM); 31.VII.1962, 1 ♂ (113802, USNM); 31.VIII.1959, 3 ♂♂ (113803; 113804; 113805, USNM); 24.VIII.1962, 1 ♂ (113806, USNM); 25.VII.1960, 1 ♂ (113807, USNM); 26.VIII.1964, 1 ♂ (113808, USNM); 9.VIII.1961, 2 ♂♂ (113809, 113811, USNM); 31.VIII.1959, 1 ♂, (113810, USNM); 20.VI.1964, 1 ♀ (113833, USNM); Pahrump [36.208 – 115.983], 3.VI.1960, R. W. Lauderdale, 1 ♀ (076874, NVDA); 2.V.1962, R. W. Lauderdale, 1 ♂ (076899, NVDA); 3.2 km N Nixon [39.861 – 119.357], 22.VI.1961, FDP, 1 ♂ (114376, MEI); Washoe County: 32.2 km E Reno [39.522 – 119.505], 27.V.1930, E. L. Bell, 1 ♂ (114501, AMNH); 4.5 km W Wadsworth [39.65 – 119.338], 21.VI.1963, G. I. Stage, 1 ♀ (131746, CASC); 6.4 km N Nixon [39.889 – 119.357], on Tetradymia, 16.VI.1994, FDP, 4 ♀♀ (073762; 073763; 075127; 075128, EMUS); 3.VII.1962, R. M. Bohart, 1 ♂ (114267, MEI); 3.VII.1964, W. K. Thrailkill, 1 ♂ (114373, WFBM); Patrick [39.547 – 119.578], 16.VI.1964, MEI, 1 ♀ (113922, MEI); C. N. Slobodchikoff, 1 ♀ (131749, CASC); 16.VI.1964, D. F. Veirs, 1 ♀ (072205, EMUS); Pyramid Lake [39.862 – 119.435], 25.VI.1970, D. S. Chandler, 1 ♀ (114385, MEI).

New Mexico: Dona Ana County: 19.3 km N Las Cruces [32.486 -106.778], 11.IV.1965, FDP, 1 ♀ (114235, UCDC); 11.IV.1965, R. M. Bohart, 1 ♂ (114345, UCDC), 1 ♀ (114348, UCDC); 4.IX.1965, R. M. Bohart, 3 ♀♀ (114342; 114328; 114351, MEI); 9.IV.1965, R. M. Bohart, 3 ♂♂ (114330; 114339; 114346, UCDC), 2 ♀♀ (114378; 114354, UCDC); 9.IV.1965, FDP, 1 ♂ (114371, UCDC), 2 ♀♀ (114377; 114334, UCDC); 8.1 km SW La Mesa Black Mountain [32.07 -106.759], 1,311 m, dunes, 18.III.1985, G. S. Forbes, 1 ♂ (051269, NMSU), 2 ♀♀ (051225, 051229, NMSU); 4 km E Anthony [36 -106.567], 1,200 m, 19.III.1999, MEI, 2 ♂♂ (111098, 111099, MEI); dunes E side of I-10 at Texas line, Anthony Dunes [32 -107.567], 1,219 m, 31.III.1984, G. S. Forbes, 1 ♂ (051265, NMSU); Jornada Road 2.6 km N Rt. 70/82 [32.401 -106.733], 1,372 m, 12.IV.1981, G. Forbes, 1 ♂ (119010, NMSU); Las Cruces [32.312 -106.778], 30.V.1952, MAC, W. Gertsch, R. Schrammel, 1 ♀ (114337, MEI); NW Corralitos 2.1 km NW C7/C8 Junction, 1,341 m, Dunes, 24.III.1984, G. S. Forbes, 1 ♂ (051270, NMSU), 1 ♀ (051230, NMSU); Eddy County: [32.35 -103.85], 11 24.IV.1979, Burke, D. R. Delorme, Schaffner, 1 ♂ (076513, TAMU); Grant County: 14.IV.1933, R. T. Kellogg, 2 ♂♂ (114713; 114734, OSUO), 2 ♀♀ (114061; 114721, OSUO); Lea County: [32.38 -103.722], 14 24.IV.1979, Burke, D. R. Delorme, Schaffner, 1 ♀ (076511, TAMU); Otero County: White Sands National Monument, 20.9 km SW Alamogordo [32.767 -106.333], 7.IV.1990, sifted, DWW, MEI, 4 ♂♂ (113993; 114022; 114080; 114179, MEI), 2 ♀♀ (113991; 113972, MEI); 2.V.1984, MEI, 5 ♂♂ (104508; 104511; 104571; 104582; 104585, MEI), 3 ♀♀ (104559; 104560; 104562, MEI); White Sands National Monument [32.75 -106.183], 20.III.1999 M. Hauser, 6 ♂♂ (111104; 111105; 111106; 111107; 111108, MEI) (111109, ZMUC); 12.IV.1965, FDP, 1 ♀ (114264, UCDC); White Sands [32.381 -106.429], 1,311 m, 26.IV.1944, C. R. Rotger, 2 ♂♂ (113232; 113228, USNM), 1 ♀ (113229, USNM).

Oregon: Harney County: [42.603 -118.382], 21.VII.1979, at light, M. J. Smith, N. Cobb, 1 ♂ (114709, UOIC); 13.VII.1979, malaise trap, N. Cobb, 2 ♂♂ (114662; 114719, UOIC); Catlow Valley [42.509, -119.117], sand dunes, 27.V.1979, Lightfoot, N. Cobb, 2 ♂♂ (114681; 114727, UOIC); [42.603 -118.382], sand dunes, 27.V.1979, Lightfoot, N. Cobb, 2 ♂♂ (114700; 114674, UOIC), 3 ♀♀ (114722; 114803; 114652; UOIC); Alvord Well #3 [42.56, -118.362], sand dunes, 19.VI.1979, Lightfoot, N. Cobb, 3 ♂♂ (114311; 114646; 114690, UOIC); [42.429, -118.421], 23.VII.1979, malaise trap N. Cobb, 1 ♂ (114688, UOIC); 9.VIII.1979, malaise trap, N. Cobb, 1 ♂ (114679, UOIC); sand dunes, 7.VIII.1979, Lightfoot N. Cobb, 1 ♂ (114705, UOIC); Malheur County: Adrian Owyhee River [43.741 -117.071], 24.VII.1934, 1 ♂ (114724, OSUO).

Texas: El Paso County: at New Mexico Line, Anthony Dunes [32 -107.567], 1,219 m, 31.III.1984, G. S. Forbes, 1 ♂ (051266, NMSU); Ward County: Monahans Sandhills State Park [31.648 -102.823], 20.IV.1990, black light (UV), E. Riley, C. Wolfe, 1 ♂

(076505, TAMU), 1 ♂ (076510, TAMU); Winkler County: NE Kermit Hwy. 115 [31.945 -102.971], sand dunes, 25.IV.1998, S. Fitzgerald, B. Kondratieff, D. Leatherman, 16 ♂♂ (106445; 106446; 106447; 106448; 106449; 106450; 106451; 106452; 106453; 106454; 106455; 106456; 106457; 106458; 106461; 106462, CSUC), 3 ♀♀ (106459; 106461; 106463, CSUC); Utah, Pahvant, [39.009 -112.369?], VII.1951, G. F. Knowlton, 1 ♂ (113235, USNM); Emery County: Temple Mountain, [38.596, -110.704], 31.VII.2000, FDP, 1 ♂ (122208, MEI), 2 ♀♀ (122202; 122203, MEI); 2.4 km NE Little Gilson Butte [38.607 -110.588], 1,539 m, 23.VII.1981, FDP, D. Veirs, Griswold, 1 ♂ (072218, EMUS); 30 km N Hanksville, Gilson Butte Well, [38.631, -110.567], 24.V.2000, Locust tree blossoms, FDP, 1 ♀ (122204, MEI); 25 km NNE Hanksville Gilson Butte Well [38.583 -110.583], 1,570 m, dunes, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 6 ♂♂ (133207; 133213; 133203; 133205; 133208; 133221, MEI), 7 ♀♀ (133232; 133231; 133233; 133234; 133239; 133240; 133241, MEI); 27 km NE Hanksville Little Flat Top [38.533 -110.483], 1,670 m, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 1 ♂ (133211, MEI), 1 ♀ (133224, MEI); 27.4 km N Hanksville [Wayne County] at "dunes" near Gilson Butte Well [38.619 -110.713], 26.VII.1978, Andrews, Hardy, 1 ♂ (072572, CDAE), 1 ♂ (072573, CDAE); 20 km NNE Hanksville, Gilson Butte, [38.583, -110.567], 16.VI.2000; FDP, 2 ♀♀ (122205; 122206, MEI); 29 km NE Hanksville 4 km E Little Flat [38.533 -110.45], 1,615 m, Quercus dunes, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 4 ♂♂ (133204; 133206; 133209; 133210, MEI), 2 ♀♀ (133223; 133229, MEI); 3.2 km E Little Gilson Butte [38.592 -110.574], 1,554 m, 5.VIII.1997, pan trap, FDP, 1 ♀ (119013, MEI); 3.2 km E Little Gilson Butte [38.592 -110.574], 1,554 m, 24. to 26.VIII.1981, D. Veirs, Griswold FDP, 2 ♂♂ (072211; 072212, EMUS), 7 ♀♀ (072203; 072204; 072208; 072213; 072222; 072223; 072227, EMUS); 30 km N Hanksville 7 km NW Gilson Butte [38.633 -110.633], 1,600 m, in dunes, 22. to 26.VIII.2001, malaise trap MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 8 ♂♂ (133202; 133212; 133215; 133216; 133217; 133218; 133219; 133220, MEI), 4 ♀♀ (133222; 133230; 133235; 133238, MEI); 30 km N Hanksville, 7 km NW Gilson Butte, [38.633, -110.633], 1,600 m, dunes, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 1 ♂ (133214, MEI); 30 km NE Hanksville 8 km E Little Flat Top [38.517 -110.433], 1,615 m, dry wash, 22. to 26.VIII.2001, malaise trap, MEI, FDP, C. Lambkin, M. Metz, M. Hauser, 4 ♀♀ (133226; 133227; 133236; 133237, MEI); 31 km N Hanksville, [38.624, -110.632], 24.V.2000, FDP, 1 ♂ (122207, MEI); 4.0 km NE Big Flat Top Dugout Spring [38.611 -110.364], 1,463 m, 28.VII.1983, F. Parker, A. Parker, T. Griswold, 3 ♂♂ (071136; 071137; 072190, EMUS); 40.3 km N Hanksville [Wayne County] at Goblin Valley Turn Off [38.557 -110.61], 16.IX.1979, FDP, 1 ♀ (072219, EMUS); 6.4 km N of Gilson Butte [38.639 -110.617], 1,554 m, 20. to 23.VII.1981, D. Veirs, FDP, Griswold, 2 ♂♂ (072207; 072210, EMUS); Little

Gilson Butte [38.592 –110.603], 29.VIII.1986, A. S. Menke, 1 ♀ (115631, USNM); N of Goblin Valley Wild Horse Creek [30.358 –110.422], 1,494 m, 21. to 23.VII.1981, D. Veirs, FDP, Griswold, 1 ♀ (072193, MEI); 3.VI.1982, FDP, T. Griswold, 1 ♀ (072209, EMUS); 27. to 28.V.1985, D. K. Broemeling, FDP, 1 ♀ (075312, EMUS); W of Goblin Valley Wild Horse Creek [30.358 –110.422], 1,463 m, 26. to 28.VII.1982, FDPs, Griswold, 1 ♂ (071133, EMUS); 1 ♀ (071134, EMUS); San Rafael Reef [30.394 –110.398], 1.VI.1967, G. F. Knowlton, 2 ♂♂ (072200; 072201, EMUS), 2 ♀♀ (072198; 072199, EMUS); Garfield County: Woodruff Spring, [37.864, –110.731], 20.II.2000, FDP, 1 ♂ (121192, MEI), 2 ♀♀ (121189; 121193, MEI); Escalante Desert Tenmile [Flat] [37.656 –111.463], VI.1936, V. M. Tanner, 1 ♂ (133769, BYUC); Shooting Canyon, 22.VI.1979, D. Vogt, 1 ♂ (071129, EMUS); Juab County: 40.3 km SE Callao 1.6 km E Sand Pass [39.617 –113.386], 1,433 m, sand dune, III. to IX.1986 pitfall trap Giuliani, 1 ♂ (072614, CDAE), 1 ♀ (072610, CDAE); Kane County: 14.5 km N Kanab [37.178 –112.526], 2.VI.1963, J. Wilcox, 2 ♀♀ (114655, MEI) (083505, UCDC); 16.1 km N. Kanab [37.192 –112.526], 31.V.1963, J. Wilcox, 1 ♂ (114697, MEI), 2 ♀♀ (114627; 114641; MEI); Bullfrog Basin [37.746 –110.84], 3.V.1976, D. N. Bennett, 1 ♂ (072206, EMUS); Early Weed Bench off Hole in the Rock Road [37.521 –111.191], 1,608 m, 3.V.2000, K. T. Huntzinger, W. N. Mendel, CRN, 1 ♀ (133840, BYUC); Fortymile Ridge off Hole in the Rock Road to Stevens Arch Overlook [37.404 –111.988], 31.V.2000, K. T. Huntzinger, W. N. Mendel, CRN, TX Folks, 1 ♀ (133837, BYUC); off Hole in the Rock Road Dry Fork Canyon Narrows [37.258 –110.928], 15.VII.2000, L. E. Harding, C. Viana, 1 ♀ (133844, BYUC); trail to Mollies Nipple [submit] off Kitchen Corral Road, [37.279 –112.085], 5.VI.2000, H. A. Barber, E. C. Green, K. T. Huntzinger, W. N. Mendel, CRN, 1 ♂ (133841, BYUC); 8.VI.2000, E. C. Green, K. T. Huntzinger, W. N. Mendel, 1 ♀ (133842, BYUC); Millard County: Delta [39.352 –112.576], 27.VI.1945, G. F. Knowlton, 1 ♂ (119014, UMSP); Leamington [39.535 –112.283], 1,444 m, 24.VI.1933, G. F. Knowlton, 1 ♀ (114443, AMNH); Lynndyl [39.519 –112.376], 1,458 m, 1.VIII.1918, G. E. King, 2 ♀♀ (113815; 113816, USNM); 2.VIII.1918, G. E. King, 1 ♂ (113238, USNM); 21.VI.1963, G. E. Bohart, 1 ♀ (114019, MEI); Oak City [39.375 –112.335], 24.VI.1949, G. E. Bohart, 2 ♂♂ (070782, EMUS) (113226, USNM), G. F. Knowlton, 1 ♀ (113227, USNM) San Juan County: Mexican Hat [37.152 –109.866], 1,294 m, 28.VI.1974, L. Draper, O. Francke, MAC, 1 ♂ (114265, ASUT), 1 ♀ (114110, MEI); Tooele County: Dugway Valley [40.227 –112.749], 14.VIII.1953, H. J. Egoscue, 1 ♀ (114375, EMUS); Utah County: Spanish Fork [40.115 –111.654], D. E. Hardy, 1 ♀ (070781, EMUS); Washington County: 6.V.1967, D. R. Harris, 1 ♂ (133749, BYUC); New Harmony [37.479 –113.309], 23.V.1959, J. Wilcox, 1 ♂ (114730, OSUO); Paradise Canyon [37.133 –113.567], 24. to 28.V.1983, malaise trap, D. Beck, 1 ♂ (072225, EMUS), 2 ♀♀ (071124; 075310, EMUS); Virgin River [37.117 –113.417], 21.V.1963, at

light, D. W. Davis, 1 ♀ (072226, EMUS); Wayne County: Capitol Reef [38.316 –111.236], 1.VI.1967, G. F. Knowlton, 1 ♀ (072202, EMUS) 1 ♀ (072197, EMUS); 4.3 km SE Hanksville, [38.341, –110.691], 1,393 m, 9.V.2000, *Wyethia*/ Purple Sage dom., J. D. Pinto, 1 ♂ (UCRC 42763, UCRC).

Ammonaios mexicanus n. sp.

(Figs. 4, 8, 12, 17, 18, 24, 28, 32, 47, 55)

Derivation of Name. This specimen is named after the location in which it is found, Mexico.

Diagnosis. White to pale brown species with shining black semicircular area around the tentorial pit. Similar to *confusus*, but wings are stronger maculated and the costal cell is transparent.

Description of Male Holotype (109196). Body length 8.5 mm, wing length 6.5 (5.8–7.3) mm.

Head. Ocellar tubercle black with golden pubescent; setae brown. Eyes reddish brown, upper frontal ommatidia larger than lower and marginal ones. Frons cuticular color yellowish brown with silver pubescence; frons only with a few filiform setae. Parafacial with erect, white, filiform setae. Gena slightly protruding, setae dark brown. Face covered with silver white pubescence. Semicircular area around tentorial pit shiny black. Antenna (Fig. 8) pale brown, scape and pedicel silver pubescent. Scape three times longer than wide, ventrally with long white setae, mostly lanceolate (sometimes with a brown macrosetae ventrally). Pedicel nearly square, filiform setae white; dorsally with brown macrosetae. First flagellomere round, with basal constriction; macrosetae brown. Flagellar style black. Maxillary palp brown with long white and some brown setae.

Thorax. Chaetotaxy: np 3, sa 1 (2), pa 1, dc 1 (2), sc 2. Macrosetae pale yellow. Mesonotal cuticle black. Postpronotum, scutellum, postalar, and supra-alar area pale brown. Mesonotum and scutellum silver pubescent; setae white, semiappressed lanceolate, intermixed with filiform-erected yellowish setae. Pleural cuticle pale brown. Ventral part of katapisternum and meron dark brown. Pleura dense silver-golden pubescent. Posterior anepisternum, upper katapisternum, katatergum, and metanepisternum with long white filiform setae.

Wing (Fig. 47). Membrane translucent whitish gray, brown maculated, especially in apical part; veins yellowish brown, some dark brown with brownish margins; pterostigma dark brown; cell m_3 closed, petiolate; costal setae dark brown to black. Halter pale yellowish brown.

Legs. Coxa pale brown; silver pubescent; filiform setae long, white. Forecoxa with 3, midcoxa with 2, hindcoxa with 1 pale brown macroseta. Forefemur pale brown. Femur with two kinds of setae: white, appressed, lanceolate, and white, erect, fine filiform setae. Forefemur with 3 av macrosetae, midfemur with 3 (4) av, and hindfemur with 7 (10) av. Tibia pale brown. Tarsus brown, tarsal segments becoming slightly darker toward tip. All macrosetae on the legs, except coxa brown.

Abdomen. Cuticle of abdomen pale brown, silver pubescent; filiform setae dense, long, white.

Terminalia. Epandrium quadrate (Fig. 24); hypoproct slightly curved ventrally; posterior margin V-shaped, emarginate. Inner gonocoxal process rectangular with rounded tip, nearly four times longer than wide; subapical tooth like projection on inner margin directed apically (Fig. 12). Gonostylus long; posterolateral apex with a small, distinct hook-shaped projection. Aedeagus with dorsal apodeme broad; ventral apodeme shorter (Figs. 17 and 18). Distiphallus simple, elongate.

Female Paratype (109264). Similar to male, except as follows. Body length 8.5 mm, wing length 6.5 mm.

Head. Frons greater than one width of eye; upper frons dark brown, lower frons pale brown; pubescence golden yellow.

Abdomen. Segments I to IV with appressed setae, which are flattened, especially on tergite IV. Tergite III with some erect, brown setae near margin; tergites IV-VIII completely covered with erect, brown setae. Segments I-VII white pubescent; segment VIII shiny.

Terminalia. Furca blunt posteriorly (Fig. 32). Bases of spermathecal ducts originate from common duct less than one furcal length distal of gonopore. Sternite VIII twice as long as broad with anterior margin curved (Fig. 28). Acanthoporphorites (T IX & X) with eight brown, blunt-tipped A_1 setae and five elongate A_2 setae, which are nearly twice as long as A_1 setae.

Immature Stages. Immature stages are not known.

Biology. Three of the four known specimens were collected at black light.

Flight Period. Only collected in September and October.

Distribution. This species is only found in Baja California, Mexico (Fig. 55).

Specimens Examined. Four specimens were examined

HOLOTYPE (δ). (Type specimen number: SDNHM 0116) MEXICO: Baja California Norte: 8.1 km N San Felipe [31.103, -114.85], 14.X.1983, black light (UV), F. Andrews, D. Faulkner (109196, SDMC).

PARATYPES. MEXICO: Baja California Sur: 20.6 km SSE Santa Rosalia [27.169, -112.199], 23.IX.1981, hand netted, D. Faulkner, F. Andrews, 1 δ (109188, SDMC); Baja California Norte: 8.1 km N San Felipe, [31.103, -114.85], 14.X.1983, black light (UV), F. Andrews, D. Faulkner, 1 δ (109287, MEI), 1 f (109264, SDMC).

Ammonaios niveus (Kröber)

(Figs. 5, 9, 13, 19, 20, 25, 29, 33, 38, 41, 48, 53, 56)

T. nivea Kröber, 1914. Type locality: Melissa Valley, NM. Holotype: Male in USNM (examined).

A. niveus (Kröber): Irwin and Lyneborg (1981a) (new comb., illust., distrib., key to genus).

Diagnosis. Wings without pterostigma, slightly brownish infuscated; female abdomen with lanceolate setae up to segment VI. Long fine filiform setae extending out of tentorial pit (Fig. 53).

Redescription of Male Holotype (114075). Body length 7.5 (7-9.5) mm, wing length 6 (5.5-7.5) mm.

Head. Ocellar tubercle black, silver pubescent; setae pale yellowish-brown. Eyes reddish brown, upper frontal ommatidia larger than lower and marginal ones. Frons cuticular color brown, silver pubescent; setae long, white, some lanceolate. Parafacial setae erect, white, filiform. Genal setae reddish brown. Face completely covered with dense silver white pubescence. Tentorial pit with long white filiform setae protruding from it. Antenna (Fig. 9) pale brown; scape and pedicel silver pubescent. Scape three times longer than wide, with long, white, lanceolate setae (sometimes with one brown dorsal macrosetae). Pedicel quadrate; setae short, thin, white; dorsal macrosetae brown. First flagellomere basally constricted; macrosetae brown mainly on inner dorsal surface. Flagellar style black. Maxillary palp pale yellow brown, setae long, white, becoming brown at base of palp.

Thorax. Chaetotaxy: np 3, sa 2, pa 1, dc 2, sc 2. Macrosetae pale yellow. Mesonotal cuticle black. Mesonotum and scutellum silver pubescent; setae white, semiappressed lanceolate, intermixed with light yellowish, erected, filiform setae. Pleural cuticle brown (in some specimens completely black). Pleura silver pubescent. Posterior anepisternum, upper katepisternum, katatergum, and metanepisternum with long, white, filiform setae.

Wing (Fig. 48). Membrane translucent yellowish brown; veins light brown; pterostigma indistinct; cell m_3 closed, petiolate; costal setae light brown. Halter knob pale yellowish, stalk pale brown.

Legs. Coxa yellowish brown (occasionally black), silver pubescent, setae filiform, long, white. Fore- and midcoxa with 2, hindcoxa with 1 pale yellow macrosetae (rarely macrosetae are dark brown). Femur pale yellowish brown (sometimes dark brown), with both; white, appressed, lanceolate, and yellow (sometimes brown to dark brown), erect, fine filiform setae. Fore-femur missing (2-3 av), midfemur with 3 (3-5) av and hindfemur with 5 (5-9) av. Tibia pale yellowish brown (occasionally dark brown). Tarsi light brown (rarely dark, but always the proximal third of the first tarsal segment yellowish brown). All macrosetae on legs (except coxa) brown.

Abdomen. Cuticle of abdomen pale yellow brown, silver pubescent; setae filiform, dense, long, white.

Terminalia. Epandrium quadrate (Fig. 25); hypoproct curved slightly ventrally; posterior margin broad U-shaped emarginate (width of emargination three times width of cercus). Inner gonocoxal process rectangular (Fig. 13), broader at tip, ≈ 3 times longer than wide; inner gonocoxal margin with 3 (up to 9) short thick dark macrosetae, numerous smaller macrosetae apically. Gonostylus broaden basely, with short conspicuous macrosetae. Aedeagus with broad dorsal apodeme, longer than ventral apodeme (Fig. 20). Distiphallus short, strongly bent ventrally. Ejaculatory apodeme with subapical posterodorsal ring.

Variation. This species varies in the coloration of the legs and the amount of the lanceolate setae on head and thorax.

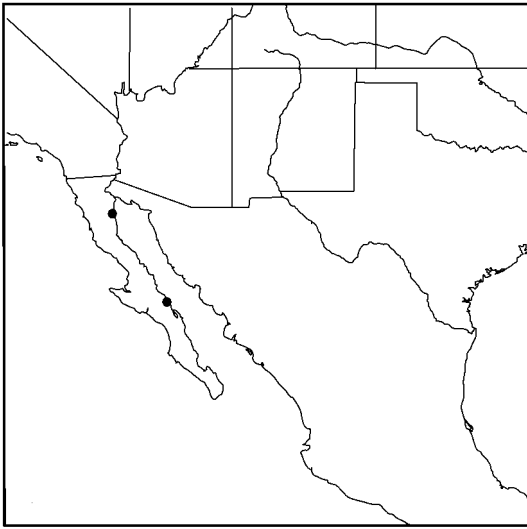


Fig. 55. Distribution map of *A. mexicanus* n. sp.

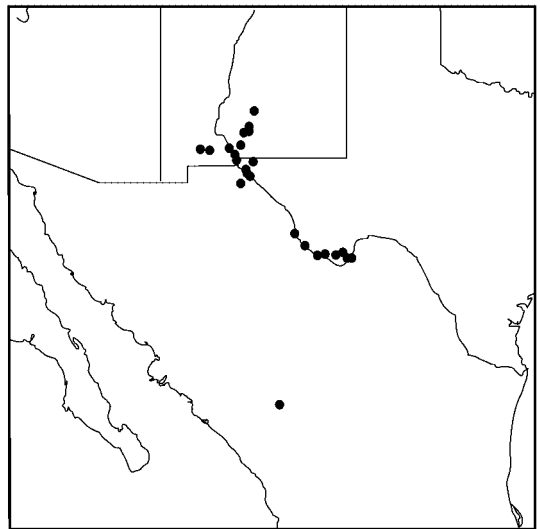


Fig. 56. Distribution map of *A. niveus* (Kröber).

Female (113920). Body length 8 (8–9.3) mm, wing length 6.3 (6–7) mm. Similar to male, except as follows:

Head. Eyes widely separated; inner eye margin parallel from gena to height of antennal insertion, convergent above antennal insertion toward ocellar tubercle. Frons twice width of one eye; silver pubescent, setae lanceolate.

Abdomen. Segments I–VI with appressed white setae; setae filiform on tergite I, lanceolate on segments II–VI. Tergite III with some erect, filiform setae near posterolateral margin; tergites IV–VIII completely covered with erect, filiform setae. These setae white on tergites III–VII, brown on tergite VIII. Segments I–VII white pubescent; segment VIII shiny.

Terminalia. Furca quadrate, rounded posteriorly (Fig. 33). Common spermathecal duct less than one furcal length distal of gonopore. Sternite VIII nearly quadrate (Fig. 29). Acanthophorites (T IX & X) with eight brown, blunt-tipped A_1 setae and four elongate A_2 setae. A_2 are nearly twice as long as A_1 setae.

Variation. The amount of lanceolate setae on frons differs as well as extent of dark coloration on legs.

Immature Stages. Pupal exuviae as in *A. confusus* n. sp., except as follows: Male pupa with two more filiform spines ventrally on segment VIII (Fig. 41); thoracic spiracle without curved extension apically (Fig. 38), pointed in profile.

Flight Period. This species was collected between the beginning of March and mid-August.

Distribution. Most localities are in the proximity of the Rio Grande, except one specimen (114143) from western Mexico (Fig. 56).

Specimens Examined. Thirty-six specimens were examined.

HOLOTYPE (δ). USA: New Mexico: Dona Ana County: Mesilla Valley: [32.279, –106.823], On *Aterflex* foliage, 19.V., coll. Townsend (114075, USNM).

Specimens Examined. MEXICO: Chihuahua: 4.8 km S Samalayuca [31.29, –106.474], 10.VII.1964, JAP, 1 ♀ (113920, MEI); Samalayuca [31.333, –106.474], 24.VI.1947, D. Rockefeller, 1 ♂ (114329, AMNH); Coahuila, Boquillas del Carmen [29.166, –102.915], 564 m, 23.V.1959, Howden, Becker, 1 ♂ (114363, CNCI); Durango, Rodeo [25.133, –104.283], 22.VII.1982, 1 ♂ (114143, SDMC).

USA: New Mexico: Dona Ana County: 1 km N Texas state line, east side of I-10 [32.011, –106.584], 1,219 m, dunes, 18.VIII.1983, G. S. Forbes, 1 ♀ (051259, NMSU); Las Cruces [32.312, –106.778], 15.V.1966, A. E. Michelbacher, 1 ♂ (113940, MEI); 30.V.1952, MAC, W. Gertsch, R. Schrammel, 1 ♂ (114682, AMNH); Mesilla Dam, Rio Grande [32.228, –106.798], 1,189 m, 29.VII.1982, G. S. Forbes, 1 ♂ (119009, NMSU); Mesquite, 4.7 km N Mesquite exit, E side I-10 [32.164, –106.696], 28.VIII.1982, G. S. Forbes, 1 ♀ (119011, NMSU); White Sands [32.381, –106.479], 26.V.1984, sifted, MEI, 1 ♂ (114130, MEI), 1 ♀ (114169, MEI); 30.VI.1932, R. H. Beamer, 1 ♂ (087978, SEMC); Luna County: 33.8 km E. Deming [32.269, –107.454], 28.V.1963, J. C. Bequaert, 1 ♂ (113955, UAIC); Deming [32.268, –107.759], 30.V.1952, MAC, W. Gertsch, R. Schrammel, 1 ♂ (119421, AMNH); Otero County: Three Rivers, Highway 54 [33.321, –106.074], 1,392 m, 17.VI.1992, B. Kondratieff, Baumann, 1 ♂ (075508, CSUC); White Sands National Monument [32.75, –106.183], 8.VIII.1931, R. H. Painter, 1 ♂ (113953, KSUC); White Sands National Monument [32.893, –106.216], 26.VIII.1951, E. L. Kessel, 1 ♂ (131820, CASC); White Sands National Monument, 20.9 km SW Alamogordo [32.767, –106.333], 7.IV.1990, sifted, DWW, MEI, 2 ♀♀ (114023, MEI) (114025, INHS).

Texas: Brewster County: Big Bend N.P., Boquillas area, 549 m, 8.V.1959, J. F. McAlpine, 1 ♂ (147692, CNCI); Big Bend National Park, Boquillas Canyon

Trail [29.211, -102.886], 11. to 12.III.1990, J. Welch, B. Kondratieff, 1 ♂, (075509, CSUC); lower Tornillo Creek [29.174, -102.994], 18.IV.1966, E. R. Jaycox, 1 ♂ (113942, MEI); Big Bend N.P., Panther Junction [29.328, -103.205], 1,200 m, 16.V. 1959, W.R.M. Mason, 1 ♂ (147679, CNCI), 1 ♀ (147676, CNCI); Big Bend N.P., Oak Spring [29.282, -103.336], 1,370 m, 1.V.1959, J. F. McAlpine, 1 ♂ (147687, CNCI); Lajitas [29.261, -103.776], 19.V.1959, Howden & Becker, 1 ♀ (147688, CNCI); El Paso County: Clint [31.592, -106.224], 16.VIII.1976, W. F. Chamberlain, 1 ♂ (076509, TAMU); Fabens [31.499, -106.155], 9.VII.1917, 1 ♂ (081090, MCZC); Hueco Tanks [31.92, -106.038], 15.V.1971, at light, Murray, Gaumer, 3 ♂♂ (076506, INHS) (076507, TAMU) (076508, TAMU); Ysleta [31.698, -106.324], 18.IV.1961, Rozen, R. Schrammel, 1 ♀ (114390, AMNH); Presidio County: 20.1 km W Lajitas [29.261, -103.957], 714 m, 30.V.1973, Gaumer, Clark, 1 ♂ (076512, TAMU); Presidio [29.56, -104.374], 28.VII.1929, E. R. Tinkham, 1 ♂ (114250, UMSP).

Ammonaios sabulosus n. sp.

(Figs. 6, 10, 14, 21, 22, 26, 30, 34, 39, 42, 45, 49, 57)

Derivation of Name. Sabulosus (Lat.) = sandy. This species seems to be restricted to shifting inland sand dunes.

Diagnosis. Sandy brown (females) to white (males) species with shining black circular area around the tentorial pit. Both sexes have relatively large, swollen heads and a cylindrical first flagellomere with white macrosetae (Fig. 10). The wings are clear and the pterostigma is not darkened (Fig. 49).

Description of Male Holotype (114063). Body length 8 (6.7–9.5) mm, wing length: 5.9 (5.4–7.2) mm.

Head. Ocellar tubercle black, silver pubescent; setae pale yellow. Eyes reddish brown; upper frontal ommatidia larger than lower and marginal ones. Frons cuticular color brown, silver pubescent; setae dense appressed and flattened. Parafacial setae semi-appressed, short, white, filiform. Genal setae white. Face covered with dense, silver white pubescence. Circular area around tentorial pit shiny black. Antenna (Fig. 10) pale brown, scape and pedicel silver pubescent. Scape two times as long as wide; setae long, white, slightly flattened. Pedicel nearly quadrate, setae filiform, white. First flagellomere cylindrical with very weak basal constriction; macrosetae white. Flagellar style black. Maxillary palp pale yellow brown with long white setae.

Thorax. Chaetotaxy: np 4, sa 1, pa 1, dc 2, sc 2. Macrosetae pale yellow. Mesonotal cuticle black. Postpronotum, scutellum, postalar, and supra-alar area pale brown. Mesonotum and scutellum silver pubescent; pale, densely covered with appressed, flattened, yellow white setae and intermixed with filiform, erected setae. Pleural cuticle pale brown. Anepisternum, ventral part of katepisternum and meron black. Pleural area dense silver pubescent. Posterior anepisternum, upper katepisternum, katatergum, and metanepisternum with long white filiform setae.

Wing (Fig. 49). Membrane translucent whitish gray; veins light brown; pterostigma indistinct; cell m_3 closed, petiolate; costal setae pale yellow. Halter knob pale brown, stalk pale yellowish brown.

Legs. Coxa yellowish brown, silver pubescent; filiform setae long, white. Light yellow macrosetae on coxa difficult to discern: forecoxa with 2, midcoxa with 1, hindcoxa with no setae. Forefemur yellowish brown. Femur with both, white, appressed, lanceolate, and white, erect, fine filiform setae. Anteroventral macrosetae (av) translucent white and difficult to discern: forefemur with 2 av, midfemur with 2 av, and hindfemur with 4 av. Tibia light yellow brown; small apical portion darker. Tarsi dark brown, with first and most of second tarsal segments pale brown. All macrosetae on the legs translucent white.

Abdomen. Cuticle pale brown, silver pubescent; filiform setae dense, appressed, white.

Terminalia. Most of the terminalia description is based on paratypes, because the holotype was not dissected. Epandrium rectangular, concave along posterior and anterior margins (Fig. 26); posterior margin of hypoproct U-shaped, emarginate (width of emargination equal to width of cercus). Inner gonocoxal process rectangular (Fig. 14), three times longer than wide, with subapical tooth-like projection on inner margin. Gonostylus long, posterolateral apex with a small, distinct, hook-shaped projection. Aedeagus with dorsal apodeme broad; ventral apodeme nearly the same length as dorsal apodeme. Distiphallus simple, bent ventrally (Figs. 21 and 22).

Female Paratype (114741). Body length 7.7 (7–12) mm, wing length 7.5 (7–8.3) mm. Similar to male, except as follows:

Head. Eyes reddish brown. Frons slightly greater than width of one eye; completely pale brown; densely covered with appressed flattened setae; pubescence golden yellow.

Wing. Veins brown, darker than in males.

Legs. Mid- and hindtarsi with long, pale yellow macrosetae (Fig. 45).

Abdomen. Segments I–IV with white, flattened, appressed setae. All tergites covered with erect, white, filiform setae. Sternites II–VIII with erect white filiform setae. Segments I–VIII white pubescent.

Terminalia. Furca blunt posteriorly (Fig. 34). Bases of spermathecal ducts originate from common duct less than one furcal length distal of gonopore. Sternite VIII nearly two times as wide as long (Fig. 30). Acanthophorites (T IX and X) with 12 brown, blunt-tipped A_1 setae and 3 elongate A_2 setae. A_2 setae only one-third longer than A_1 setae.

Immature Stages. Pupal exuviae as in *A. confusus* n. sp., except the following differences: spines on abdomen in general longer, more numerous, and more erect. Male pupa with multiple broad, long, blunt spines ventrally on segment VIII (Fig. 42). Thoracic spiracle with long, pointed extension (Fig. 39).

Biology. This species seems well adapted to sand dunes: the pale sandy brown color provides the species good camouflage. The long macrosetae on the hindlegs are found also in the genus *Orthactia* Kröber,

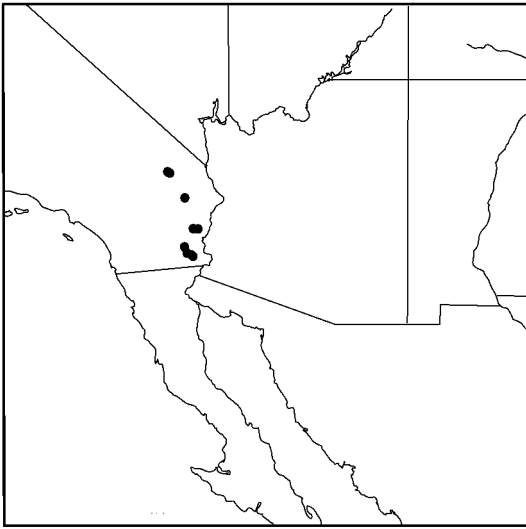


Fig. 57. Distribution map of *A. sabulosus* n. sp.

and are used for digging in loose sand (Lyneborg 1988). The species is restricted to a few sand dune systems in Southern California.

Flight Period. This species has an early flight period, from the beginning of March to the end of April.

Distribution. Only in South California in Imperial County, Riverside County, and San Bernardino County (Fig. 57).

Specimens Examined. Seventy-nine specimens were examined.

HOLOTYPE (δ). USA: CA: Imperial County: 27.4 km NW Glamis, [33.172, -115.245], 31.III.1978, J. A. Powell, (114063, EMEC).

PARATYPES. USA: CA: Imperial County: S Ruthven, Algodones Dunes, [32.925, -114.993], 28.IV.2001, Hawks, DYA, 1 ♀ (UCRC 51025, UCRC); 1.6 km W Glamis [32.997, -115.088], 2.III.1968, MEI, 2 ♂♂ (114255; 114259, MEI); sand dunes, 30.III.1977, sieved, JAP, 1 ♂ (114777, EMEC), 4 ♀♀ (114755; 114763; 114766; 114787, EMEC); 105 m, sand dune, 19.IV.1964, MEI, 9 ♂♂ (114252, OSUO) (114041; 114177; 114231; 114243; 114258; 114303; 114427, MEI) (114386, CSUC), 2 ♀♀ (114244; 114459, MEI); 100 m, sifting dune sand, 28.I.1965, sieved, MEI, FDP, D. R. Miller, 10 ♂♂ (114740; 114789, MEI) (114768, ZMUC) (114781, UCRC) (114790, USNM) (114792, LACM) (114793, UCMC) (114797, CICESE) (114802; 114383, INHS), 8 ♀♀ (114745, ZMUC) (114749, USNM) (114753, CASC) (114771, LACM) (114776, UCMC) (114780, CICESE) (114782; 114791, INHS); 4.8 km NW Glamis [33.028, -115.102], 9.IV.1972, A. R. Hardy, 2 ♂♂ (UCRC 64603; UCRC 64602, UCRC), 1 ♀ (UCRC 64605, UCRC); 14. to 15.IV.1972, A. Tabet, 1 ♀ (114362, MEI); 24.III.1972, W. D. Sumlin, 10 ♂♂ (028330, SMNS) (028331; 114270; 114273; 114280; 114306; MEI) (114322, BMNH) (114312, ANIC) (114344; NMSU) (114347, SDMC), 2 ♀♀ (028332, NMSU) (028333, SDMC); 10 km W Glamis [32.998, -115.161], Sand dune, 2.III.1968, sieved, MEI, P. A.

Rauch, 1 ♀ (114277, MEI); 12.9 km N Glamis [33.053, -115.191], 100 m, Larva collected in inland dunes, 20.II.1965, sieved, E. I. Schlinger, MEI, 1 ♂ (114760, MEI); Algodones Dunes, 11.2 km SE Glamis [32.922, -114.987], 9.-24.IV.1979, 1 ♀ (146370, CDAE); 22.5 km NW Glamis [33.141, -115.214], 31.III.1978, J. Dietz, JAP, 1 ♂ (114233, EMEC); Riverside County, 29 km W Blythe [33.61, -114.856], 120 m, Larva collected in inland dunes, 29.I.1965, sieved, MEI, FDP, D. R. Miller, 1 ♂ (114765, MEI); Hopkins Well [33.612, -114.995], 29.IV.1952, P. A. Marsh, 1 ♀ (113934, MEI); San Bernardino County, Cadiz Dunes [34.348, -115.377], 25.IV.1978, Alan R. Hardy, F.G. Andrews, 1 ♀ (146372, CDAE); 15.IV.1988, F. Andrews, 1 ♀ (146371, CDAE); 16.1 air km SW Kelso, [34.91, -115.755], *Chilopsis linearis*, 24.IV.1977, G. Ulrich, 1 ♂ (114037, EMEC); Kelso Dunes [34.9, -115.702], 792 m, 17.IV.1977, T. Griswold, 1 ♂ (071132, EMUS), 1 ♀ (071131, EMUS); 16.1 air km SW Kelso, Kelso Dunes [34.911, -115.73], 949 m, 24.IV.1971, MEI, 1 ♀, (003450, BMNH); 17.IV.1986, E. Cordes, 2 ♂♂ (114743, MEI) (114779, WSUC), 2 ♀♀ (114163; 114220, EMEC); 16.IV.1974, E. Anderson, 1 ♂ (131722, CASC), 1 ♀ (131719, CASC); 24.IV.1977, M. E. Buegler, 2 ♂♂ (114148; 114174, EMEC); 23.IV.1977, J. T. Doyen, 1 ♂ (113988, EMEC); 23. to 24.IV.1977, JAP, 3 ♂♂ (114159; 114141; 114217, EMEC), 1 ♀ (114741, EMEC).

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Appendix 1. Acronyms of collections and institutes

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| AMNH | American Museum of Natural History, New York, USA. |
| ANIC | Australian National Insect Collection, Canberra, Australia. |
| ASUT | Frank M. Hasbrouck Insect Collection, Arizona State University, Tempe, Arizona, USA. |
| BMNH | The Natural History Museum, London, United Kingdom. |
| BYUC | Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, USA. |
| CAES | Connecticut Agriculture Experiment Station, New Haven, Connecticut, USA. |
| CASC | California Academy of Science, San Francisco, California, USA. |
| CDAE | California State Collection of Arthropods, Sacramento, California, USA. |
| CICESE | Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California Norte, Mexico. |
| CIDA | Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell, Idaho, USA. |
| CNCI | Canadian National Collection of Insects, Ottawa, Ontario, Canada. |
| CSUC | Gillette Arthropod Biodiversity Museum, Colorado State University, Fort Collins, Colorado, USA. |
| CUIC | Cornell University Insect Collection, Ithaca, New York, USA. |
| EMEC | Essig Museum of Entomology, University of California, Berkeley, California, USA. |
| EMUS | Entomological Museum of Utah State University, Logan, Utah, USA. |
| FSCA | Florida State Collection of Arthropods, Gainesville, Florida, USA. |
| IRCW | University of Wisconsin Insect Research Collection, Madison, Wisconsin, USA. |
| INHS | Illinois Natural History Survey, Champaign, Illinois, USA. |
| KSUC | Kansas State University Collection, Manhattan, Kansas, USA. |
| LACM | Los Angeles County Museum of Natural History, Los Angeles, California, USA. |
| MCZC | Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA. |
| MEI | Collection of M. E. Irwin. |
| MEUC | Museo Entomológico, Universidad de Chile, Santiago, Chile. |
| NMSU | New Mexico State University, Las Cruces, New Mexico, USA. |
| NVDA | Nevada State Department of Agriculture, Reno, Nevada, USA. |
| OSUO | Oregon State University, Department of Entomology, Corvallis, Oregon, USA. |
| PMNH | Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA. |
| SDMC | San Diego Natural History Museum, San Diego, California, USA. |
| SEMC | Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA. |
| SMNS | Staatliches Museum für Naturkunde, Stuttgart, Germany. |
| TAMU | Texas A&M University Insect Collection, Austin, Texas, USA. |
| TAUI | Tel Aviv University Insect Collection, Tel Aviv, Israel. |
| UAIC | University of Arizona Insect Collection, Tucson, Arizona, USA. |
| UCDC | Bohart Museum of Entomology, University of California, Davis, California, USA. |
| UCMC | University of Colorado Museum, Boulder, Colorado, USA. |
| UCRC | University of California, Entomological Collection, Riverside, California, USA. |
| UMSP | University of Minnesota Insect Collection, St. Paul, Minnesota, USA. |
| UNAM | Colección Nacional de Insectos, Universidad Nacional Autónoma de México, México, Distrito Federal, México. |
| UOIC | Museum of Natural History, University of Oregon, Eugene, Oregon, USA. |
| USNM | National Museum of Natural History, Washington, D.C., USA. |
| WFBM | W. F. Barr Entomological Museum, University of Idaho, Moscow, Idaho, USA. |
| WSUC | James Entomological Collection, Washington State University, Pullman, Washington, USA. |
| ZMUC | Zoologisk Museum of the University of Copenhagen, Copenhagen, Denmark. |
