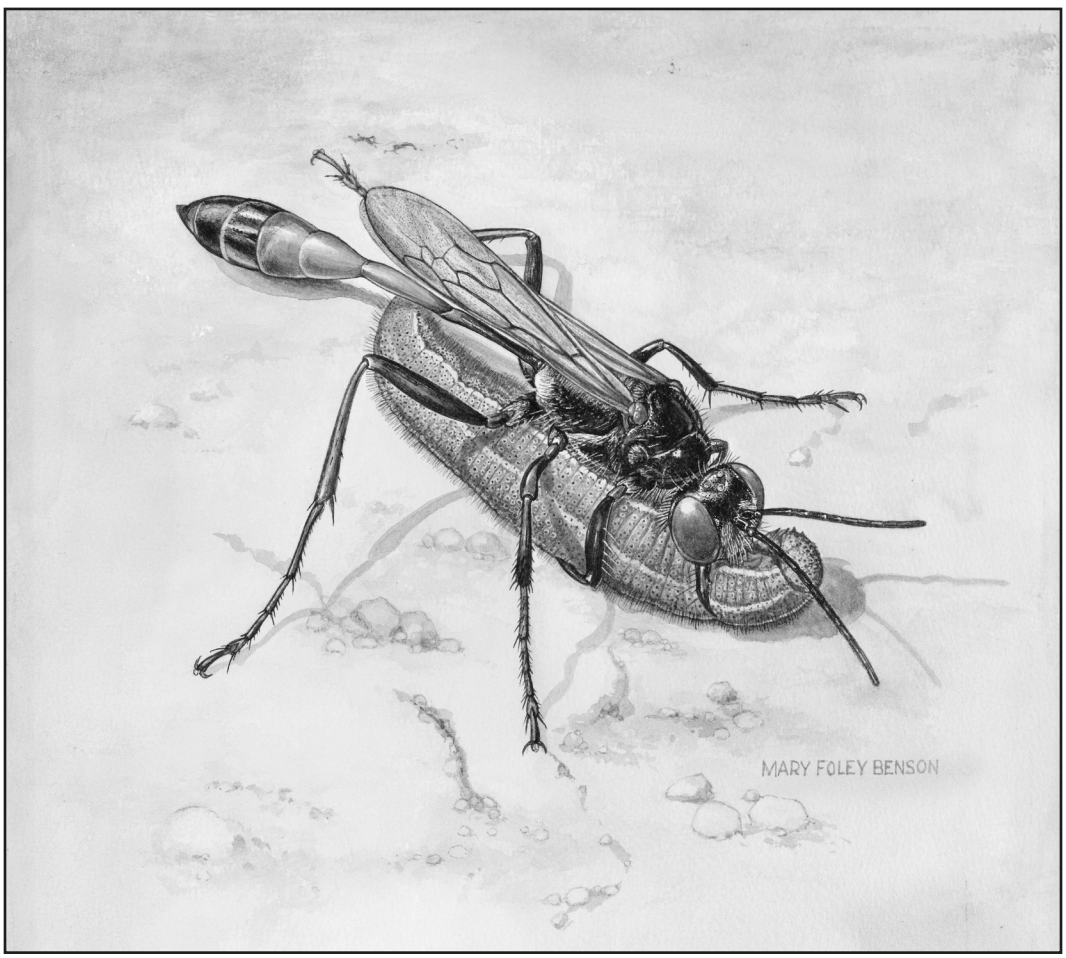
The *Ammophila* of North & Central America (Hymenoptera, Sphecidae)

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Dedication

I warmly dedicate this work on *Ammophila* to my late wife, Nancy Menke, aka "Wasp Woman." Nancy loved collecting these wasps. She and I had many wonderful collecting adventures together.



Sycamore Wash, Arizona, September 18, 2003, Arn Menke photo

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Abstract

The North and Central American species of *Ammophila* are described and a key provided for their identification. Sixty-nine species are recognized, of which 62 are known from North America. The other seven are known only from Mexico. Four new species are described, *hallelujah* from northeastern California, *linda* from southern California, *mexica* and *zapoteca* from south central Mexico. The following new synonymy is proposed: *Ammophila intercepta* Lepeletier de Saint-Fargeau, 1845 = *Ammophila nigricans* Dahlbom, 1843; *Ammophila shoshone* Menke, 1967, and *Ammophila silvestris* Kirkbride, 1982 = *Ammophila azteca* Cameron; *Ammophila alticola* Cameron, 1888, *Ammophila volcanica* Cameron, 1888, and *Ammophila chiriquensis* Cameron, 1888 = *Ammophila gracilis* Lepeletier de Saint-Fargeau, 1845. Lectotypes are designated for *Ammophila azteca* Cameron, *Ammophila micans* Cameron, 1888; *Ammophila urnaria* Dahlbom, 1843; and *Ammophila nearctica* Kohl, 1889. A neotype is established for *Ammophila aberti* Haldeman, 1852. In an appendix the species found in the White Mountains of California/Nevada are briefly discussed. The fauna of *Ammophila* at my home in Bisbee, Arizona is also covered. I also briefly discuss variation in *Ammophila rufpes* Guérin-Méneville, a Peruvian species.

Introduction & Acknowledgments

I first became interested in the genus *Ammophila* in 1957 when I was helping Richard M. Bohart in the laboratory of his Systematic Entomology class. He chose *Ammophila* as the group for the students to study that semester. I quickly became fascinated with these slender wasps. One student, Dick James, discovered a new species, an ant mimic, and that got me excited about studying the genus. I subsequently described the ant mimic as *formicoides* (Menke, 1964). It has only taken me about 60 years to complete this revision! When I first started my study of the genus, separating species seemed easy. But now, after many years of study of many thousands of specimens, it is obvious that there are a number of "gray areas", and resolution of these will need more study. Quite possibly DNA work may resolve some problems in species limits. I have outlined some of these problem areas under the genus below.

Richard M. Bohart was my advisor during the early stages of this work. In 1960, while on his type study tour of various European museums, Bohart took time to examine types of *Ammophila* species for me. His notes, and the homotypes he made, enabled me to properly identify various species. I owe a great deal of thanks to him for all his help and encouragement. For me it is sad that he did not live long enough to see my revision published. In 1964 I received a grant from Sigma Xi which paid for a trip to Europe that year. I was able to study type material of *Ammophila* at museums in Paris, Torino, Genoa and London.

I have had a lot of help from Wojciech Pulawski, of the California Academy of Sciences, San Francisco. He spent many hours running specimens through my identification keys, finding many problems that had to be resolved. He also used Photoshop to improve and clean up many of the photographs made by Erin Prado. His skill with Photoshop is amazing. Finally Woj has been a relentless task master on terminology. He has read through all of the descriptions several times. I cannot thank him enough for all his help*. The many fine color illustrations used here are the work of Erin Prado, using a Leica DFC550 with a Planapo 1.0X lens at the California Academy of Sciences. I am much indebted to her for the fine photography. She also cleaned up many of the images in Photoshop very skillfully. Ken Matesich reframbulated my morphology drawings in Photoshop and I thank him very much for this favor. My wife, Linda Rosenfield, has read over the entire MS. I very much appreciate her help with English and pointing out various inconsistancies.

The late Don Murray, who had published on *Ammophila* (as the genus *Sphex*) in the late 1930s, learned in 1967 that I was revising the genus. He graciously turned over to me all his notes, sketches, and unfinished manuscript, relinquishing his hope of completing his revision. I thank Jeremy Field, University of Exeter, Cornwall, England for the DNA studies he did for me.

Michael Irwin ran many Malaise traps in eastern Arizona in the spring that produced many *Ammophila*, including rare species such as *hurdi* and *mimica*. He has continued running traps in the Western United States. I very much appreciate his contribution. Frank Parker and Eric Grissell also provided *Ammophila* from Malaise traps that they ran. Eric and I have gone collecting together many times looking for *Ammophila*. For 6 or 7 years, I have run a malaise trap on my 4 acres at home in Bisbee. The results reveal that 20 species occur here which represents nearly a third of the North American fauna! Gary

---

* Woj and I were both born on November 22 and we both work on the same group of insects!

Lechner sent me many specimens of *Ammophila* that he collected in western Iowa, some of which were unusual.

For 25 years I have spent 4 or 5 days each year in the White Mountains of California collecting *Ammophila*. I used the University of California research station at Crooked Creek as my research base. This facility offers researchers a superb location with food and lodging provided. I want to thank Tim Forsell, the cook at Crooked Creek, for taking such good care of me. His extensive knowledge of the Whites greatly facilitated my research.

Lynn Kimsey provided me with a scan of Mary Benson's painting of *Ammophila azteca* Cameron carrying a caterpillar of *Colias eurytheme* Boisduval which is on the cover of this publication. I very much appreciate her generosity. Lynn often encouraged me to finish this revision! Robert Parks of Hereford, Arizona, gave me a beautiful photograph that he took of *Ammophila formicoides* (fig. 203, p. 114).

Lastly, I thank Bob Rigel for his assistance with the publishing program, InDesign, and getting my revision installed in it. His expertise in this program, as well as Photoshop, made the task of getting this manuscript to press much easier. I also thank Tony Thompson of Berkeley, California, for help in finalizing the maps and some of the photographs. The typefaces used in this revison are ITC Garamond Standard and Helvetica Neue LT Std.

Scope and Procedure

This revision includes all the North American and Central American species. Quite a few North American species also occur in Mexico. Some Mexican species occur as far south as Venezuela. I treated the species of Costa Rica (Menke, 1996). I also reviewed the West Indian species (Menke, 1970) so they are not treated here. Genaro (2006) recently reviewed the Cuban species. South America has many species, especially in the Andes, all in the *urnaria* group, except two Central American *nigricans* group species that occur in northern Venezuela and Colombia (*centralis*, *gaumeri*). I have treated some of the Andean species (Menke, 2004).

My species treatments are not uniform and for that I apologize. Some have complete descriptions, others only have information on identification and distribution. After 60 years I just want to get this revision to press! For ease in comparing species I have divided each description into three sections: color, vestiture, and structure. Vestiture patterns, especially bands of appressed silver mesosomal setae, are of considerable importance in species identification. Unfortunately in old, worn specimens, especially females, the setae are worn off making identification more difficult. Similarly details of the clypeus and mandibles of females are lost with age because nest excavation wears down these structures. Proportions used in descriptions must be considered guides only since there is considerable variation in some species. Leg color in stylopized females can vary from what is typical for the species. Some females can only be positively identified with associated males.

Sources of Material

Over the past 60 years I have examined a great many specimens of *Ammophila* from many museums. I have no idea of the total number but it has to be nearly a hundred thousand specimens. Listed below are most of the institutions that have lent me material. Acronyms for each one cited in the text are enclosed in parentheses. My personal

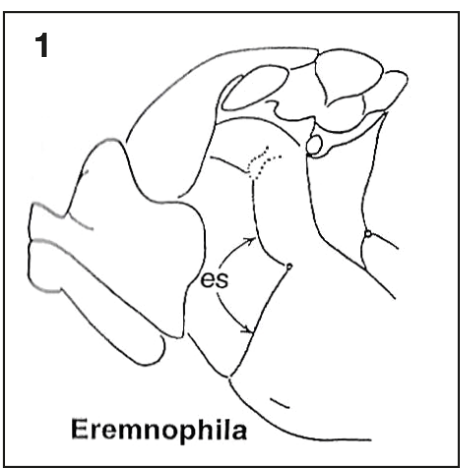
collection (ASM) will eventually be transferred to the Bohart Museum at the University of California, Davis, California.

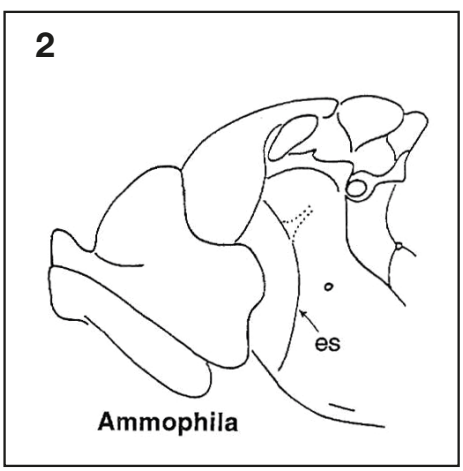
Academy of Natural Sciences, Philadelphia, USA (ANSP).
American Museum of Natural History, New York, New York (AMNH).
Arizona State University, Tempe, Arizona. USA (ASU).
Bee Biology and Systematics Laboratory, USDA, Utah State University, Logan, Utah (LOGAN).
Bohart Museum, University of California, Davis, California, USA (UCD).
California Academy of Sciences, San Francisco, California, USA (CAS).
California Insect Survey, University of California, Berkeley, California, USA (CIS).
California State Department of Agriculture, Sacramento, California.
Canadian National Collection, Ottawa, Canada (CNC).
Carnegie Museum, Pittsburgh, Pennsylvania, USA.
Chicago Natural History Museum, Chicago, Illinois, USA.
Cornell University, Ithaca, New York, USA (CUI).
Florida Department of Agriculture, Gainesville, Florida (FSDA).
Istituto e Museo di Zoologia, Università di Torino, Torino, Italy (TURIN).
Illinois Natural History Survey, Urbana, Illinois, USA (INHS).
Kansas State University, Manhattan, Kansas, USA (KSU).
Laval University, St. Foy, Quebec, Canada.
Los Angeles County Museum of Natural History, Los Angeles, California, USA (LACM).
Martin-Luther-Universität, Halle, Germany (HALLE).
Museo Civico de Storia Naturale, Genoa , Italy (GENOA).
Musée National d'Histoire Naturelle, Paris, France.
Museum für Naturkunde, Berlin, Germany.
Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA (MCZ).
Museum of Northern Arizona, Flagstaff, Arizona, USA.
Naturhistorisches Museum, Wien, Austria (VIENNA).
Nevada State Department of Agriculture, Reno, Nevada, USA.
Oregon State University, Corvallis, Oregon, USA (OSU).
San Diego Natural History Museum, San Diego, California, USA (SDNHM).
The Natural History Museum, London, England (BMNH).
United States National Museum, Washington D.C., USA (USNM).
University of Arizona, Tucson, Arizona, USA (UA).
University of California, Los Angeles, California, USA.
University of California, Riverside, California, USA (UCR).
University of Colorado, Boulder, Colorado, USA.
University of Idaho, Moscow, Idaho, USA (UI).
University of Kansas, Lawrence, Kansas, USA (UK).
University of Minnesota, St. Paul, Minnesota, USA (UM).
University of Nebraska, Lincoln, Nebraska, USA (UN)
Universitets Zoologiska Institution, Lund, Sweden (LUND).
Washington State University, Pullman, Washington, USA (WSU).

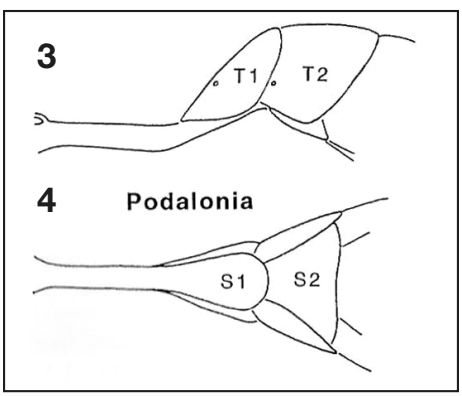
Key to Genera of New World Ammophilini

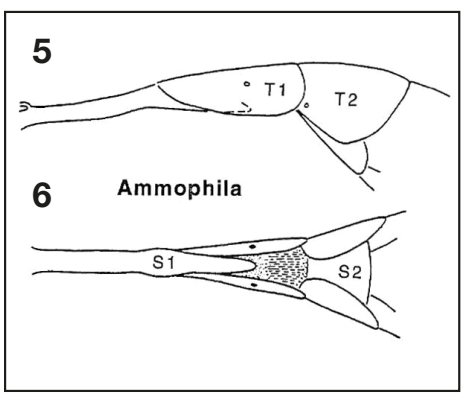
In the New World there are three genera of Ammophilini: *Ammophila* W. Kirby, *Podalonia*, Fernald. and *Eremnophila* Menke. *Podalonia* is unknown in South America. The species of *Podalonia* were treated by Murray (1940), and Menke (1964c) covered the species of *Eremnophila*. The Costa Rican *Eremnophila* and *Podalonia* were treated by Menke (1996). The key below is modified from Menke (1996):

1. Episternal sulcus curving posterad from subalar fossa to scrobe, then extending obliquely ventrad to anteroventral area of mesopleuron (fig. 1). . . . . ***Eremnophila*** Menke
– Episternal sulcus extending straight down from subalara fossa (fig. 2), sulcus sometimes short or even absent 2
2. Petiole apex (sternum I) meeting base of sternum II; spiracle of tergum I located before apex of sternum I in profile; sternum I usually bending up at its apex (figs. 3 & 4) . . . . . ***Podalonia*** Fernald
– Apex of sternum I separated from II, the space between them consisting of membrane and a ligament (fig. 6); spiracle of tergum I located at or beyond apex of sternum I; apex of sternum I usually straight or slightly bent downward apically (fig. 5) . . . . . ***Ammophila*** W. Kirby









Terminology

Mesosomal Terms: In *Ammophila* the mesosoma is very important for species characters. Terms specific to *Ammophila* have been treated in Menke (1964a, 1966b, and 1967). Terms I use in this paper that are new or which need identification are explained below. Figures of the mesosoma with structures labeled will aid in identifying them. See figures 7 and 8.

Episcrobal area: In my previous work I called this hypoepimeral area. Budrys (1990) coined this term (in Russian) and it is more appropriate and a bit shorter. See illustration of the thorax for identification. Menke (1964a) used the term "first rectangle" and Fernald (1934) used "rectangle" for this area.

Episternal sulcus: A mesopleural sulcus that extends vertically downward from the subalar fossa. This sulcus varies in length. It may end at about the level of the pronotal lobe, ie., short, or it may extend to the ventral area of the thorax in which case it is termed "long". I think a long sulcus is the plesiomorphic condition and a short sulcus is apomorphic. Prentice (1998) termed this the mesepisternal sulcus.

Lamelliform: Used in reference to the metapleural flange when the carina is expanded into a lamella.

Lower (and upper) metapleuron: I used the terms inferior (and superior) metapleural area for these structures. Lower and upper makes the terms shorter. These were also used by Prentice (1998, p. 449). Menke (1964a) used the term "second rectangle" for the upper metapleuron, and Fernald (1934) called it the "metapleural triangle".

Metapleural flange: This structure is below the base of the hindwing. Anteriorly is a round plate, the peritreme, that covers the metathoracic spiracle. In most *Ammophila* the flange is cariniform; but in some species the flange is expanded into a lamella. This lamella may be quite large and angular. The term was coined by Bohart and Menke (1976). The lamelliform condition is apomorphic.

Peritreme: A small round plate at the base of the metapleural flange that covers a spiracle.

Scutal fossa: A broad posterolateral depression of the scutum next to the tegula which is often covered with dense appressed silver setae. In the past I have used the terms scutal gutter or furrow.

Scutal welt: One of a pair of broad, longitudinal raised lines on the scutum in some species. The pair of welts are separated by the median scutal sulcus.

Streptaulus: This is a transverse line that separates the pronotal collar from the pronotal rim (Prentice 1998). Day (1988) used this term in Pompilidae. In my earlier publications I called this the transverse line.

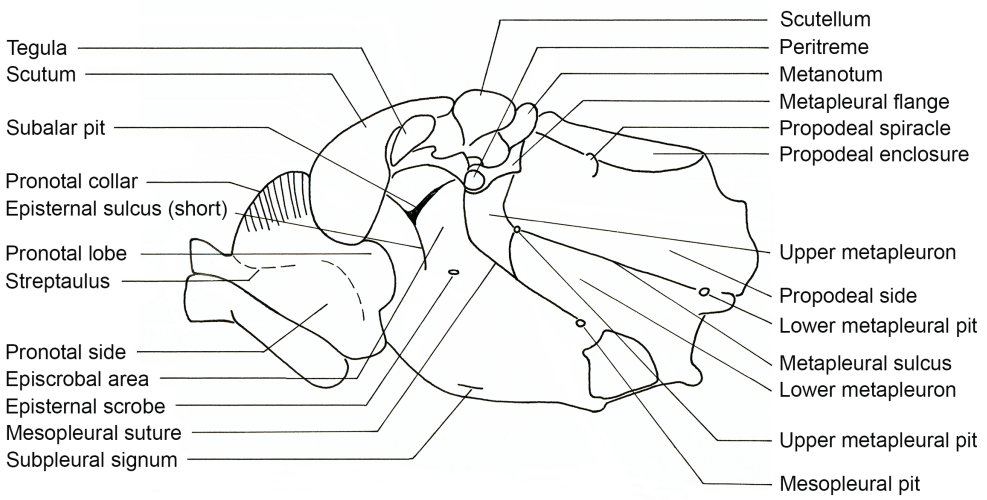
Thoracic pleura: This term refers to the meso- and metapleuron.

Other Terms:

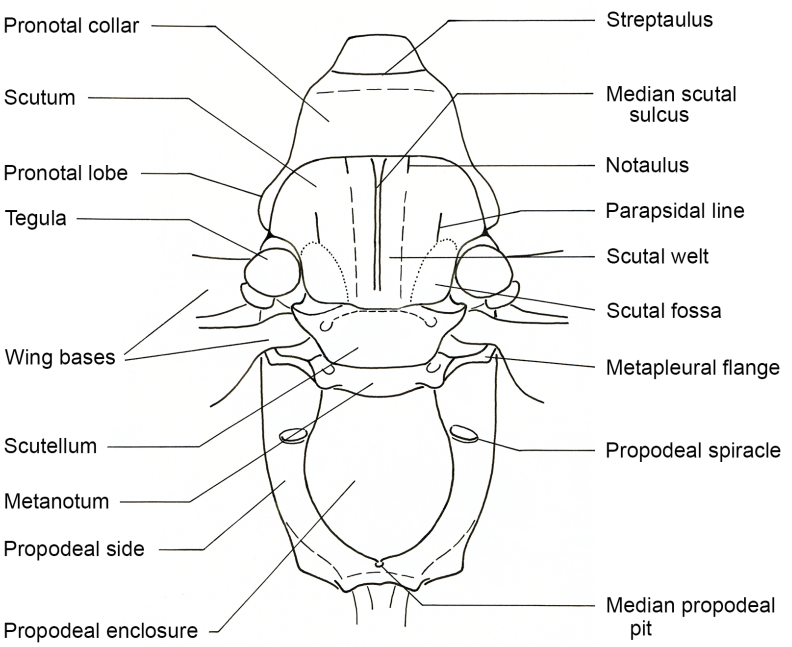
Clypeal lobe: The projecting part of the free margin between the clypeal teeth or angles. The width of the lobe is measured between the two teeth.

Galea/stipes: See figures 9 and 10.

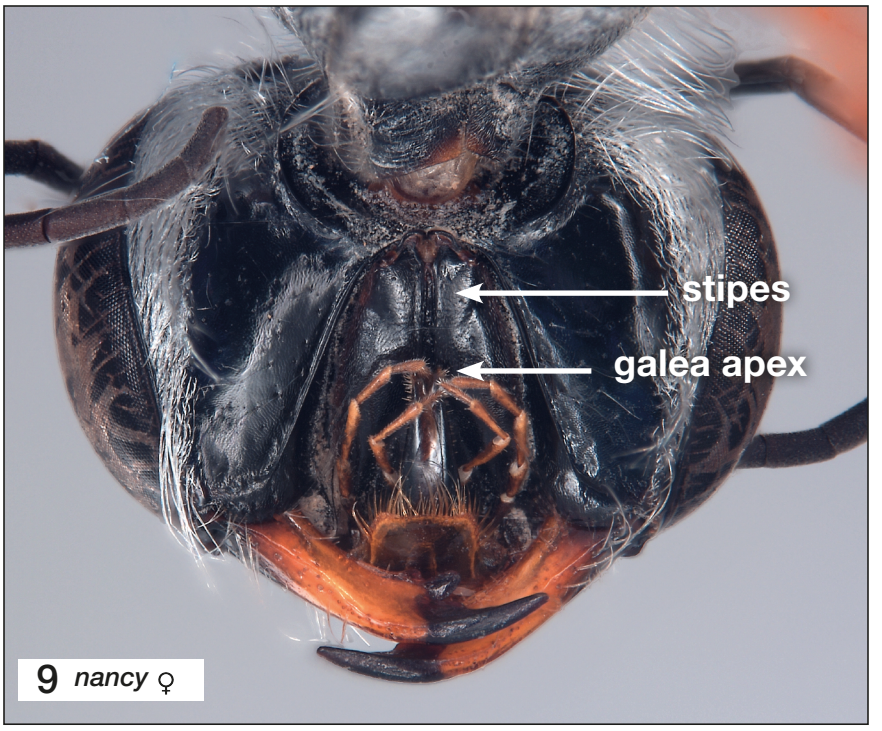
Gaster: The swollen terminal portion of the abdomen beyond the petiole (Nichols, 1989, Menke, 1964a). Bohart and Menke (1976:20) defined gaster as including the petiole. In *Ammophila* it is convenient to use gaster for the swollen part of the abdomen and not include the two-segmented petiole. Prentice (1998) and Michener (2007:42) use the term metasoma instead of gaster.



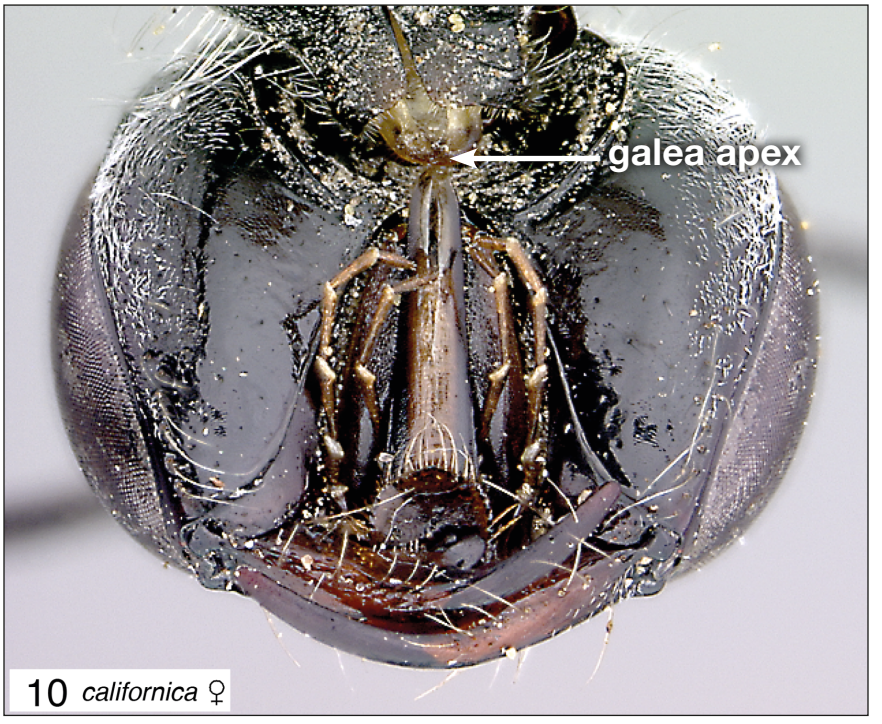
7. Left side of Mesosoma



8. Top of Mesosoma



9 *nancy* ♀



10 *californica* ♀

Gonocoxite: The paired, lateral-most part of the male genitalia (Prentice 1998). Bohart and Menke (1976) called this the gonostyle.

Greatest interocular distance (GID): Normally the distance between the eyes measured along a line tangential to the anterior ocellus.

Least interocular distance (LID): The shortest line that can be drawn between the compound eyes, usually at the lower part of the face but at the upper part in some females.

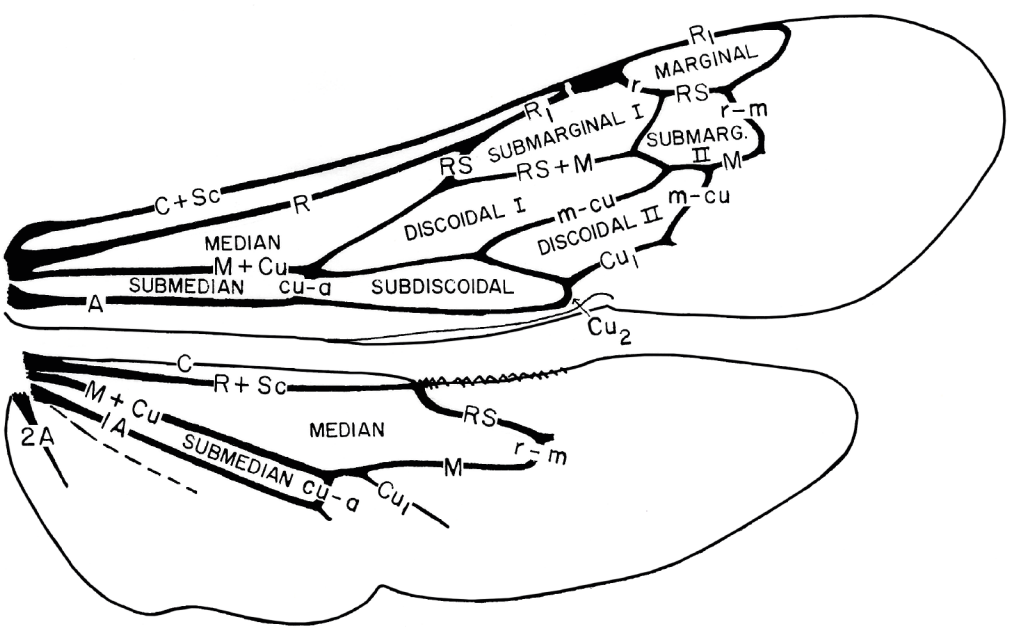
Mesally: This adverb means along the middle. I often use mesally when talking about the propodeal enclosure.

Puncture: Three grades of punctation are used in the descriptions:

a. sparse - more than two diameters apart.
b. moderate - one to two diameters apart.
c. dense - less than one diameter apart.

Petiole: The slender two-segmented basal part of the abdomen. True tergum I is the second segment of the petiole. See Menke (1964a) for original use of this term as well as gaster.

Vertex: The top of the head (Nichols, 1989).



11 Wing Terminology, *Ammophila nearctica*

Genus Ammophila W. Kirby

Ammophila W. Kirby, 1798. Transactions of the Linnean Society of London, 4:199. Type species: *Sphex sabulosa* Linnaeus, 1758. Designated by International Commission on Zoological Nomenclature, Opinion 180, 1946, Opinions and Declarations of the International Commission on Zoological Nomenclature. 2:569-585.

Ammophylus Latreille, 1802, Histoire naturelle, générale et particulière des Crustacés et des Insectes. 3:332. Lapsus or emendation of *Ammophila* W. Kirby, 1798.

Miscus Jurine, 1807. Nouvelle Méthode de classer les Hyménoptères et les Diptères. Hyménoptères, Tome Premier, p. 130. Type species: *Ammophila campestris* Latreille, 1809. Designated by Shuckard, 1837:79.

Ammophilus Latreille, 1829. Les Crustacés, les Arachnides et les Insectes. 5:322. Lapsus or emendation of *Ammophila* W. Kirby, 1798.

Coloptera Lepeletier de Saint-Fargeau, 1845. Histoire Naturelle des Insectes. Hyménoptères. 3:387. Type species: *Coloptera barbara* Lepeletier de Saint-Fargeau, 1845. Monotypic.

Argyrammophila Gussakovskij, 1928. Bulletin de l'Institute de Zoologie Appliquée et de Phytopathologie 4:7. Type species: *Ammophila induta* Kohl, 1901. Original designation. Proposed as a subgenus of "Ammohilla Kby".

Apycnemia Leclercq, 1961. Revista Española de Entomologia 37:211. Type species: *Ammophila fallax* Kohl, 1884, original designation. Proposed as a subgenus of *Ammophila* W. Kirby.

Description:

Inner orbits straight, or slightly bowed, converging below in both sexes, or sometimes parallel in female; free margin of female clypeus typically with a sinuate or truncate median lobe which is usually delimited laterally by a small tooth or angle, lobe sometimes with median emargination, clypeal margin sometimes sinuately transverse or broadly arcuate and without teeth; male clypeal margin variable, but most often with apical notch; labrum broader than long to twice as long as broad, apex truncate, rounded, or emarginate, sometimes with apicomedian process; female mandible with one to three teeth which can be subapical; male mandible with one or two subapical teeth, rarely with ventrobasal tooth; mouthparts usually quite long, galea in most species reaching or exceeding base of stipes when folded; hypostoma closing mandible socket (narrowly open in some males); hypostomal carina with projecting lobe or spine in males of a few species; collar short to long; propodeal enclosure defined by differential sculpture or vestiture (sometimes obscured by vestiture); episternal sulcus usually present, extending vertically from subalar fossa, ending opposite pronotal lobe or extending to ventral area of mesopleuron; lower metapleural area usually defined but sometimes poorly differentiated from propodeal side (no clear sulcus); marginal cell apex acuminate to rounded; shape of submarginal cell II variable, submarginal cell III infrequently absent or petiolate on the radius; female foretarsus with rake composed of short, stiff spines or long, flexible, blade-like spines, outer apex of tarsomeres, especially I, usually prolonged; midtibia usually with two apical spurs, but one may be very short, or absent; tarsal claw with sharp basal tooth in some species of *nigricans* group; petiole very long, consisting of cylindrical sternum I and slender tergum I, thus appearing two-segmented; sternum I not reaching base of II, both connected by a ligament visible in intervening space which is long, tergum I often as long as sternum I and in lateral profile forming a fairly continuous plane with sternum I, thickest at level of spiracle and usually parallel sided or somewhat constricted posterad of spiracle

(continuously expanding from base to apex in some species of *nigricans* group); sternum VIII of male usually truncate apically and often emarginate there; penis valve head usually with teeth on ventral margin, and often with a basal spine-like process, gonocoxite ending in a single apical finger-like process which is usually subtended by large setae.

Systematics:

At present this genus contains 240 species world wide (Catalog of Sphecidae, Wojciech Pulawski, 2019). There are 69 species in North and Central America. If the Mexican and Central American species are subtracted from this total there are 62 in North America. The South American species all belong to the *urnaria* group (defined below) except for two *nigricans* group species that occur in northern Venezuela. Amarante (2002) catalogued the Neotropical species but did not include *hevans* Menke described in 2004.

Although past workers have used subgenera, I am using species groups instead. Kohl (1906), in his revision of the Palaearctic species of *Ammophila*, treated the genus very conservatively as it included all the genera now recognized in the tribe Ammophilini. He recognized nine Artengruppen, using generic names to identify each one. Of course four of these groups are now recognized as genera (Menke, p. 137 in Bohart and Menke, 1976).

Species Groups:

In the past some authors have established subgenera to encompass the morphological diversity in *Ammophila*. I feel that species groups are a better solution (Menke, p. 149 in Bohart and Menke, 1976). Species groups are defined by the length of the episternal sulcus, sculpture of the thoracic dorsum, male genitalia, presence or absence of claw teeth, and number of midtibial spurs. Kohl (1897) in his monumental work on the genera of apoid wasps (as sphecoid wasps), established the *fallax* group for Old World species with a tooth on the claw (see p. 266 of Kohl). Leclercq (1961) proposed the subgeneric name *Apycnemia* for this assemblage. Kohl's group should be called the *hungarica* group because of synonymy. The *hungarica* group has a short episternal sulcus but otherwise is similar to my *nigricans* group (Menke, 1970), some species of which have claw teeth. The episternal sulcus is usually long in the *nigricans* group and the sculpture of the propodeal dorsum differs between these two species groups. Field, Ohl, and Kennedy (2011) indicated that the *nigricans* group is probably the most plesiomorphic assemblage in *Ammophila*. The European species *campestris* and its relatives have a petiolate third submarginal cell and the generic name *Miscus* has been used for this group, but wing venation varies. However, the *campestris* group has a long episternal sulcus and the propodeal enclosure is similar to the *nigricans* group. The two groups are obviously related.

Roth (1928) recognized species groups in his review of the North African *Ammophila* in which he followed Kohl's conservative version of the genus. His *sabulosa* group is similar to my *azteca* group, the biggest assemblage of North American species. The New World *azteca* group (Menke 1967) and the Old World *sabulosa* group share a long episternal sulcus, a usually non-ridged collar and scutum, and the form of the genitalia. These two groups contain the majority of species of *Ammophila*. Some would argue that the two groups should be united as the *sabulosa* Group but I prefer to keep them separate.

I described the North American *urnaria* group (Menke, 1966) for species with a short episternal sulcus, and an unsculptured collar and scutum. Some species in this group have only one midtibial spur. It and the *azteca* group are sister groups. Several North American *Ammophila* are unusual and do not easily fit into the groups just outlined. These

are *nasalis, nefertiti,* and *coachella*. *A. nasalis* is an isolated taxon and forms its own group. The other two species may belong in the *procera* group or at least are closely allied.

The New World *procera* group (Menke 1964a) and the Old World *clavus* group (Kohl 1906:326) contain species in which the episternal sulcus is short or even absent, the collar and scutum are usually covered with cross ridges, and the pattern of the penis valve is distinctive. Based on genitalia, the North American species *aphrodite* belongs in the *procera* group even though the collar and scutum lack cross ridging.

For a discussion of other Old World species groups see my treatment on page 149 in Bohart and Menke (1976). Sub Saharan Africa has a diversity of species, but unfortunately in his revision Dollfuss (2015) does not discuss groupings. Field, Ohl and Kennedy (2011) published a molecular phylogeny of Ammophilini. Most of the species groups I recognize were supported by their study.

Taxonomic History of North American *Ammophila:*

The earliest descriptions of North American *Ammophila* were by Europeans. A. G. Dahlbom (1843) described three species from material sent to him by the early collector of American insects, C. Zimmermann. The American species described by Lepeletier de Saint-Fargeau (1845) puzzled later taxonomists who could not locate his types; and their interpretations of his descriptions varied. Bradley (1957) informed entomologists of the existence of many Lepeletier types in Spinola's collection in Torino, Italy. R. M. Bohart examined the Spinola collection in 1960 and made notes for me on the Lepeletier's *Ammophila* types housed there. In 1964 I examined the same types and verified the identity of nearly all of Lepeletier's names. One Lepeletier species, *arvensis*, described from North America, has defied identification. I saw putative type material in Torino, but it did not agree with the original description. These specimens were a species of *Podalonia*. I listed the species in *Ammophila* (Menke, 1976, p. 150) with a question mark. In any event, Lepeletier's name is a homonym of *Ammophila arvensis* (Dahlbom). Dahlbom (1843:8) described *arvensis* from a unique specimen he said came from Pennsylvania. He compared it with the European species *campestris*, which like *arvensis*, has a petiolate third submarginal cell. I synonymized Dahlbom's species with *pubescens* Curtis, a European species (Menke, 1964b). No eastern North American species has a petiolate third submarginal cell.

The third European to describe American species was F. Smith (1856) who established a number of new species, three of which are still valid. The first American worker to describe an *Ammophila* was S. S. Haldeman (1852) who described *A. aberti* from material collected during a survey of the Salt Lake area of Utah. Similar government explorations of the Colorado Territory and other areas produced material which served as the basis for many of the new species described by the pioneer American hymenopterist Ezra T. Cresson (1865, 1868, 1873, 1875). The fact that only three of the fourteen species he described are synonyms attests to his taxonomic acumen. Another American, B. J. Walsh (1869), described one new species from Illinois, *A. pictipennis*. Later that same year the German, E. Taschenberg (1869), described the same species from Illinois under the name *anomala*. In 1888 the English worker, Peter Cameron, described many new species of *Ammophila* from Mexico and Central America. Thirteen of his species are now known to occur in the United States but only four are valid, the others being junior synonyms of his own species, or those of previous authors. The next year Kohl (1889) described a single species, *nearctica*, from the Washington Territory.

J. Fox (1894a) described *Ammophila femurrubra* which he collected in Baja California, but which occurs commonly in the southwestern United States. In 1895, *Ammophila*

nasalis was described posthumously by the Canadian entomologist, Léon Provancher, from material collected in southern California. A. L. Melander (1903) essentially brought to a close the purely descriptive phase of the work on North American *Ammophila* with his attempt to provide a key for the species known up to that time. Melander recognized twenty-five species from North America, but some of these are now recognized as junior synonyms and others have been removed from our fauna. Furthermore, some of the species he listed as synonyms are now recognized as valid, so that all things considered, Melander's key is of little use. For approximately the next thirty years there were few additions to the knowledge of the North American *Ammophila*. Fernald (1905) made the generic name change from *Ammophila* to *Sphex*. This necessitated the renaming of two *Ammophila* species because of secondary homonomy. Thus, H. Smith (1908) proposed the name *cressoni* for *collaris* Cresson, and Fernald (1931) renamed *argentata* Hart (described in 1907) as *harti*. Rohwer (1912) described a species from Mexico which is probably synonymous with *pictipennis* Walsh. In 1916, Cresson published a paper in which he designated lectotypes for the species of *Ammophila* he had described much earlier. H. T. Fernald (1931) summarized some of the notes he had made in 1913 during a type study tour in Europe. Although Fernald's notes were important, they suffered from his failure to grasp the limits of the species with which be was dealing.

In 1934 Fernald culminated his many years of research on *Ammophila* with a revision of the North and Central American species. He reversed some of the synonymy he expressed in 1931 but confounded these corrections by committing further errors. Fernald sometimes failed to associate the sexes of species with the result that he described the two as different species. On other occasions Fernald described the same species twice. Altogether, he described twelve new species and subspecies in his paper, only five of which remain valid today. Probably the lack of sufficient material from the western United States, an area which has many more species than the eastern part of the country, played a large role in Fernald's inability to understand the great "variation" he saw in many of his species.

In 1938 W. D. Murray described for the first time a feature of considerable taxonomic importance in species discrimination. This was a structure he termed the "metanotal flange". The metapleural flange, as the structure is more properly called, apparently becomes modified only in Nearctic *Ammophila*, and the degree of its development, e. g. lamelliform or not, and the outer margin arcuate or angulate, is very useful in defining species or groups of species. Murray also demonstrated the value of the male genitalia in species diagnoses. In the same paper he resurrected some of the species placed in synonymy by Fernald, described a new one, and proposed a new name for a preoccupied species name. In the catalog of North American Hymenoptera, Murray (1951) removed more species from synonymy and renamed two species names that were preoccupied. He recognized 36 species. In the most recent catalog of the North American fauna, Krombein (1979) listed 61 species of *Ammophila*. The increase in numbers of species from the 1951 catalog reflects of the all the new species I described (Menke, 1964, 1966, 1967). Kirkbride (1982) described a new species from western North America, *silvestris* which I regard as a junior synonym of *azteca*. I described a new species, *nancy*, from the southwestern US (Menke, 2007).

Problems:

The *pruinosa* complex is currently represented by four species: *pruinosa*, *nancy*, *californica* and *linda*. Male genitalia are useful in separating these taxa, but I have seen

genitalia that do not fit these four. Thus there are likely several more species in this complex that someone else will have to identify. Wasps in the *pruinosa* complex are common in collections so there is no dearth of material. It is clear from this complex that the penis valve head may vary. I have not attempted to study this problem in detail. But this needs to be studied for all of the North American species of *Ammophila*.

Ammophila gracilis occurs over much of South America and it occurs in Panama and Costa Rica. However it is a variable species both in color and in the sculpture of the scutal surface. *Ammophila picipes* is a similar Central American species that occurs as far north as Arizona and Oklahoma. Both taxa need further study to determine if only one species is involved, or if *gracilis* itself is a complex. DNA work may be necessary.

Genitalia are usually fairly constant and reliable in this genus but in the *pruinosa* complex and in *strenua* there is variability that needs further study.

Ammophila azteca is a common North American species that ranges across the continent from near sea level to 13,200 feet in the White Mts. of California. The extent of appressed silver setae, abdominal color, and whether or not the metapleural flange is lamelliform, vary considerably over the wasps' range. This is another species that needs further study.

Ammophila procera occurs all across North America and occurs as far south as Costa Rica. Over this range the erect setae vary from black to pale, and there is some morphological variation as well. Someone should study this species in depth.

Females of *placida* and *pictipennis* are essentially identical. Males differ in the presence or absence of a basal spine on the penis valve head. The spine is absent in *pictipennis* which occurs in eastern North America. The spine is present in *placida* which occurs in the western US. It is possible that only one species is involved and the penis valve difference would then be a geographic variable. For example, the forewing of *wrightii* has two submarginal cells in the eastern part of its range. Westward three cells are the norm and intermediates occur where one wing has two and the other three submarginal cells. However, the ranges of *pictipennis* and *placida* overlap in Texas which suggests they are distinct species.

Females of *imitator*, *mimica* and some *unita* appear identical and associated males are usually necessary for identification.

The females of *Ammophila bella* and *bellula* are seemingly inseparable while their males are quite different in details of the head and penis valve. Compounding this problem is the fact that in southern Arizona the two species occur together. *A. bella* is a Mexican species that is known from three locations in southern Arizona. I and friends have collected about 100 males of *bella* at one of the localities and nearly 200 females. These females cannot be divided into two species. I had hoped to collect a mating pair of *bella*, but many trips to the location have been fruitless. I have captured mating pairs of *bellula* here and elsewhere.

Although I have seen quite a bit of Mexican material, it is obvious that much more surveying for *Ammophila* needs to be done in that country, especially at higher elevations. I have a single record of the common eastern North American species *nigricans* from Michoacán, Mexico. I have seen no material of this species between there and Texas. At higher elevations (2200 m+) I have seen specimens of what appears to be *strenua* from central Mexico. It is likely that there are undescribed species in Mexico. See my comments in the *nigricans* group for a discussion of possible new species in Mexico. In North America, the Great Basin is an area where more collecting needs to be done.

Mandibular glands:

As reported by Duffield, et al., (1981) live specimens of *Ammophila* often emit a chocolate fragrance from their mandibular glands. This odor is quite noticable in specimens of *procera* Dahlbom when they are in a collecting net. I have noted the same odor in some females of *azteca*. The function of the secretion is unknown.

Nesting behavior:

More has been written about the biology of *Ammophila* than perhaps any other genus of solitary wasps. They make easy subjects for observation since they are difficult to disturb during nest construction and provisioning. Claims have been made that these wasps actually possess intelligence, or, more simply, recognize in advance the results of their actions. The act of using a "tool" in nest closing, first described by Williston (1892) and later popularized by the Peckham's (1898, 1900), is one of the arguments used to prove that *Ammophila* are "intelligent". However, Frisch (1940), Evans (1959) and others have demonstrated that the tool-using habit is the result of a gradual succession of instinctive behavioral elements.

Evans (1959, 1965, and 1970) and Powell (1964) have reviewed most of the literature on North American species, and included their own extensive observations. Menke (1965b) cleared up the identity of most of the species observed by Hicks who published a number of papers on the biology of *Ammophila* in the 1930s. More recent papers are by Gwynne (1977), Parker, Tepedino and Vincent (1981), O'Brien and O'Brien (1988), Rosenheim (1987, 1988, 1989), Genaro and Sanchez Alonso (1990), Spofford and Kurczewski (1992), Kurczewski and Spofford (1998), Jiménez-Jiménez and Palacios-Cardiel (2008), Kathirithamby, Lechner, McMahon, Bryson and Johnston (2012), Chiappa, Mandujano and Passi (2020), Field, Gonzalez-Voyer and Boulton (2020), and Rosenheim (in Press). Evans (1958) briefly touched on the diversity of nesting habits in *Ammophila*.

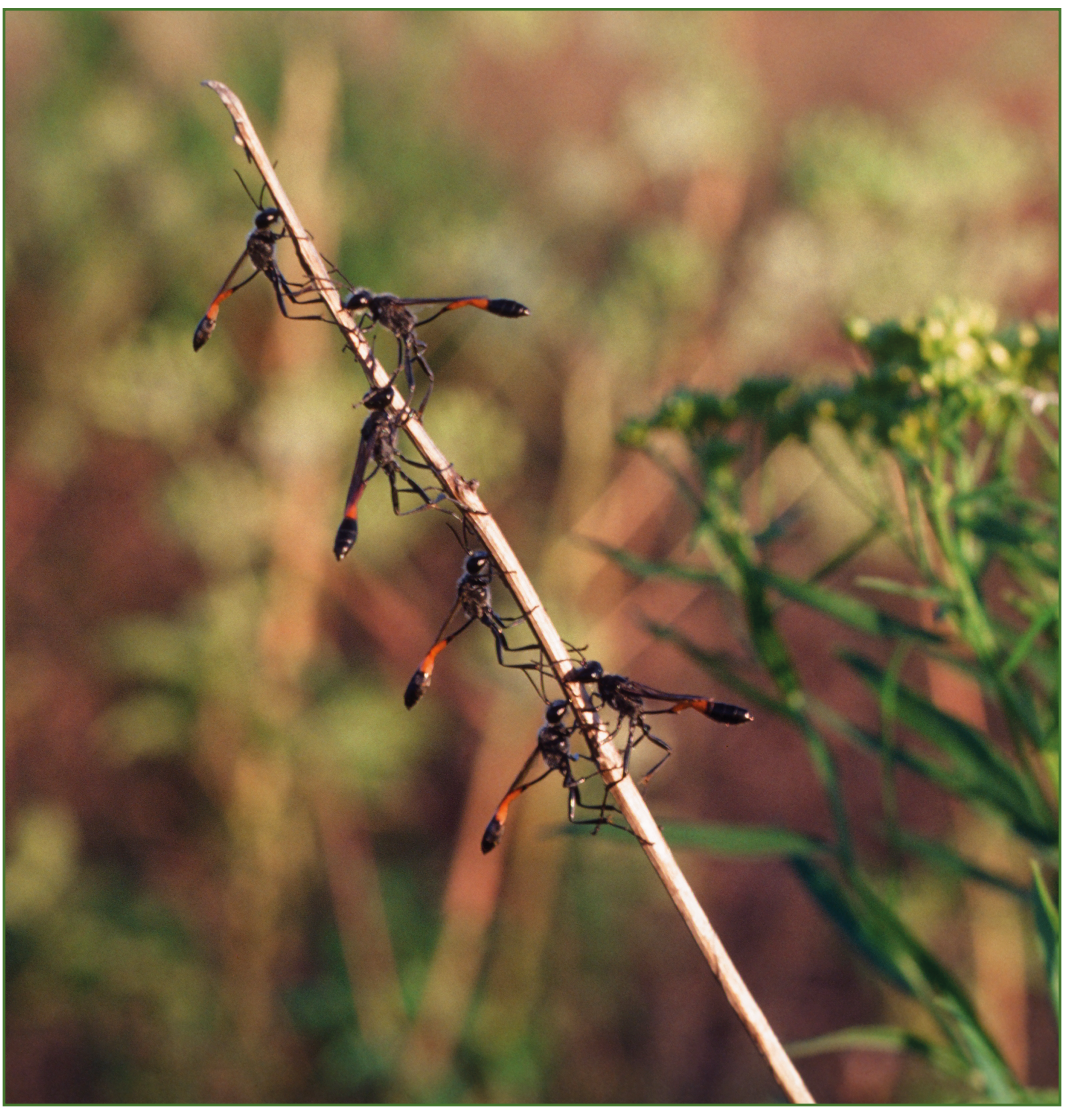
Most species are solitary nesters, but a few such as *aberti* form nesting aggregations (Parker, Tepedino and Vincent, 1981). Typically nests are excavated before searching for prey, but Hicks (1934) claimed the reverse for the ant mimic *wrightii*. Alcock (1984) described the biology of *novita* and it catches prey prior to digging a nest. According to Rosenheim (1987, p 747) two other species, *boharti* and *marshi*, also dig their nests after catching prey. These four species are members of the *procera* group. Roth (1928, p. 232) indicated that the north African and southwest Asian species *haimatosoma* Kohl catches prey before digging the nest. This species is a member of the *clavus* group, the Old World equivalent of the *procera* group. Obtaining prey before nest excavation is typical for the genus *Podalonia*.

The burrow of *Ammophila* usually ends in a single cell, but two-celled nests have been reported (Frisch, 1940). When excavation is completed the wasp usually makes a temporary closure. Prey in North American species are typically lepidopterous caterpillars. However, *azteca* has been known to provision with weevil larvae, *Hypera postica* in Utah (Frank Parker, personal communication). Hairless caterpillars are usually used, but hairy larvae are sometimes used. Depending on size of prey the caterpillar is either flown to the nest or transported on the ground. The caterpillar is held by the wasps' mandibles upside down with the head forward. The front pair of legs may assist in carrying prey.

Species like the large *procera* which collects large sphingid caterpillars, provision their nest with one prey. Smaller species of *Ammophila* may put 2 to 11 caterpillars in the cell, the egg being laid on the first provision near its head. Mass provisioning is most common

in *Ammophila*, but Powell (1964) and Evans (1965) documented progressive provisioning in *azteca*, *pruinosa* and *harti*. These three species belong to the *azteca* group. Progressive provisioners must visit the nest periodically to determine if additional prey caterpillars are required by the developing wasp larva. Evans (1965) discovered that *azteca* may maintain more than one nest at the same time. The ability of *azteca* females to remember the location of each nest and their changing prey requirements is amazing. Baerends (1941) reported that the European species, *pubescens* Curtis (as *campestris* Latreille), also takes care of more than one nest at a time, as did Tsuneki (1968) for *sabulosa*.

Species of *Ammophila* commonly form loose sleeping aggregations on grasses and bushes in the late afternoon (Evans and Linsley, 1960; Steiner, 1977). Steiner found that each wasp prefered to sleep on the same plant stem over a series of days. This photograph was taken at Kouchibouguac N. P., New Brunswick, Canada. The wasps appear to be females, possibly of *kennedyi* (Murray).



Species of *Ammophila* are common hosts for Strepsiptera (Kathirithamby, Lechner, McMahon, Bryson and Spencer, 2012). Typically there is one strepsipteran per host, but occasionally there may be as many as 4, or even 6 (Lechner, 2019). The parasites project between the gastral terga and sterna, and are quite conspicuous.

Two North American species, *formicoides* and *wrightii*, both of which are small and largely reddish, closely resemble red or brown mymicine ants. These wasps are often found running about on the ground in association with ants of the genus *Pogonomymex* for which they are easily mistaken.

Stevens and Menke (2014) discussed the biogeography of species of *Ammophila* in the Grand Canyon area of Arizona. Zalom, Meyer and Mason (1979) discussed the sympatric associations of *Ammophila* mimics in the Bombyliidae with species of *Ammophila* in Arizona. Menke and Parker (1996) discussed the phenology of species of *Ammophila* in Costa Rica.



Ammophila procera on ***Asclepias tuberosa*** Linnaeus

Photograph by Frank Greenwell

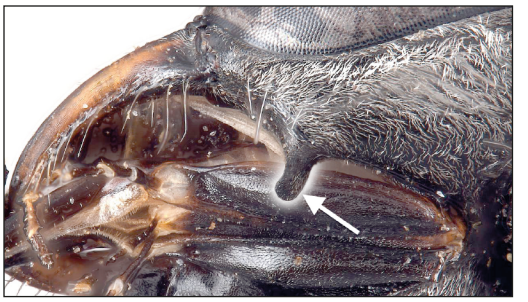


Fig. 12, *nefertiti* male

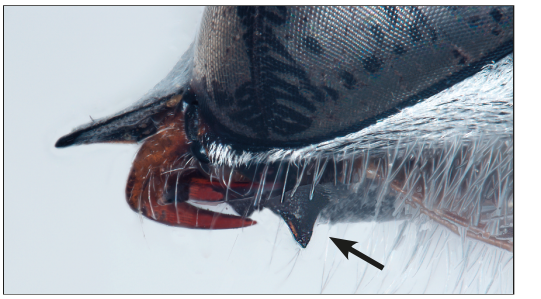


Fig. 13, male *nasalis*

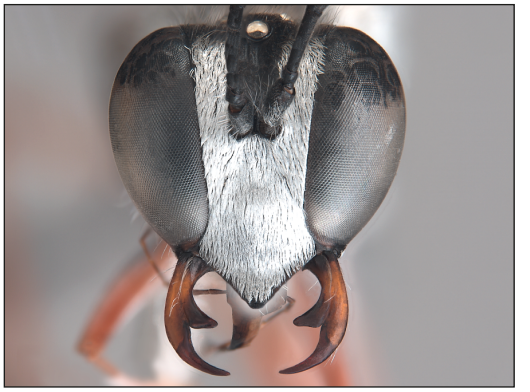


Fig. 14, male *nasalis*

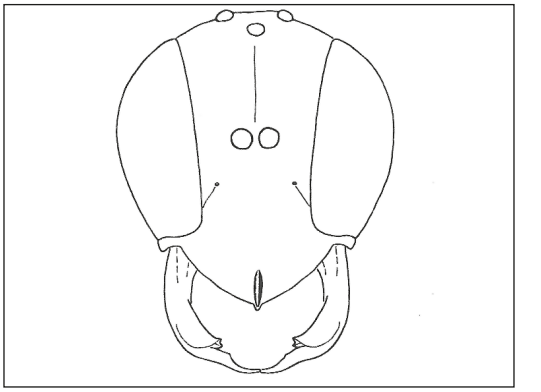


Fig. 15, male *coachella*



Fig. 16, male *coachella*

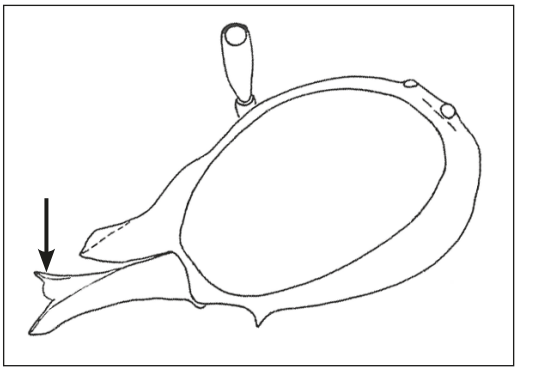


Fig. 17, male *coachella* mandible

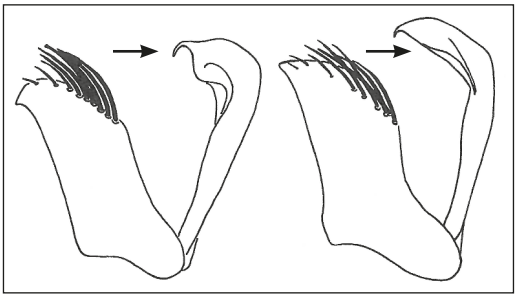


Fig. 18, *coachella*, **Fig. 19**, *nefertiti*



Fig. 20, *formicoides*

Fig. 21, *wrightii*

Using the Identification Key

Most features used in the key should be viewed at 12 to 25× using an Aristo cold light (Mic-O-Lite). The metapleural flange is best viewed at 50×, as are penis valve details. Old or worn specimens may not run well in the key because patterns of appressed silver setae are important and such setae are worn or lost with age. Some species vary in important characters and therefore some specimens may not be identified reliably. Users should know that I use the term "red" for various shades of red, orange, and various reddish colors. Determining if the episternal sulcus is long can be challenging for the novice user. Sometimes the sulcus is shallow, and in species with dense appressed setae on the mesopleuron seeing the sulcus may require scraping away some of the setae.

Key to North and Central American Species of *Ammophila*

1. Male, antenna with eleven flagellomeres; gaster appearing six-segmented 2
– Female, antenna with ten flagellomeres; gaster appearing five-segmented 81
2. Hypostomal carina with thumb-like or triangular process (figs. 12, 13) 3
– Hypostomal carina simple, without process 5
3. Clypeal free margin triangular (fig. 14); hypostomal carina with triangular process near mandible base (fig. 13); Pacific coast from San Francisco Bay area to northern Baja California . . . . . ***nasalis*** Provancher
– Clypeal free margin semi-circular but with median carinate tooth (fig. 15); hypostomal carina process variable (fig. 12, 16) 4
4. Inner tooth of mandible with raised, lamelliform carina (fig. 17); penis valve (fig. 18); southern California, southern Nevada. . . . . .***coachella*** Menke
– Inner tooth of mandible without carina; penis valve (fig. 19); Great Basin region. . . . . ***nefertiti*** Menke
5. Head, thorax and legs orange or reddish brown; length 8-12 mm 6
– Head and thorax black (thorax sometimes partially or completely red); legs black or red and black; length 13 mm or greater 7
6. Forewing with only two submarginal cells (fig. 20), veins C + Sc with pale spot basad of stigma, median cell with infumate spot apically, wing tip infumate; body reddish brown; clypeus with two bulges . . . . . ***formicoides*** Menke
– Forewing with two or three submarginal cells (figs. 21, 22), veins uniform in color, wing slightly infumate; body orange red; clypeus broadly swollen . . . . . .***wrightii*** (Cresson)
7. Episternal sulcus long, ending in sternal region of thorax[1] 8
– Episternal sulcus short, ending opposite pronotal lobe 38
8. Propodeal enclosure with erect setae (45° or more) that are black or pale, pale setae may be sparse 9
– Propodeal enclosure without erect setae, glabrous or with appressed silver setae mesally. 29

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[1] It may be necessary to scrape away the setation in order to see the sulcus clearly.

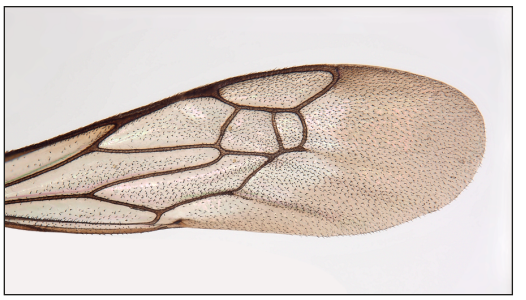


Fig. 22, *wrightii*



Fig. 23, *gaumeri*

Fig. 24, *centralis*



Fig. 25, *azteca*



Fig. 26, *azteca*



Fig. 27, *peckhami*



Fig. 28, *varipes*



Fig. 29, *linda* male



Fig. 30, *californica* male



Fig. 31, *nancy* male

9. Erect setae of propodeal enclosure black 10
– Erect setae of propodeal enclosure pale 14
10. Gonocoxite fringed with row of five or more stout setae (fig. 23). 11
– Gonocoxite with only two to four finer fringing setae (fig. 24). 12
11. Body entirely black, face with appressed silver setae; apical process of gonocoxite acuminate (fig. 23); Mexico to northern Venezuela. . . . . ***gaumeri*** Cameron
– Petiole tergum and gastral segment I orange red; face without silver setae; apical process of gonocoxite elongate, apex rounded; central Mexico . . . ***mexica*** Menke
12. Face (densely) and thoracic pleura with appressed silver setae; pronotal collar and scutum usually with traces of appressed silver setae; southern Texas to northern. Venezuela. . . . . ***centralis*** Cameron
– Face (with traces) and thoracic pleura without appressed silver setae[2]. 13
13. Wings strongly infumate, veins black; eastern United States . ***nigricans*** Dahlbom
– Wings lightly tinted with yellow (western United States), or moderately infumate (eastern United States), veins reddish or brown; eastern United States to Arizona, south to Guanajuato and Guadalajara, Mexico. . . . . ***fernaldi*** (Murray)
14. Vertex of head with pale setae 15
– Vertex of head with black setae 23
15. Metapleural flange not lamelliform; legs black or black and red. 16
– Metapleural flange lamelliform (figs. 25, 26); legs black. 21
16. Legs black; pleura with silver bands along mesopleural suture and metapleural sulcus (fig. 27); penis valve (fig. 33). . . . . ***peckhami*** (Fernald)[3]
– Legs red and black 17
17. Meso- and metapleuron uniformly, densely covered with appressed silver setae 18
– Mesopleuron with band of appressed silver setae along mesopleural suture, rest of surface with sparse silver setae (fig. 28) . . . . . ***varipes*** Cresson;
18. Clypeus projecting, its straight sides converging, apex notched (fig. 29); southern California . . . . . ***linda*** Menke
– Clypeus not projecting, sides curving, apex shallowly emarginate 19
19. Apex of folded proboscis reaching base of stipes, or surpassing it (fig. 30), if proboscis extended then galea from apex to palpal socket exceeding length of stipes (galea 1.14 × stipes length); penis valve as in fig. 34 . . . . . ***californica*** Menke
– Apex of folded proboscis extending only about one half to three fourths distance to base of stipes (fig. 31), if proboscis extended, then galea clearly shorter than stipes (galea 0.68-to 0.78 × stipes length); penis valve as in figs. 35, 36 20

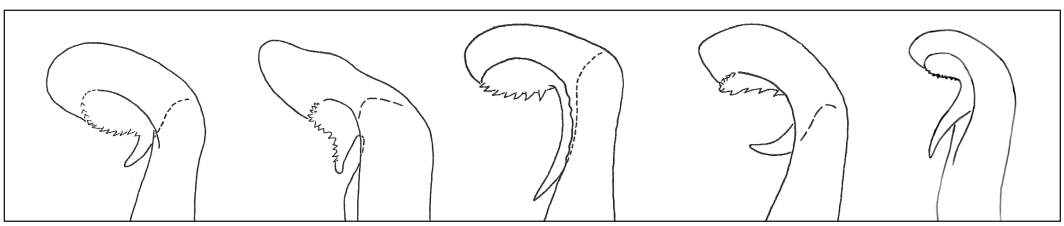


Fig. 32, *evansi*, **Fig. 33**, *peckhami* **Fig. 34**, *californica*, **Fig. 35** , *pruinosa* **Fig. 36**, *nancy*

[2] Rarely with sparse appressed silver setae on pleura.
[3] Most *peckhami* will key out at couplet 26.



Fig. 37, *mediata*



Fig. 38, *zanthoptera*

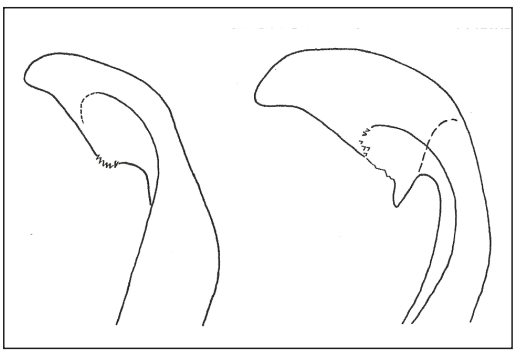


Fig. 39, *regina*,

Fig. 40, *acuta*



Fig. 41, *femurrubra*

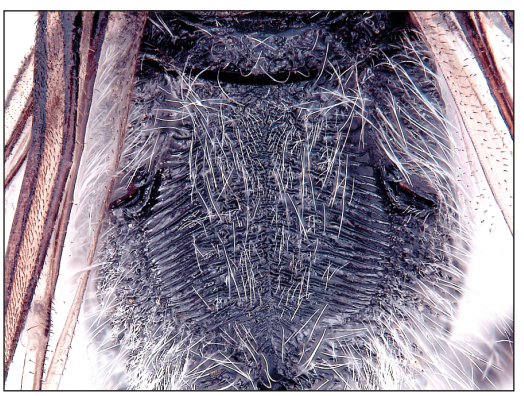


Fig. 42, *azteca* male



Fig. 43, *hallelujah* male



Fig. 44, *evansi* male



Fig. 45, *strenua*

20. Ventral spine of penis valve head forming a C-shape (fig. 35); labrum apex rounded, sometimes acuminate apically. . . . . ***pruinosa*** Cresson
– Ventral spine of penis valve head directed basad (fig. 36); labrum apex straight, without median projection . . . . . ***nancy*** Menke
21. Forewing veins amber or yellowish; pleura and propodeal side generally covered with apppressed silver setae, sometimes with discrete band along mesopleural suture; scutal fossae often with appressed silver setae, hind surface of forefemur with appressed silver setae . . . . . ***harti*** (Fernald)
– Forewing veins brown or black; appressed silver setae of pleura usually sparse except for distinct band along mesopleural suture; scutal fossae asetose; hind surface of forefemur without appressed silver setae. . . . . ***azteca*** Cameron. . . .22
22. Abdominal terga I-II, and sometimes III, extensively red; mainland North America . . . . . ***azteca*** subsp. ***azteca*** Cameron
– Abdomen wholly black; California: San Clemente Island . . . . . ***azteca*** subsp. ***clemente*** Menke
23. Thoracic pleura without appressed silver setae along mesopleural suture 24
– Thoracic pleura with appressed silver band of setae along mesopleural suture . .25
24. Apex of gonoforceps with numerous long setae; clypeus densely silvery setose, clypeal edge usually truncate, reflexed (fig. 37). . . . . ***mediata*** Cresson
– Apex of gonoforceps with only two or three long setae; clypeus sparsely silvery setose, clypeal margin broadly, shallowly emarginate, not reflexed (fig. 38). . . . . ***zanthoptera*** Cameron
25. Pronotal collar flattened lateral to midline, collar wedge-like; clypeus entire, narrowly spatulate; erect thoracic setae very short, sparse; penis valve (fig. 39) . ***regina*** Menke
– Pronotal collar evenly rounded from side to side. 26
26. Gastral segment I mostly red, or mostly black, remaining segments black; erect scutal setae black (pale in midwest); collar cutoff at streptaulus, (fig. 44); eastern Canada and United States to Wyoming, Colorado, Texas . . . . . .***evansi*** Menke
– Gastral segments I-II mostly red; erect scutal setae usually pale; western United States 27
27. Gastral segment III partially or totally red;[4] clypeus usually entire or shallowly emarginate; penis valve as in fig. 40 . . . . . .***acuta*** (Fernald)
– Gastral segment III black 28
28. Penis valve fig. 45. . . . . .***strenua*** Cresson
– Penis valve fig. 33. . . . . ***peckhami*** (Fernald)
29. Propodeal enclosure glabrous, surface dull, interspaces entirely finely microaereolate between ridges, at least laterally (fig. 41). 30
– Propodeal enclosure often with appressed silver setae mesally, usually with close-set transverse ridges laterally which may reach midline, surface usually irregularly ridged or variably rugose on middle third, interspaces smooth,[5] shiny at least laterally, sometimes minutely roughened, dull, but not microareolate (figs. 42, 43). . 34
30. Thorax with erect pale setae; meso- and metapleuron with appressed silver setae 31
– Thorax with erect black setae; meso- and metapleuron without appressed silver setae (rarely with some appressed silvery setae). 32

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[4] Gastral tergum II is black in males from Nebraska.

[5] Sometimes the entire enclosure is uniformly cross ridged, with no appressed silver setae.

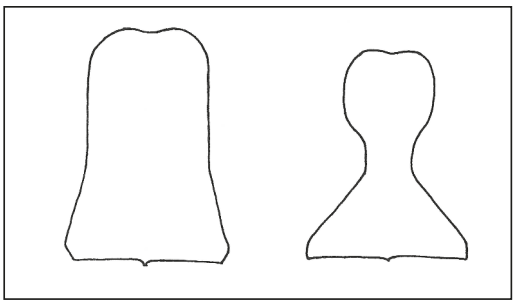


Fig. 46, *mcclayi*, Fig. 47, *placida*



Fig. 48, *placida*, Fig. 49, *pictipennis*



Fig. 50, *moenkopi* female



Fig. 51, *azteca* male



Fig. 52, *azteca*

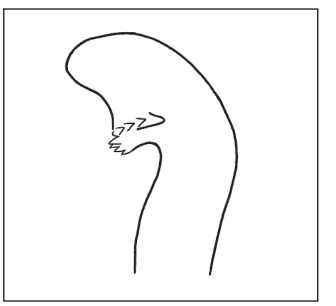


Fig. 53, *karenae*



Fig. 54, *hallelujah*



Fig. 55, *breviceps*



Fig. 56, *mimica*



Fig. 57, *procera* female



Fig. 58, *macra*

31. Flagellomere I length nearly equal to least interocular distance (.78-.95× LID); collar and scutum sometimes with appressed silver setae . . . . . ***femurrubra*** Fox-
– Flagellomere I length much less than least interocular distance (.67-.72× LID); collar and scutum without silver setae . . . . . ***extremitata*** Cresson
32. Wings without amber tint, veins brown or black; gastral sternum VII (fig. 46), face with appressed silver setae; western United States. . . . . ***mcclayi*** Menke
– Wings often with amber tint, veins reddish brown or amber, at least basally; gastral sternum VII (fig. 47); face with or without silver setae. 33
33. Penis valve head with basal spine (fig. 48); face sometimes with appressed silver setae; western United States, western Mexico . . . . . ***placida*** Smith
– Penis valve head without spine (fig. 49); face without silver setae except rarely present on clypeus (Iowa); eastern United States, eastern Mexico . . . . ***pictipennis*** Walsh
34. Metapleural flange lamelliform (figs. 25, 26, 50) 35
– Metapleural flange not lamelliform 36
35. Legs partly red, thoracic pleura with considerable appressed silver setae (fig. 50); metapleural flange foliaceous; Great Basin . . . . . ***moenkopi*** Menke
– Legs black; thoracic pleura with band of silver setae along mesopleural suture (fig. 51); metapleural flange less developed (fig. 26). . . . . ***azteca*** Cameron
36. Pronotal collar with appressed silver setae, setae densest posteriorly, forming transverse band (fig. 55); scutum with appressed silver setae, densest in fossae and forming longitudinal stripe along midline . . . . . ***breviceps*** Smith
– Pronotal collar without transverse band of appressed silver setae 37
37. Penis valve as in fig. 52. . . . . ***azteca*** Cameron
– Penis valve as in fig. 53 . . . . . ***karenae*** Menke
– Penis valve as in fig. 54 . . . . . ***ballelujah*** Menke
38. Propodeal enclosure asetose, surface dull, interspaces entirely finely microaereolate between ridges, at least laterally (fig. 41). 39
– Propodeal enclosure with appressed silver setae mesally and/or with semi-erect long pale setae in same area, usually with close-set transverse ridges laterally that may reach midline, usually irregularly ridged or variably rugose on the middle third, interspaces smooth, shining at least laterally, sometimes minutely roughened, dull, but not microareolate (figs. 55-58). 44
39. Thorax with erect black setae; meso- and metapleuron without appressed silver setae 40
– Thorax with erect pale setae; meso- and metapleuron with appressed silver setae 42
40. Wings without amber tint[6], veins brown or black; gastral sternum VII (fig. 46); face with appressed silver setae; western United States. . . . . ***mcclayi*** Menke
– Wings often with amber tint , veins reddish brown or amber, at least basally; gastral sternum VII (fig. 47); face with or without silver setae. 41
41. Penis valve head with basal spine (fig. 48); face sometimes with appressed silver setae; western United States, western Mexico . . . . . ***placida*** Smith
– Penis valve head without spine (fig. 49); face without silver setae;[7] eastern United States. eastern Mexico. . . . . ***pictipennis*** Walsh

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6 Some males from Fort Collins, Colorado are darker.

7 Some specimens from Iowa are a little silvery on the clypeus.



Fig. 59, *cora*



Fig. 60, *femurrubra*



Fig. 61, *leoparda* female



Fig. 62, *procera* female

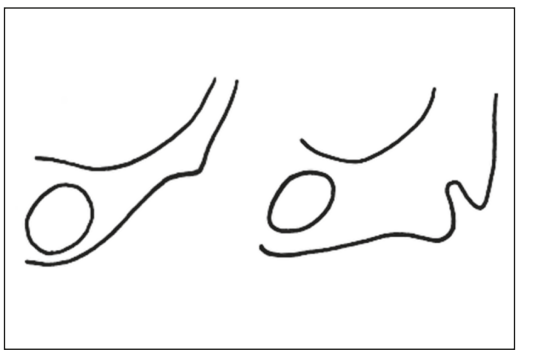


Fig. 63, *marshi* male

Fig. 64, *azteca* male



Fig. 65, *bohbarti* male

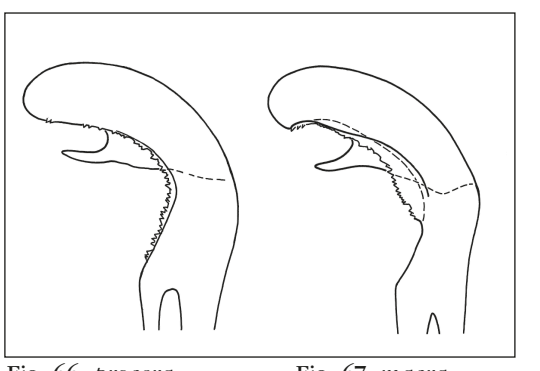


Fig. 66, *procera*

Fig. 67, *macra*



Fig. 68, *parapolita* male



Fig. 69, *marshi* male

42. Stalk of penis valve expanded at base of head (fig. 59); Mexico . . . . ***cora*** Cameron
– Stalk of penis valve slender to head (fig. 60); western United States, Mexico . .. .43
43. Flagellomere I length nearly equal to least interocular distance (.78-.95× LID); collar and scutum sometimes with appressed silver setae . . . . . ***femurrubra*** Fox
– Flagellomere I length much less than least interocular distance (.67-.72× LID); collar and scutum without silver setae . . . . . ***extremitata*** Cresson
44. Scutum smooth, punctate, without cross ridging 45
– Scutum transversely ridged. 46
45. Metapleural flange broadly foliaceous (fig. 61). . . . . ***leoparda*** (Fernald)
– Metapleural flange not lamelliform 64
46. Metapleural flange lamelliform, often angular in outline (figs. 62-64) 47
– Metapleural flange not lamelliform 57
47. Outer margin of metapleural flange arcuate, not angulate (fig. 62), or narrowly lamelliform;[8] pronotal side with many strong ridges; large species, average length over 22 mm; erect head setae often completely or partially black 48
– Outer margin of metapleural flange angulate (figs. 63-64); medium to small species, average length 16 mm or less; erect head setae pale 49
48. Scutal fossa with dense appressed silver setae (as seen from behind (fig. 57); collar usually with patch of appressed silver setae posteromedially; erect head setae black (eastern United States) or black and pale mixed, or pale (western United States); penis valve (fig. 66) . . . . . ***procera*** Dahlbom
– Scutal fossa and collar without appressed silver setae (fig. 58); erect head setae black; penis valve (fig. 67) ; western United States. . . . . ***macra*** Cresson
49. Pronotal side without appressed silver setae or if setae present, very sparse, legs completely black. 50



Fig. 70, *marshi*



Fig. 71, *parkeri*

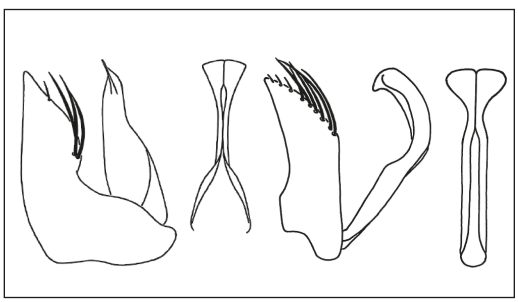


Fig. 72, *imitator*

Fig. 73, *mimica*

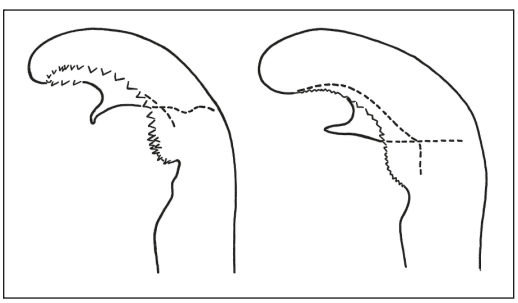


Fig. 74, *stangei*

Fig. 75, *boharti*

[8] Flange may be very narrow and not angulate in some specimens.

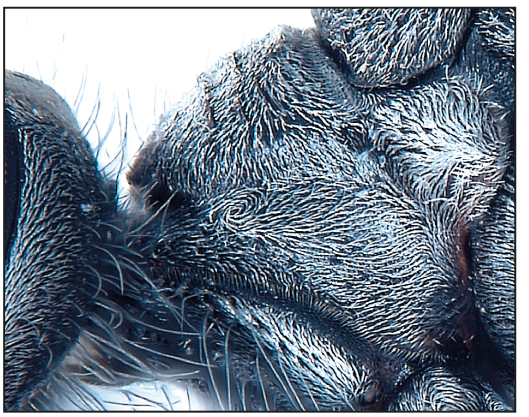


Fig. 76, *bohartí* male

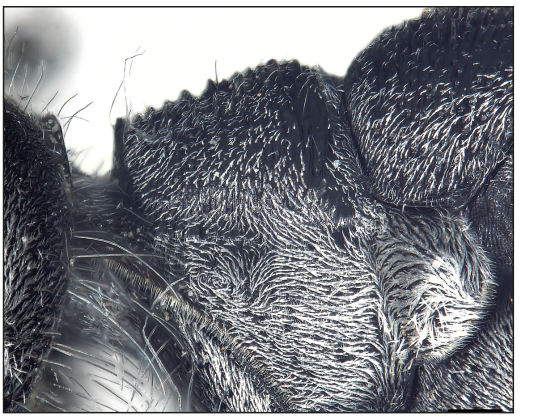


Fig. 77, *hurdi* male

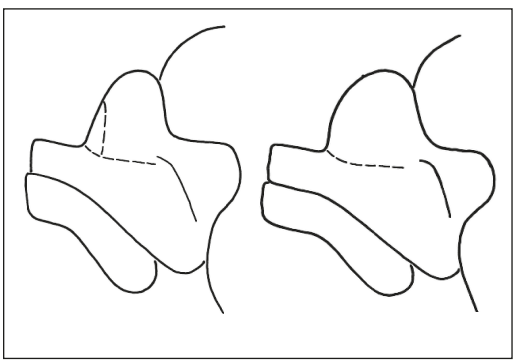


Fig. 78, *murrayi* male

Fig. 79, *stangei* male

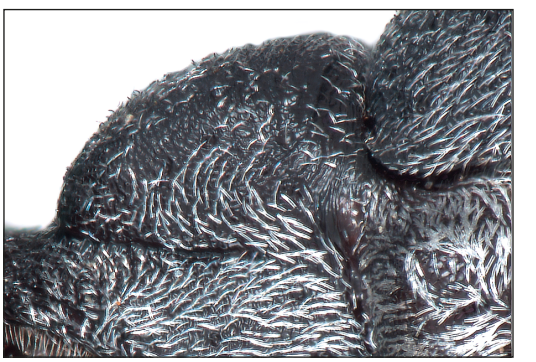


Fig. 80, *monachi* male

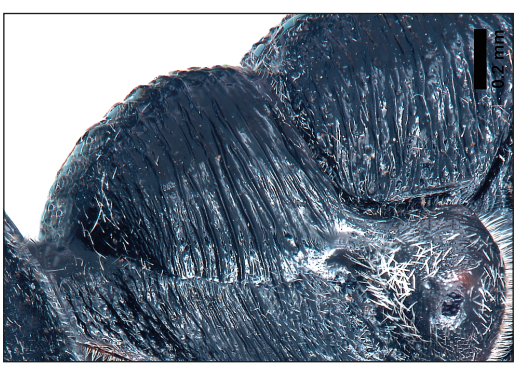


Fig. 81, *nearctica* male

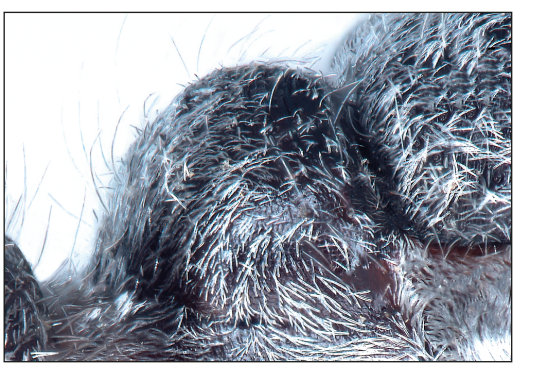


Fig. 82, *aphrodite* male



Fig. 83, *picipes* clypeus



Fig. 84, *stangei* clypeus

– Pronotal side covered densely with appressed silver setae or scale-like micropubescence; one or more pairs of legs usually partly red, rarely all black 52
50. Gastral segment I red, segments II-V black; eastern United States . . ***conditor*** Smith
– Gastral segments I-II red (terga may be black above) 51
51. Gastral terga I-II red, II may be partially black; collar profile (fig. 68) . . . . . ***parapolita*** (Fernald)
– Gastral terga I-II with triangular black spots (fig. 70)[9]; collar in profile (fig. 69) . . . . . ***marshi*** Menke
52. Penis valve: figs. 72-73 53
– Penis valve: similar to figs. 74-75. 54
53. Penis valve as in fig. 72, southeastern Arizona, northwestern Mexico . . . . . ***imitator*** Menke
– Penis valve fig. 73; California deserts, southern Arizona . . . . . ***mimica*** Menke
54. Flagellomere I length about 0.75× LID; thorax with reddish areas (at least near petiole socket); tegula red . . . . . ***ferruginosa*** Cresson
– Flagellomere I length nearly equal to LID; thorax black;[10] tegula usually black 55
55. Pronotal collar smooth, without cross ridging[11] . . . . . ***novita*** (Fernald)
– Pronotal collar with transverse wrinkles or ridges. 56
56. Pronotal collar with strong cross ridging (fig. 76) . . . . . ***boharti*** Menke
– Pronotal collar with some transverse wrinkles; Great Basin area . . . ***unita*** Menke
57. Thorax extensively or completely red[12] 58
– Thorax black 59
58. Collar elongate, cutoff sharply at streptaulus, truncation usually with prominent transverse carina dorsally (fig. 77) . . . . . ***burdi*** Menke
– Collar not cutoff sharply at streptaulus, not carinate (fig. 80) . . . ***monachi*** Menke
59. Pronotal side without appressed silver setae or scale-like micro-pubescence; legs black 60
– Pronotal side covered with appressed silver setae or scale-like micro-pubescence,[13] legs black or partially red 61
60. Propodeal side along metapleural sulcus with band of appressed silver setae, setae oriented vertically (fig. 93).; collar smooth, no cross ridges . . . . ***cleopatra*** Menke
– Propodeal side without band of silver setae; collar with fine cross ridges 60A
60A. Forewing with three submarginal cells;[14] collar in profile short, tall (fig. 78) . . . . . ***murrayi*** Menke
– Forewing with only two submarginal cells (rare exceptions) (fig. 11); collar about as long as tall (fig. 81). . . . . ***nearctica*** Kohl
61. Collar sharply cutoff at streptaulus, truncation margined by sharp carina (fig. 77) . . . . . ***burdi*** Menke
– Collar rounded, without sharp marginal carina at streptaulus 62

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9 Tergum II may be entirely red in some males

10 Occasional specimens of *boharti* have red areas near the petiole socket.

11 Collar sometimes with weak wrinkles anteriorly.

12 Thorax of some Arizona specimens of *burdi* are black.

13 Worn specimens of *stangei* may lack the micropubescence.

14 Males of *marshi* that have an indistinct lamelliform metapleural flange will key out here but the collar is similar to fig. 69.



Fig. 85, *polita* male



Fig. 86, *bella* male



Fig. 87, *bellula* male



Fig. 88, *aberti* backside of male clypeus



Fig. 89, *bellula* male



Fig. 90, *kennedyi* male

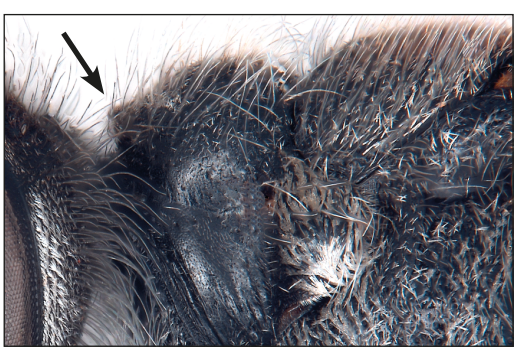


Fig. 91, *mescalero* male collar



Fig. 92, *aucella* male

62. Clypeal free margin not emarginate (exceptions), reflexed, spatulate (fig. 84); collar as in fig. 79; thoracic appressed setae densest on mesopleuron along mesopleural suture . . . . . ***stangei*** Menke
– Clypeal free margin broadly, shallowly emarginate, reflexed or not; thorax nearly completely and evenly covered with appressed silver setae (densest along mesopleural suture in some *polita*) 63
63. Collar in profile as in fig. 85; clypeal free margin not reflexed; legs red or black . . . . . ***polita*** Cresson
– Collar in profile as in fig. 82; free margin of clypeus reflexed; legs largely red . . . . . ***aphrodite*** Menke
64. One or more pairs of legs partially red[15] 65
– Legs completely black. 72
65. Propodeal side along metapleural sulcus with discrete band of appressed silver setae, setae oriented about 90° to sulcus (figs. 85, 89); scutum with median band of appressed silver setae 66
– Propodeal side with or without silver setae, if present not forming discrete band 67
66. Clypeus reflexed, not emarginate (fig. 87); mesosoma without erect setae; southern Arizona to Texas, northwest Mexico . . . . . ***bellula*** Menke
– Clypeal margin with median notch; mesosoma with much erect setae; southern Arizona to central Mexico . . . . . ***bella*** Menke
67. Thoracic pleura uniformly covered with appressed silver setae . ***aphrodite*** Menke
– Thoracic pleura with band of appressed silver setae along mesopleural suture . . 68
68. Scutal fossa with patch of appressed silver setae; clypeal free margin entire, straight, rarely with small, shallow, median emargination (fig. 88) . . . . . ***aberti*** Haldeman
– Scutal fossa usually without silver setae; clypeal free margin emarginate, general outline trapezoidal 69
69. Gastral terga I-II and usually III-V with continuous narrow median black line (fig. 71). . . . . ***parkeri*** Menke
– Gastral tergum II red, or red and broadly black 70
70. Collar strongly cutoff at streptaulus (fig. 91); southern United States to Guanajuato, Mexico . . . . . ***mescalero*** Menke
– Collar curving up gradually from streptaulus; western United States, Mexico. . . .71
71. Gastral tergum II red;[16] western United States, northern Mexico. ***hermosa*** Menke
– Gastral tergum II red basally, broadly black apically, northwestern Mexico . . . . . ***aellos*** Menke
72. Scutal fossa covered with appressed silver setae; clypeal free margin entire, straight, rarely with small shallow median emargination (fig. 88) . . . . . ***aberti*** Haldeman
– Scutal fossa usually without silver setae; clypeal free margin emarginate 73
73. Mesopleuron with band of appressed silver setae along mesopleural suture, band ending at top of episcrobal area (figs. 92-95). 74

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15 Red may be confined tiny area pro- and midfemora in *parkeri* from Idaho and Mono Co., Calif.
16 Occasional males of *hermosa* have a small central black spot on tergum II.



Fig. 93, *cleopatra* male



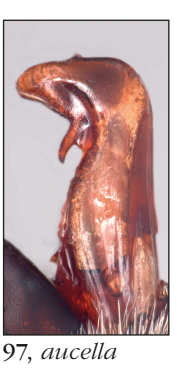
Fig. 94, *dejecta* male



Fig.. 95, *juncea* male



Fig. 96, *urnaria* male



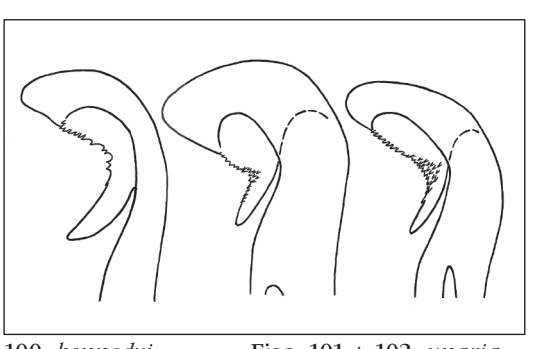
97, *aucella*



98, *dejecta*



99, *juncea*



100, *kennedyi,* Figs. 101 + 102, *unaria*



Fig. 103, *picipes* male



Fig. 104, *nasalis* female

– Episcrobal area without dense appressed silver setae, mesopleural band of setae (if present) not reaching top of episcrobal area, or only feebly so, usually ending at level of scrobe (figs. 94, 96)[17] 78

74. Penis valve head as in fig. 97; Mexico to Guatemala . . . . . ***aucella*** Menke

– Penis valve head different (figs. 98, 99) 75

75. Propodeal side from upper metapleural pit to near hindcoxa with band of appressed silver setae, setae perpendicularly oriented to interface between lower metapleuron and propodeal side (fig. 93); labrum acuminate apically; scutum usually with some transverse ridges lateral to midline; scutum usually without median, longitudinal, silver stripe . . . . . ***cleopatra*** Menke

– Appressed silver setae of propodeal side, if present, not perpendicularly oriented to metapleural sulcus or interface; labrum various; scutum without cross ridges, or often coarsely rugosopunctate (New Jersey, Florida); scutum often with median silver stripe of appressed setae posteriorly 76

76 . Lower metapleuron without appressed silver setae; propodeal side with patch of appressed silver setae (fig. 103); clypeal appressed setae usually sparse or lacking anteromedially, exposing smooth, polished, scarcely punctate surface (fig. 83);[18] scutum without median longitudinal silver stripe ; Arizona to Texas and Costa Rica . . . . . ***picipes*** Cameron

– Lower metapleuron with some appressed silver setae which may or may not cross metapleural sulcus and extend onto propodeal side (fig. 104); appressed silver setae of clypeus variable; scutum sometimes with median longitudinal band of appressed silver setae 77

77. Penis valve head and spine as in fig. 99 ; legs black; widespread in North America . . . . . ***juncea*** Cresson

– Penis valve head and spine as in fig. 98 ; front and midlegs sometimes with reddish areas; southern Arizona, Mexico . . . . . ***dejecta*** Cameron

78. Gastral segment II red, tergum with narrow median longitudinal black spot, may widen posterad. 79

– Gastral segment II completely black, or only red basally and broadly black apically 80

79. Gastral sterna I-II or III red, remaining sterna black . . . . . ***dysmica*** Menke

– Gastral sterna I-VI red . . . . . ***parkeri*** Menke[19]

80. Gastral tergum I completely red;[20] penis valve as in fig. 100. . ***kennedyi*** (Murray)

– Gastral tergum I red but with median longitudinal black stripe ; penis valve as in figs. 101-102 . . . . . ***urnaria*** Dahlbom

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17 Specimens of *urnaria* from southern Florida can have considerable silver setae on the episcrobal area.

18 In specimens of *picipes* from Costa Rica the clypeus may be uniformly setose. Also Panamanian specimens of *gracilis* will key out here and the clypeus is uniformly setose.

19 Most *parkeri* males will key out at couplet 67.

20 Some Floridian *kennedyi* have a narrow black spot on tergum I but the penis valve is diagnostic.



Fig. 105, *wrightii*



Fig. 106, *formicoides*



Fig. 107, *monachi*

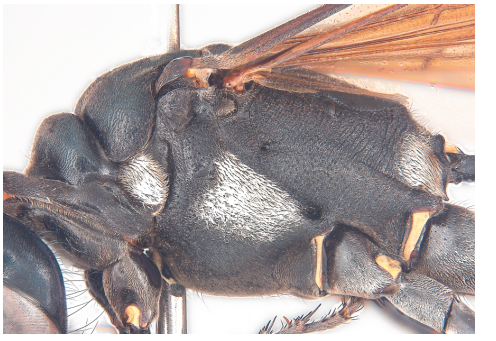


Fig. 108, *centralis*



Fig. 109, *femurrubra*



Fig. 110, *zanthoptera*



Fig. 111, *halleluja*



Fig. 112, *marshi*

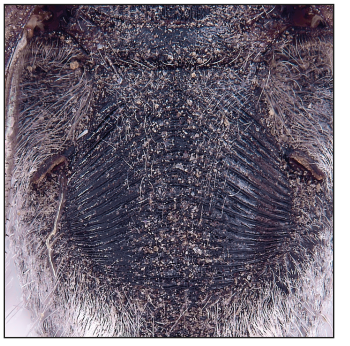


Fig. 113, *azteca*

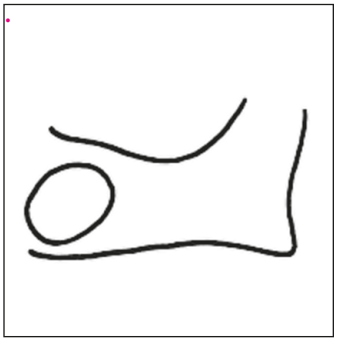


Fig. 114, *ferruginosa*

Females

81. Head mostly red 82
– Head black (clypeal margin sometimes reddish) 87
82. Metapleural flange expanded into an angular lamella (fig. 114); Great Plains, Great Basin, Arizona, northern Mexico. . . . . ***ferruginosa*** Cresson
– Metapleural flange not lamelliform 83
83. Pronotal collar without cross ridges, smooth; thorax red but pleura black, other parts of dorsum sometimes black . . . . . ***aphrodite*** Menke
– Pronotal collar with many fine cross ridges; thorax red 84
84. Scutum with fine, transverse ridges which are uninterrupted except at median longitudinal sulcus; collar flattened, elongate (figs. 105, 106); forewing often with only two submarginal cells 85
– Scutal ridges strongest posterolaterally, weaker anterolaterally, and lacking or feeble toward midline; collar arcuate in profile (fig. 107); forewing with three submarginal cells 86
85. Episcrobal area finely, longitudinally ridged, dull (fig. 105); metapleuron finely ridged; wings clear, forewing with two or three submarginal cells (figs. 21, 22). . . . . ***wrightii*** (Cresson)
– Episcrobal area polished (fig. 106), without ridges or weakly ridged; lower metapleuron weakly ridged or smooth; forewing tip and apex of median cell infumate, only two submarginal cells (fig. 20); southern Arizona, northwest Mexico . . . . . ***formicoides*** Menke
86. Lower metapleuron smooth, punctate, ridges lacking (except near propodeal side). . . . . ***burdi*** Menke
– Lower metapleuron with ridges, at least near metapleural sulcus; Nevada . . . . . ***monachi*** Menke
87. Propodeal enclosure dull, without appressed setae (fig. 109), but may have erect, hairlike setae (fig. 110) 88
– Propodeal enclosure shiny at least laterally, with appressed silver or gold setae mesally or some erect setae (figs. 111, 112, 113); sometimes asetose 100
88. Erect thoracic setae pale or absent 89
– Erect thoracic setae black 93
89. Legs partly to largely red . . . . . ***femurrubra*** Fox
– Legs black 90
90. Thoracic pleura without appressed silver setae;[21] propodeal enclosure with pale erect hairlike setae (fig. 110); Arizona, New Mexico, Mexico. . . . . ***zanthoptera*** Cameron
– Thoracic pleura with areas of appressed silver setae; propodeal enclosure asetose, ... 91
91. Petiole sternum black; episcrobal area and lower part of lower metapleuron dull; W. North America to Chihuahua . . . . . ***extremitata*** Cresson
– Petiole sternum red; Mexico 92

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[21] Mexican specimens may have a small silver spot near the midcoxa. Some specimens of *extremitata* lack appressed silver sete on the pleura (New Mexico) but the wings are dark.



Fig. 115, *cora*



Fig. 116, *zapoteca*



Fig. 117, *fernaldi*



Fig. 118, *mexica*

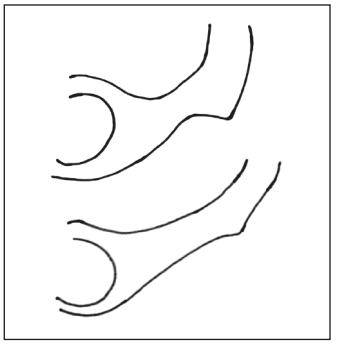


Fig. 119, *marshi*



Fig. 120, *harti* metapleural flange

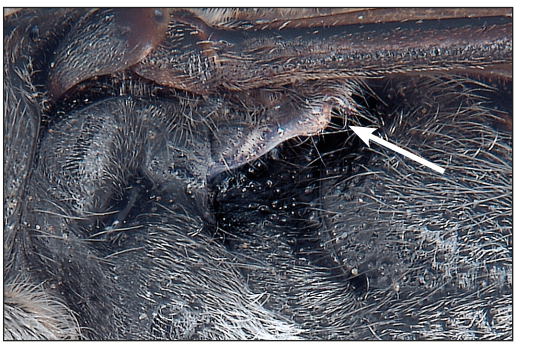


Fig. 121, *azteca* metapleural flange



Fig. 122, *nasalis*



Fig 123, *harti*

92. Episcrobal area asetose, shiny; pleural setal pattern as in fig. 115; episternal sulcus short; Jalisco, Nayarit, Morelos, and Chiapas . . . . . ***cora*** Cameron
– Episcrobal area covered with appressed silver setae (fig. 116); episternal suture long; Oaxaca . . . . . ***zapoteca*** Menke
93. Face and mesopleuron with appressed silver setae 94
– Face and thoracic pleura without appressed silver setae 95
94. Abdominal terga I-II mostly red; southern Texas to Venezuela . . . . . ***centralis*** Cameron
– Abdomen completely black; Coahuila, Mexico south to Panama and Venezuela . . . . . ***gaumeri*** Cameron
95. Wings dark stained, veins black or nearly so 96
– Wings often amber colored, not dark stained, veins amber to dark brown 97
96. Gastral tergum I red; southern Canada south to Texas and Mexico, east to Atlantic coast . . . . . ***nigricans*** Dahlbom
– Gaster entirely black; Mexico to Venezuela . . . . . ***gaumeri*** Cameron
97. Mesopleuron shiny 98
– Mesopleuron dull 99
98. Labrum apex triangular but without apical spine (fig. 117); wing veins yellowish; North America, Mexico . . . . . ***fernaldi*** (Murray
– Labrum apex with sharp spine (fig. 118); wing veins brown; central Mexico . . . . . ***mexica*** Menke
99. Wings amber colored . . . . . ***pictipennis*** Walsh & ***placida*** F. Smith[22]
– Wings light brown . . . . . ***mcclayi*** Menke
100. Episternal sulcus long, ending in sternal region 101
– Episternal sulcus short, ending opposite pronotal lobe 121
101. Metapleural flange broadly lamelliform, outer edge emarginate (figs. 120, 121); flange sometimes narrowly lamelliform, not emarginate (fig. 119) 102
– Metapleural flange not expanded into lamella 106
102. Legs mostly red; abdomen red except for black spot on gastral tergum V; Utah, northeastern Arizona . . . . . ***moenkopi*** Menke
– Legs completely black, or nearly so; petiole sternum black and at least gastral terga IV-V with black spots or mostly black 103
103. Clypeal free margin trapezoidal, margin broadly lamelliform, without teeth (fig. 122); midtibia with one apical spur; coast of California and Baja California . . . . . ***nasalis*** Provancher
– Clypeal free margin various but not broadly lamelliform, margin often with two teeth or angles; midtibia usually with two apical spurs 104
104. Mesopleural band of appressed silver setae ending at top of episcrobal area, subalar area also densely silvery setose (fig. 123); outer surface of forefemur with dense appressed silver setae; scutal fossae usually with silver setae; upper gena densely silvery setose along outer orbit; veins of forewing, at least Sc+R, orange red or reddish brown; eastern United States westward to Utah and northeastern Arizona . . . . . ***harti*** (Fernald)

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[22] Associated males are required for positive identification. *A. pictipennis* occurs in eastern North America as far west as about the 100th meridian and south into eastern Mexcio to Oaxaca. *A. placida* ranges over much of western North America and south into western Mexico.



Fig. 124, *azteca*



Fig. 125, *azteca*



Fig. 126, *pruinosa*

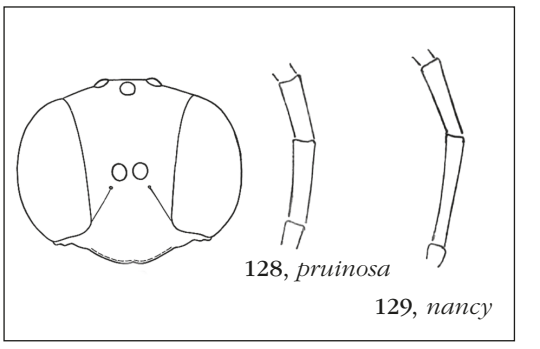


Fig. 127, *californica*



Fig. 130, *californica* female



Fig. 131, *pruinosa* female



Fig. 132, *linda* female underside of head

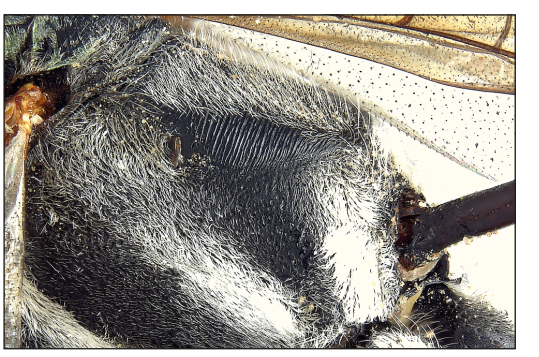


Fig. 133, *varipes*

– Mesopleural band of setae not reaching top of episcrobal area, usually ending at bottom of area at level of scrobe (fig. 124), or setae much sparser if band extends onto episcrobal area (fig. 125); outer surface of forefemur asetose; scutal fossa asetose; upper gena at most sparsely silvery setose; veins of forewing, at least Sc+R, brown or black. . . . . ***azteca*** Cameron . . . 105

105. Petiole tergum red, gastral tergum I red, and often II-III; mainland North America, and California islands: Santa Rosa, San Miguel, and Santa Cruz . . . . . ***azteca*** subspecies ***azteca*** Cameron

– Abdomen completely black; San Clemente Island, California . . . . . ***azteca*** subspecies ***clemente*** Menke

106. Thoracic pleura, including upper metapleuron, uniformly covered with appressed silver setae (fig. 126); legs partly red 107

– Upper metapleuron essentially glabrous; appressed silver setae of mesopleuron (if present) usually forming dense band along mesopleural suture, sparser elsewhere; legs partly red or entirely black 110

107. Inner orbits strongly converging below (fig. 127), lower interocular distance 37× head width; apex of folded proboscis reaching base of stipes, or surpassing it (fig. 130), if proboscis extended then galea length from apex to palpal socket clearly longer than length of stipes (galea 1.14× stipes length); clypeus largely asetose, free margin usually arcuate (median lobe rarely defined by lateral teeth), and usually with narrow, median notch; legs black or red and black . . . . . ***californica*** Menke

– Inner orbits slightly converging below (fig. 131), lower interocular distance .43-.44× head width; length of galea variable; clypeal details variable 108

108. Folded galea ending just short of stipes base (fig. 132) . . . . . ***linda*** Menke

– Folded galea ending at about middle of stipes 109

109. Flagellomere I length equal to about half lower interocular distance (FI .47-.53× LID); flagellomeres I-II as in fig. 128 . . . . . ***pruinosa*** Cresson[23]

– Flagellomere I length slightly more than half the lower interocular distance (FI 0.56-0.62× LID); flagellomeres I-II slender, elongate (fig. 129) . . . . . ***nancy*** Menke

110. Erect head setae pale; legs black or partly red. 111

– Erect head setae black at least on vertex; legs black 115

111. Mesopleural band of setae not reaching top of episcrobal area, usually ending at level of scrobe, or setae much sparser if band extends onto episcrobal area (fig. 124); legs black . . . . . ***azteca*** Cameron

– Mesopleural band of setae ending at top of episcrobal area (fig. 134); legs red and black or all black 112

112. Appressed silver setae of collar densest posteriorly, forming transverse band along hind margin (fig. 136); legs red and black; galea not surpassing midpoint of stipes when folded . . . . . ***breviceps*** F. Smith

– Collar without strong silver band posteriorly; galea length variable.. 113

113. Propodeal dorsum with erect pale setae mesally (fig. 133). . . . . ***varipes*** Cresson

– Propodeal dorsum without erect setae, only appressed silver setae mesally . . . 114

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[23] One or more undescribed species will key out here. Associated males offer the best way of determining true females of *pruinosa*.



Fig. 134, *breviceps*



Fig. 135, *peckhami*



Fig. 136, *breviceps*



Fig. 137 *strenua* female



Fig. 138, *acuta* female



Fig 139, *karenae*

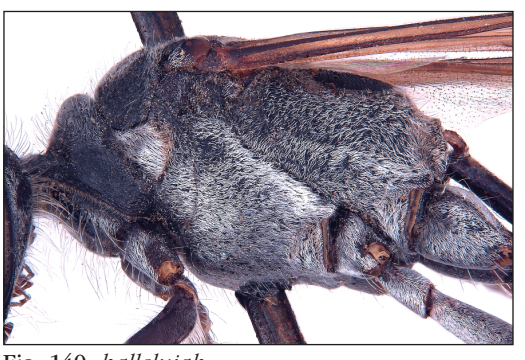


Fig. 140, *hallelujah*

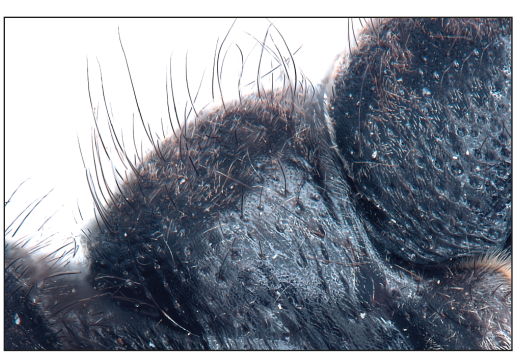


Fig. 141, *evansi* female



Fig. 142, *evansi*

114. Upper metapleuron glabrous; lower metapleuron with broad band of appressed silver setae that extends onto propodeal side to near wing bases (fig. 139); scutum usually with cross ridges or rugae; legs black and red, or black. . . . . ***karenae*** Menke
– Upper metapleuron with sparse appressed silver setae; lower metapleuron with sparse appressed silver setae that do not form band, propodeal side without broad band of appressed silver setae (fig. 140); scutum without ridges ; legs black but mid and hindtarsi usually reddish . . . . . ***hallelujah*** Menke
115. Appressed setae of clypeus and frons brownish or black 116
– Appressed setae of clypeus and frons silver 117
116. Collar profile short, tall . . . . . ***mediata*** Cresson
– Collar elongate, abruptly rising from streptaulus, then curving back gradually (fig. 141) . . . . . ***evansi*** Menke
117. Thoracic pleura without appressed silver setae or sometimes a small patch by mid-coxa and petiole socket. . . . . ***mediata*** Cresson
– Thoracic pleura with band of silver setae along mesopleural sulcus. 118
118. Flagellomere I length nearly equal to width of clypeal lobe (65:63); clypeal outline as in fig. 137); usually only gastral segments I-II red . . . . . 119[24]
– Flagellomere I length obviously more than width of clypeal lobe (70:59); clypeal outline as in fig. 138; gastral segments I-III red 120
119. Shape of collar in profile as in fig. 143 . . . . . ***strenua*** Cresson
– Shape of collar in profile as in fig. 144 . . . . . ***peckhami*** (Fernald)


Fig. 143, *strenua*


Fig. 144, *peckhami*


Fig. 145, *regina*


Fig. 146, *acuta*

[24] Positive identification requires associated males.



Fig. 147, *conditor*



Fig. 148, *stangei*



Fig. 149, *polita*



Fig. 150, *murrayi*



Fig. 151, *marshi*



Fig. 152, *conditor*



Fig. 153, *nefertiti* female



Fig. 154, *coachella* female

120. Lower metapleuron without band of appressed silver setae along metapleural sulcus (fig. 145); collar usually flattened lateral to midline . . . . . ***regina*** Menke
– Lower metapleuron usually with band of appressed silver setae along metapleural sulcus (fig. 146); collar evenly rounded from side (rarely slightly flattened), collar sometimes cut-off at streptaulus, truncation cariniform above . . .***acuta*** (Fernald)
121. Collar with fine or coarse transverse ridges. 122
– Collar smooth, variously punctate, without ridges 139
122. Metapleural flange not lamelliform 123
– Metapleural flange expanded into lamella (figs. 155, 156, 157) (narrowly so in ***marshi,*** fig. 119) 128
123. Pronotal side with appressed silver setae or scale-like micropubescence; free margin of clypeus without two teeth 124
- Pronotal side essentially glabrous; clypeal free margin usually with two teeth 125
124. Profile of pronotal collar as in fig. 148; legs black . . . . . ***stangei*** Menke
– Profile of pronotal collar as in fig. 149; legs partly red or all black. . . . . ***polita*** Cresson
125. Forewing with only two submarginal cells (fig. 11). . . . . ***nearctica*** Kohl
– Forewing with three submarginal cells 126
126. Labrum strongly acuminate; collar short, in profile (fig. 150) . . . . ***murrayi*** Menke
– Labrum rounded or truncate; collar long, gradually sloping up from streptaulus in profile (figs. 147, 149) 127
127. Legs often partly red; metapleural flange not lamelliform. . . . . ***polita*** Cresson[25]
– Legs black; metapleural flange narrowly lamelliform, the edge slightly angulate (figs. 119, 151) . . . . . .***marshi*** Menke[26]
128. Pronotal side glabrous 129
– Pronotal side covered with appressed silver setae or scale-like micropubescence 134
129. Legs red except for coxae and trochanters. . . . . ***parapolita*** (Fernald)
– Legs black 130
130. Clypeal free margin without teeth or angles (fig. 152); metapleural flange broad, outer margin strongly angulate (fig. 147); Atlantic coastal states . . . . ***conditor*** F. Smith
– Clypeal lobe defined by two angles; outer margin of metapleural flange arcuate (fig. 157); or angulate (figs. 155, 156) 131
131. Labrum strongly acuminate; size large, average length 29 mm. or more; metapleural flange as in fig. 157 132
– Labrum rounded or truncate; average length 14-20 mm., metapleural flange angulate (figs. 157-156) 133
132. Scutal fossae with dense appressed silver setae (as seen from behind) (fig. 160); collar usually with small posteromedian patch of appressed silver setae; lower metapleuron with band of appressed silver setae along metapleural sulcus (fig. 159); erect head setae black (eastern United States) or partially pale (western United States); gena with appressed silver setae (western United States only) . . . . . ***procera*** Dahlbom

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25 Most *polita* will key out at couplet 124.
26 Most *marshi* will key out at couplet 133.



Fig. 155, *bohartí*



Fig. 156, *ferruginosa*



Fig. 157, *procera* metapleural flange



Fig. 158, *parapolita* female



Fig. 159, *procera*



Fig. 160, *procera*



Fig. 161, *macra*



Fig. 162, *leoparda*



Fig. 163, *mimica*

– Scutal fossae glabrous; collar without posteromedian patch of appressed silver setae (fig. 161); lower metapleuron without appressed silver setae along metapleural sulcus, or with very feeble patch of setae; erect head setae black; gena without appressed silver setae; west of 100th meridian . . . . . ***macra*** Cresson

133. Gastral terga I-II red; metapleural flange broadly lamelliform (fig. 155) . . . . . ***boharti*** Menke

– Gastral terga I-II with black spots, or if red then metapleural flange is narrowly lamelliform (fig. 119). . . . . ***marshi*** Menke

134. Scutum with pair of submedian, longitudinal, raised welts that are punctate and shiny; scutum laterally with transverse ridges that may be weak 135

– Scutum without welts, but with cross ridges that reach median sulcus. 136

135. Clypeal lobe slightly wider than lateral free margin (fig. 153); Great Basin and adjacent cold desert regions . . . . . ***nefertiti*** Menke

– Clypeal lobe obviously wider than lateral free margin (fig. 154); deserts of southern California and southern Nevada . . . . . ***coachella*** Menke

136. Collar with only a few coarse wrinkle-like ridges, collar sometimes cutoff at streptaulus . . . . . ***unita*** Menke[27]

– Collar with many fine or coarse ridges 137

137. Clypeal disk flat or very slightly bulging; collar as in fig. 155; California, Oregon, western Nevada and northern Mexico . . . . . ***boharti*** Menke

– Clypeal disk moderately bulging; collar as in fig. 156; Great Plains, Great Basin, Washington, eastern California, Arizona, northern Mexico . . . . . ***ferruginosa*** Cresson[28]

139. Metapleural flange broadly lamelliform, outer margin strongly angulate or excised (figs. 162, 163) 140

– Metapleural flange not lamelliform or narrowly so 143

140. Inner orbits converging below (fig. 165); clypeal free margin without teeth (fig. 165); scutum without transverse ridges; eastern United States to central Texas . . . . . ***leoparda*** (Fernald)

– Inner orbits parallel; clypeal free margin with two teeth; scutum with transverse ridges; western United States 141



Fig. 164, *hermosa* female



Fig. 165, *leoparda* female

[27] *A. unita* will usually key out at couplet 142.

[28] Most specimens of *ferruginosa* are mostly red and will key out at couplet 82.



Fig. 166, *novita*



Fig. 167, *parkeri*



Fig. 168, *bellula*



Fig. 169, *aellos*

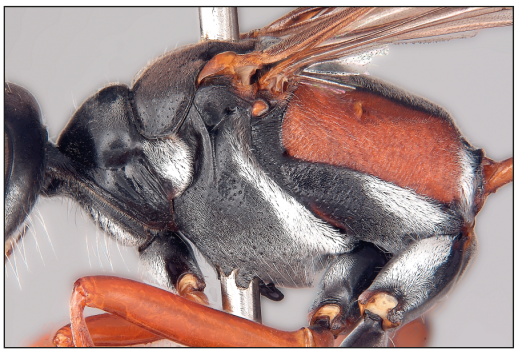


Fig. 170, *hermosa*



Fig. 171, *aberti*

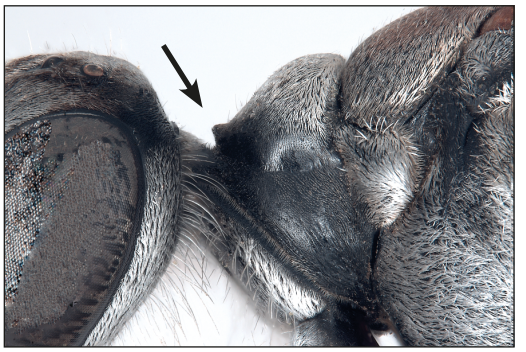


Fig. 172, *mescalero*



Fig. 173, *urnaria*

141. Abdomen entirely red;[29] southern California, southern Arizona, Baja California. . . . . ***novita*** (Fernald)
– Gastral terga III-IV with black spots; petiole frequently partly black . . . . . .142[30]
142. From Great Basin and adjacent desert areas . . . . . .***unita*** Menke
– From southern California deserts and Arizona . . . . . ***mimica*** Menke
– From southeastern Arizona (Cochise Co.) . . . . . ***imitator*** Menke
143. One or more pairs of legs partially[31] or completely red[32] 144
– All legs black 151
144. Gastral terga III-V with continuous black stripe, stripe sometimes continuous on terga II-VI , sometimes III-IV broadly black, abdomen sometimes entirely red (fig. 167); episcrobal area usually not obscured by dense, appressed silver setae . . . . . ***parkeri*** Menke
– Gastral terga all red, or with black maculations that are broad or circular on terga III-V or IV-V; episcrobal area wholly or partly obscured by dense, appressed, silver or gold setae. 145
145. Dense, appressed silver setae along mesopleural suture interrupted at level of scrobe, then narrowly continued on rear part of episcrobal area as wedge-shaped patch (fig. 168); southern Arizona, southern New Mexico, western Texas, Mexico . . 146
– Dense, appressed silver or gold setae along mesopleural suture continuous (at least narrowly so) to top of episcrobal area (figs. 147, 171). 147
146. Collar strongly humped, with slight overhang at streptaulus; southern Arizona, southern New Mexico, western Texas, Mexico. . . . . ***bellula*** Menke
– Collar shorter, without overhang; southern Arizona, Mexico . . . . . ***bella*** Menke
147. Legs mostly black but inner surface of forefemur and tibia usually reddish, mid and hindfemora sometimes with reddish areas; scutum usually with median longitudinal band of appressed silver setae; southern Arizona, Mexico . . . . . .***dejecta*** Cameron
– Legs largely red, coxae and trochanters usually black; scutum usually without silver median band 148
148. Pronotal collar with elevated rim just above streptaulus (fig. 172); southwestern United States except California, Mexico . . . . . ***mescalero*** Menke
– Pronotal collar gradually curving up from streptaulus 150
149. Appressed setae of head and thorax golden (fig. 169); Jalisco and Morelos, Mexico . . . . . .***aellos*** Menke
– Appressed setae of head and thorax silver; western North America and Mexico.148
150. Thorax elongate (fig. 171); large wasps, averaging 25 mm long; propodeal side black (rarely partly red); scutal fossa with appressed silver setae . . . . ***aberti*** Haldeman
– Thorax more globose (fig. 170); smaller wasps, average length less than 21 mm; propodeal side wholly or partly red (rarely black); scutal fossa without silver setae . . . . . ***hermosa*** Menke

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29 Some specimens of *novita* may have a black spot on tergum IV.
30 Identification of females is difficult except by association with males and/or distribution.
31 Females of *dejecta* have reddish color at least on the inner surface of the foretibia and forefemur.
32 Some Nevada specimens are almost all black.



Fig. 174, *dysmica*



Fig. 175, *picipes*

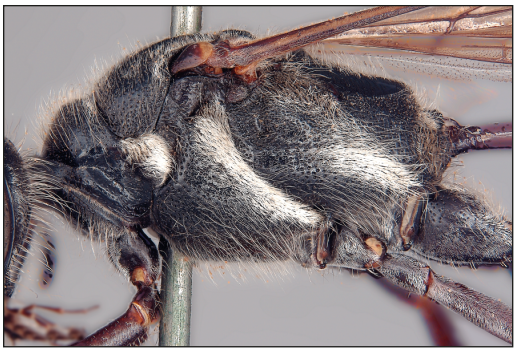


Fig. 176, *aucella*



Fig. 177, *cleopatra*



Fig. 178, *juncea*

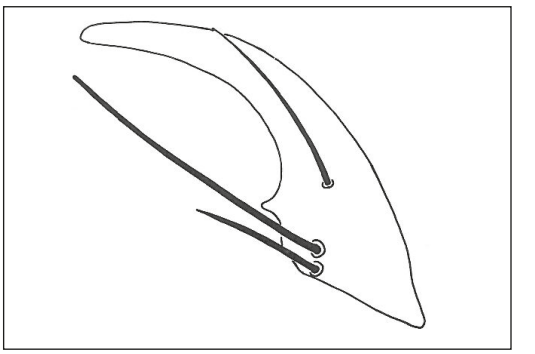


Fig. 179, claw of *pictipennis*

151. Mesopleural band of appressed silver setae ending at top of episcrobal area, if band only extends weakly onto episcrobal area, then following combination of characters present: metapleuron with well defined band of setae along metapleural sulcus, only gastral segment I red, and scutum with posteromedian silver stripe . . . . . 152[33]

– Mesopleural band of setae ending at bottom of episcrobal area (fig. 173),[34] if band weakly extends onto episcrobal area, then metapleuron without well defined band of silver setae (except some western ***kennedyi***); gena without appressed silver setae . . . . . 155[35]

152. Lower metapleuron without band of appressed silver setae; propodeal side with patch of appressed silver setae which is sometimes small and indistinct (fig. 175); gena covered with appressed silver or dark setae; southern Arizona to northeastern and southern Texas to Costa Rica . . . . . ***picipes*** Cameron[36]

– Lower metapleuron with band of appressed setae along metapleural suture (figs. 174, 176, 177, 178); gena densely covered with appressed silver setae (except in some specimens from Atlantic Seaboard) 153

153. Scutal fossa with appressed silver setae; Mexico, Guatemala . . . . . ***aucella*** Menke

– Scutal fossa without appressed silver setae 154

154. Propodeal side next to metapleural-propodeal interface with silver appressed setae that are vertically oriented (fig. 177); scutum usually feebly transversely ridged or wrinkled; tegula frequently orange or reddish brown; North America, northern Mexico . . . . . ***cleopatra*** Menke

– Propodeal side with or without band of silver setae (fig. 178); tegula black; scutum smooth except in most specimens from eastern United States; scutum with median silver stripe; western North America, Atlantic seaboard, northern Mexico . . . . . ***juncea*** Cresson

155. Clypeus and frons with appressed silver setae (as seen from above); lower metapleuron minutely roughened, not strongly shining; western United States ***dysmica*** Menke

– Face without appressed silver setae, or at least only feebly silvery (as seen from above); appressed setae dark; lower metapleuron smooth, strongly shining . . . 156

156. Pronotal lobe completely covered with dense appressed silver setae (anterior view); widespread in the United States . . . . . ***kennedyi*** (Murray)

– Pronotal lobe with dense silver setae only posteriorly, setae sparse or lacking anteriorly (anterior view); Rocky Mountains to Atlantic Coast. . . . . ***urnaria*** Dahlbom

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[33] The following females are often difficult to identify without associated males.

[34] *A. dysmica* can be a problem here.

[35] The following females are often difficult to identify without associated males.

[36] Panamanian specimens of *Ammophila gracilis* will key out here.

NIGRICANS SPECIES GROUP

Diagnosis: The dull appearance of the propodeal enclosure is diagnostic for the *nigricans* group. The surface typically has many close transverse ridges which are uniform across the width of the enclosure. The interspaces are granulate (figs. 41, 109, 110). The surface is asetose in seven species (*apicalis, cora, extremitata, femurrubra, mcclayi, pictipennis*, *placida*). In addition, the mesosoma in most North American species is largely devoid of appressed silver setae and the integument is mostly dull black or opaque. The collar and scutum do not have ridges. The episternal sulcus is usually long, ending in the ventral region (sometimes indistinct below pronotal lobe or lacking in *apicalis*, *pictipennis*, *extremitata, placida* and *nigricans* males and both sexes of *cora*). The metapleural flange is not lamelliform. The forewing has three submarginal cells. The free margin of the male clypeus is essentially truncate apically, the truncation sometimes broadly, shallowly emarginate. The hypostoma in the male does not have a process. The penis valve head usually has a basal spine (except in *apicalis*, *extremitata* and *pictipennis*). Some species in the *nigricans* group have bluish micropubescence on the head and mesosomal dorsum, and in a few species it covers the entire body. Females of six species (*cora*, *extremitata*, *femurrubra*, *pictipennis*, *placida,* and *zapoteca*) usually have a minute tooth on the inside edge of the claw near the base (fig. 179). The other species sometimes have a poorly defined tooth on the claw.

Included species: *Ammophila centralis* Cameron, *cora* Cameron, *extremitata* Cresson, *fernaldi* (Murray), *femurrubra* Fox, *gaumeri* Cameron, *mcclayi* Menke, *mexica* Menke, *nigricans* Dahlbom, *pictipennis* Walsh, *placida* Smith, *zanthoptera* Cameron, and *zapoteca* Menke.

One other New World species in the group is the West Indian *apicalis* (Guérin-Méneville). I have seen two females from Mexico (7 mi. N Tehuacan, 6000', Puebla, and 26 mi. SE of Oaxaca, 5300', Oaxaca, both KSU) that look like *apicalis* but the erect mesosomal setae are black. These setae are white in *apicalis*. So these two females may represent a new species.

Discussion: The male genitalia, especially the penis valve and gonocoxite, display excellent specific differences in most species of this group. The shape of abdominal sternum VIII is useful. The presence or absence of appressed silver setae on the face, pronotal lobe and other mesosomal areas is of considerable value in species discrimination. Erect thoracic setal color is black except in *cora*, *extremitata* and *femurrubra* which have pale setae. Wing color is often diagnostic when used with other characters.

Distribution: The *nigricans* group is restricted to North and Central America, and the northern edge of South America (Venezuela, Colombia). The Palearctic *hungarica* group has similar features.

***Ammophila centralis* Cameron**

Figures 24, 108, 181, Map 1.

Ammophila centralis Cameron, 1888. Biologia Centrali-Americana 2:6. Lectotype: male, El Reposo, Guatemala (BMNH), designated by Menke, 1976:151. Type studied.

Ammophila consors Cameron, 1888. Biologia Centrali-Americana 2:12. Lectotype: male, Temax, Yucatán, Mexico (BMNH), designated by Menke, 1976:151. Synonymy by Menke 1976:151 and 1996:192. Type studied.

Ammophila nigrocaerulea Cameron, 1888. Biologia Centrali-Americana 2:12. Lectotype: female, San Geronimo, Guatemala (BMNH), present designation. Synonymy by Menke, 1976:151 and 1996:192. Type studied.

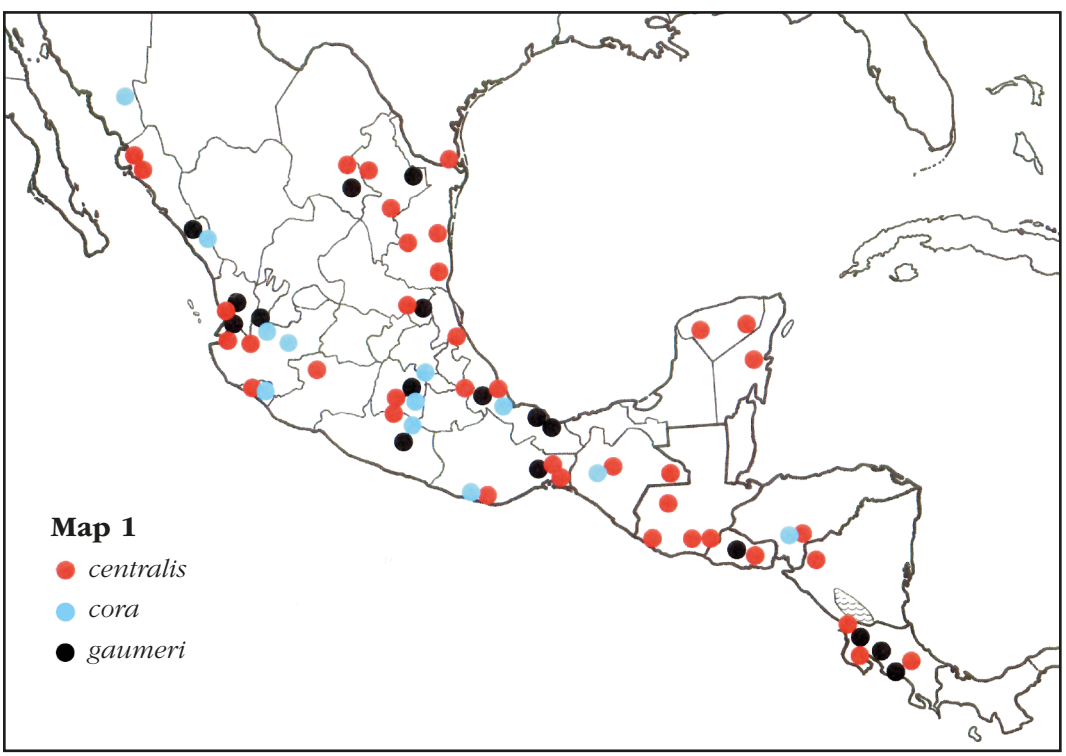
Recognition: The silver facial setae of the female, and large, roughly triangular patch of appressed silver setae on the mesopleuron (fig. 108) are diagnostic for this sex. Males also have a silver face but the extensive appressed silver setae of the pleura are distinctive. The male abdomen is usually all black, but rarely the petiole tergum and gastral tergum I are red laterally. The apex of the gonocoxite with only one or two long, stout setae at the outer corner is also diagnostic (fig. 24). Erect head and mesosomal setae are black. The female clypeal lobe is sharply delimited and its width is less than the length of flagellomere I (fig. 181). Typically the female petiole tergum and gastral tergum I are red, but in some Venezuelan specimens tergum II is red basally. The entire abdomen is black in some Costa Rican and Venezuelan females. Females are 16-23 mm long, and males are 16-20 mm.

Geographic range (map 1): *Ammophila centralis* is a common Central American species. Its range includes extreme southern Texas: Cameron and Hidalgo Counties. The species also occurs in northern Venezuela and probably Columbia.

Ammophila cora **Cameron**

Figures 59, 115, Map 1.

Ammophila cora Cameron, 1888. Biologia Centrali-Americana, 2:14. Lectotype: male, San Geronimo, Guatemala (BMNH), designated by Menke, 1976:151. Type studied.



Recognition: The pattern of appressed silver setae on the pleura is distinctive in both sexes (fig. 115). The episcrobal area lacks appressed silver setae and is shiny. The episternal sulcus is short. The erect head and mesosomal setae are pale, and the propodeal dorsum is asetose. The female labrum of *cora* is truncate and the petiole is red. Females of *extremitata* are similar but the episcrobal area is not shiny and the petiole is black. The enlarged stalk of the penis valve just below the head also helps identify males of *cora* (fig. 59). Females are about 18 mm long, males are 16-20 mm.

Geographic range (map 1): This species is widespread in Mexico: Sonora to Chiapas. I have also seen material from Honduras (USNM).

Ammophila extremitata **Cresson**

Figure 47.

Ammophila extremitata Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:457. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916:94. Type studied.

Recognition: The pale erect head and mesosomal setae is a feature only shared with females of *cora, femurubra* and *zapoteca*, but *femurrubra* females have partly red legs, and *extremitata* has black legs. The female clypeus is flat in *extremitata* while in *femurrubra* it is tumescent. The female labrum is truncate in *extremitata*. Appressed silver setae on the mesopleuron of females is somewhat similar to *cora* but is not as sharply defined Some females have hardly any silver pleural setae. Also in *cora* the episcrobal area and the lower metapleuron are shiny. In *extremitata* these areas are dull, and sometimes covered with appressed silver setae. Males of *extremitata* are most similar to *femurrubra* but the head measurements given in the key usually separate the two species. The eighth sternum is is hour-glass shaped similar to fig. 47. Females are 12-17 mm long, males are 14-17 mm.

Nomenclature: Although Cresson spelled *extremitata* with an "i" in his description, he referred to his species as *extrematata* in subsequent papers.

Geographic range: *A. extremitata* occurs widely in the western United States and occurs as far north as British Columbia, Alberta, and east to western Kansas. There are records also from Chihuahua, Mexico.

Ammophila femurrubra **W. Fox**

Figures 41, 60, 109.

Ammophila femurrubra W. Fox, 1894. Proceedings of the California Academy of Sciences (2)4:102. Lectotype: female, San Jose del Cabo, Baja California Sur (CAS), designated by Menke, 1966a:2392. Type studied.

Ammophila volcanica Cameron, Fernald, 1934. North American and West Indian digger wasps of the genus *Sphex* (*Ammophila* auct.), p. 54.

Recognition: The partly to extensively red legs of *femurrubra* females are distinctive in the *nigricans* group. The band of appressed silver setae along the mesopleural suture ends at the bottom of the episcrobal area. The female clypeus is tumescent while in *extremitata* it is flat. Males of *femurrubra* have black legs and thus are similar to *extremitata* but the penis valve head of the latter species lacks a basal spine. Occasional males

have some red on the legs. Both species have pale erect setae on the head and thorax. Females are 15-17 mm long, males are 12-19 mm.

I have seen one female from Huajuapan, Oaxaca, Mexico (KSU) that is very similar to *femurrubra* but the legs are black and the band of appressed silver setae along the mesopleural sulcus extends to the top of the eipscrobal area. More material is need to ascertain the status of this specimen.

Nomenclature: Fernald (1934) confused *volcanica* Cameron with *femurrubra* Fox.

Geographic range: *Ammophila femurrubra* is found in desert areas from southeastern California to southeastern Colorado, western Texas, and south into Baja California, Guerrero and Puebla, Mexico.

***Ammophila fernaldi* (Murray)**

Figure 117.

Sphex fermaldi Murray, 1938. Annals of the Entomological Society of America 31:19. Holotype: female, Luverne, Minnesota (UM). Type studied.

Recognition: This species most closely resembles *placida* and *pictipennis* but the shiny pleura immediately identifies *fernaldi*. The pleura are dull in *placida* and *pictipennis*. The mesosoma has appressed silver setae next to the petiole socket in southern Arizona and Mexico. Females of *fernaldi* are 16-20 mm long, males are 15-20 mm.

Variation: Over most the range females do not have patches of appressed silver setae on each side of the petiole socket, but in southern Arizona and Mexico there are large silver patches next to the socket.

Geographic range: *Ammophila fernaldi* is a commonly collected species and it occurs over much of the eastern United States and ranges west through the Great Plains to eastern Colorado, Arizona, Montana, and Manitoba in Canada. *A. fernaldi* occurs over much of Mexico. I have seen a specimen of *fernaldi* labeled as collected in Bishop, California (UCD) which may be a spurious record.

***Ammophila gaumeri* Cameron**

Figure 23, Map 1.

Ammophila gaumeri Cameron, 1888. Biologia Centrali-Americana, 2:4. Lectotype: female Temax, Yucatán, Mexico (BMNH), designated by Menke, 1976:152. Type studied.

Ammophila micans Cameron, 1888. Biologia Centrali-Americana, 2:5. Lectotype: female, San Geronimo, Guatemala, present designation (BMNH). Synonymy by Fernald, 1934:114. Type studied.

Recognition: The completely black body identifies both sexes of *gaumeri*. The mesopleuron of the female may have a small patch of appressed silver setae near the midcoxa, but many have none. Males have a sparse silver band along the mesopleural suture. The lower metapleuron may have some appressed silver setae. The propodeal enclosure has black erect setae as do the head and mesosoma. The male genitalia are also diagnostic (fig. 23). No other Central American species resembles *gaumeri* except for *nigricans* whose gaster is partially red. Females are 21-28 mm long, males are 17-23 mm.

Geographic range (map 1): This species occurs from northern Mexico (Sinaloa, Coahuila) south to the northern edge of Venezuela and Colombia.

Ammophila mcclayi Menke

Figure 46.

Ammophila mcclayi Menke, 1964. Acta Hymenopterologica 2:24. Holotype: male, Woody, Kern Co., California (CIS).

Recognition: This species is very difficult to identify. It is very similar to *placida* but the wing veins are brown or black in *mcclayi* and they are reddish in *placida* males and yellowish red in *placida* females (on the basal half). The erect head and mesosomal setae are black in both species. In the female I called attention to the pair of broad scutal bands in the original description, but I have found that they are sometimes seen in *placida* and *extremitata*, and thus are of no use for identiflying *mcclayi*. Also they are not always evident. Abdominal sternum VIII in the male is parallel sided in *mcclayi.* In *placida* is it hour glass shaped. The penis valves of the two species are similar (fig. 48, *placida*) but the penis valve head spine is usually shorter in *mcclayi.* Females are 17-20 mm long, males are 14-17 mm.

Geographic range: *Ammophila mcclayi* occurs from British Columbia to northern Baja California. It is also found in Arizona, New Mexico, and Nevada. The species occurs on three of the California Channel Islands: Santa Cruz, San Clemente, and Santa Catalina.

Ammophila mexica Menke, new species

Figures 118, 182.

Recognition: Females of *mexica* resemble *fernaldi* but the labrum has a sharp projection apically (fig. 118). The female labrum of *fernaldi* is triangular or rounded apically and lacks a tooth. Also there is no patch of appressed silver setae next to the petiole socket (fig. 182) in females of *mexica*. In Mexico females of *fernaldi* have a patch of silver setae there. The male of *mexica* lacks appressed silver setae on the mesosoma. Males of *fernaldi* have silver setae on the pronotal lobe and next to the petiole socket. The genitalia of *mexica* are quite different from *fernaldi.* The gonocoxite has a row of stout fringing spines similar to *gaumeri* (see fig. 23).

Description:

Holotype female: Length 20 mm.

Color: Black; petiole tergum and gastral segment I red, segment II red basally, rest of gaster bluish black; wing veins dark brown, membrane lightly stained.

Vestiture: Head and mesosoma (including propodeal enclosure) with dense, black, erect setae; head and mesosoma without silver setae.

Structure: Clypeus with broad, prominent lobe, its width more than length of flagellomere I (36:27); labrum with prominent apical tooth; mesopleuron and lower part of lower metapleuron shiny, episternal sulcus long, ending ventrally; claws not toothed.

Male: Length 20 mm.

Color: Like female but petiole tergum with black stripe, and gastral segment II is black.

Vestiture: Same as female.

Structure: Clypeus projecting with broad, deep emargination; labrum without apical tooth; gonocoxite with fringing row of stout spines (somewhat similar to *gaumeri* (fig. 23); penis valve head unlike that of *gaumeri*, but similar to *urnaria*.

Type material:

Holotype female: MEXICO, Morelos, Cuernavaca, Crawford (UCD). One female paratype with same data (UCD). One female paratype from mountains near Curenavaca, Mexico, Crawford (ASM). One paratype male: Mexico, Michoacán, 5 km W Zacapu, July 13, 1951, P. D. Hurd (UCD).

Etymology: The word mexica was the name the Aztecs gave themselves. It is pronounced "me-shee-ka". It is a noun in apposition.

Ammophila nigricans Dahlbom

Ammophila nigricans Dahlbom, 1843. Hymenoptera Europaea praecipue borealia. Tomus *Sphex* in sensu Linnaeano, 1(fasc. 1), p. 14. Holotype: male, South Carolina (LUND).

Ammophila intercepta Lepeletier de Saint-Fargeau, 1845. Histoire Naturelle des Insectes Hyménoptères. 3:378. Holotype: female, Amérique Septentrionale (TURIN). **New synonymy.** Type studied.

Recognition: These are big wasps averaging about 23 mm in length. Some females reach 30 mm. The largely black body, black erect head and mesosomal setae, and the very dark wings readily identify this species in North America. The pleura typically lack appressed silver setae. In the female the petiole tergum and gastral segment I are typically red. Males are similarly colored although they vary to completely black. The penis valve is distinctive. Females are 22-30 mm long, males are 15-25 mm.

Nomenclature: I have not seen Dahlbom's type, but R. M. Bohart studied it in 1960 and verified the identity of *nigricans*. I have also seen a homotype made by Fernald (USNM).

Geographic range: This well known species ranges from southeastern Canada to Texas and east to the Atlantic Coast. It also occurs in Mexico (Michoacan: Areo de Rosales (LOGAN). *A. nigricans* is not found west of the Rocky Mountains although I have seen a female labeled Magdalena Mts., NM which may be a spurious record (west of Socorro, CUI).

Ammophila pictipennis Walsh

Figures 49, 179, Map 2.

Ammophila pictipennis Walsh, 1869 (June). The American Entomologist 1:128, fig. 100. Syntypes: male and female, South Illinois, presumably in Chicago Academy of Science (see Entomologist and Botanist 2:275, 1870). See also 1:164 where material from Colorado is cited. Type material is presumably destroyed.

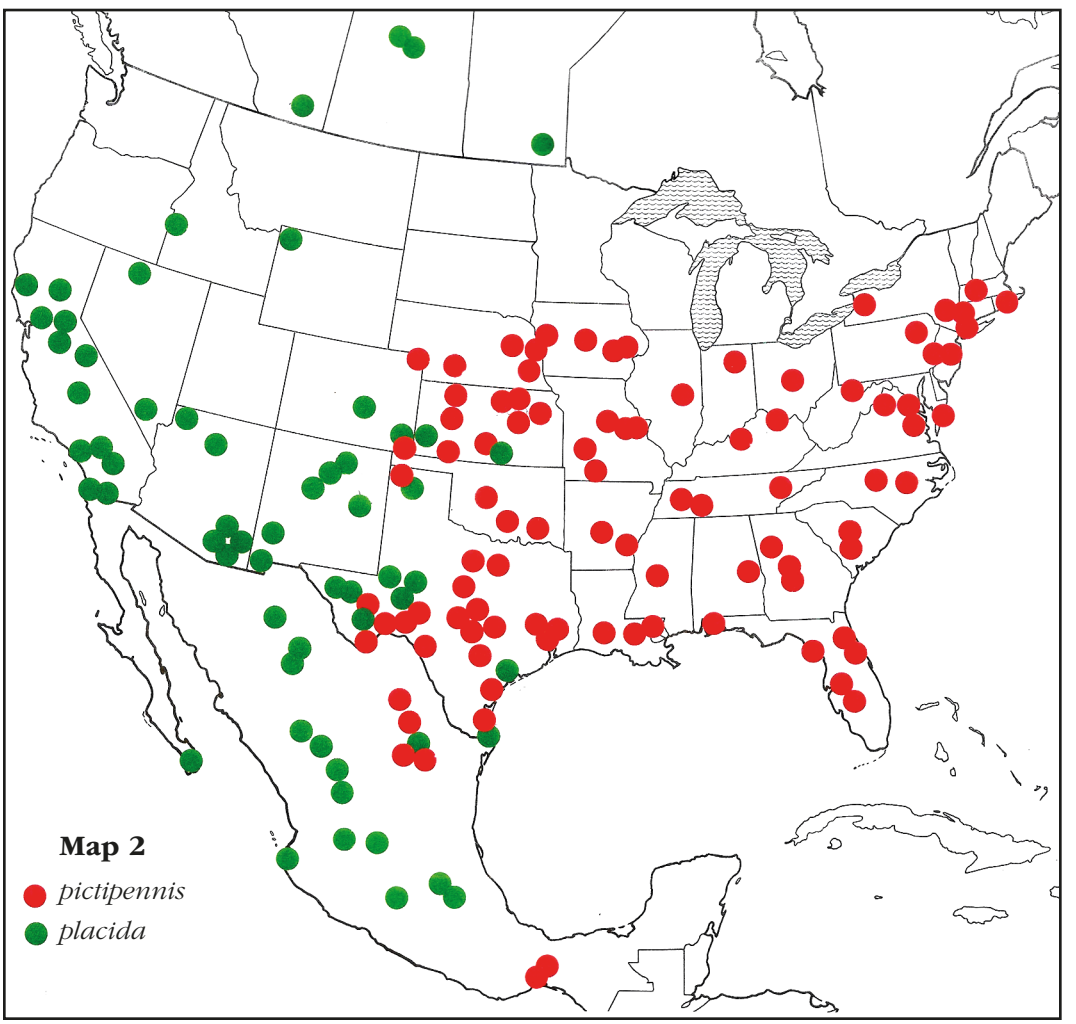
Ammophila anomala Taschenberg. 1869 (December). Zeitschrift für die gesammten Naturwissenschaften Halle 34:434. Lectotype: female, Illinois (HALLE), designated by Menke, 1976:153. Synonymy by Menke 1966a:2392. Type studied.

Sphex nigropilosus Rohwer, 1912. Proceedings of the United States National Museum 41:465. Holotype: female, Distrito Federal, Mexico (USNM). Type studied. Tentative synonymy.

Recogniton: The amber forewings and veins identify this species. The forewing is darker on the apical third. A large (21 rmm long) male from Sioux City, Iowa and a smaller male from Columbia, Missouri have a small amount of appressed silver setae on the meso- and metapleuron and also on the propodeal side near the petiole socket, but generally the pleura in *pictipennis* are devoid of appressed silver setae. Females of *pictipennis* are identical with those of *placida* and identification requires associated males in the areas

of overlap of the two species. The penis valve head of *pictipennis* does not have a spine (fig. 49). The male of *placida* has a spine on the penis valve head (fig. 48). Both species have black erect setae on the head and mesosoma. It is possible that only one species is involved and that the presence or absence of a penis valve head spine is geographic variation. However, the distribution of both species overlaps broadly in Texas (based on the penis valve) which suggests that they are different taxa. Also, I have not seen any intermediate spines on specimens, so I regard them as separate species. The labrum in females is truncate and the edge is usually slightly concave. The same is true for females of *placida*. Females are 19-22 mm. long, males are 14-21 mm.

The West Indian species *apicalis* shares the simple penis valve of *pictipennis* but the mesosoma of *apicalis* has considerable appressed silver setae as does the face. *Ammophila apicalis* shares the black erect setae on the head and mesosoma. The mesosoma of *pictipennis* usually lacks apppressed silver setae, but sometimes the pleura have small patches as noted above. The face of *pictipennis* lacks silver setae except in males from Oaxaca, Mexico.



Nomenclature: *Ammophila pictipennis* has generally been considered a synonym of *placida*. Taschenberg's description of *anomala* was published in late 1869 (November-December) while Walsh's name apparently appeared in the spring of the same year, hence *pictipennis* has priority over *anomala*. The types of *pictipennis* have been destroyed. Fernald (1934) studied Taschenburg's syntypes and in one male the third submarginal cell was lacking. I have seen the female. The type of *nigropilosus* appears to be synonymous with *pictipennis* but it could be *placida*.

Geographic range (map 2): *Ammophila pictipennis* occurs over most of the United States east of the Rocky Mountains, starting at about 104° longitude. In Texas the species occurs widely from Brownsville to Fort Davis, and the upper panhandle of the state. It occurs south along the eastern half of Mexico as far as the state of Oaxaca. These map records are based on males. In Texas and Kansas the ranges of *pictipennis* and *placida* broadly overlap which suggests they really are two different species.

Ammophila placida **Smith**

Figures 47, 48, Map 2.

Ammophila placida Smith, 1856. Catalogue of Hymenopterous Insects in the Collectionof the British Museum 4:221. Holotype: male, California (BMNH). Type studied.

Recognition: The amber forewings and veins are shared with *pictipennis*. The forewing is darker on the apical third. Like *pictipennis, placida* has black erect setae on the head and mesosoma. No definite means of separation have been found for females of *placida* and *pictipennis*. However, the penis valve head of *placida* has a basal spine (fig. 48) which is lacking in males of *pictipennis* (fig. 49). Both species have an hour-glass-shaped abdominal eighth sternum (figs. 47) which will separate the species from males of *mcclayi.* Of course the two species are largely allopatric except in Texas. Females are 14-22 mm. long, males are 12-20 mm.

Nomenclature: Fernald (1934) appears to have confused *placida* with *zanthoptera* at least in part.

Geographic range (Map 2): This species is restricted to western North America and western Mexico. The easternmost record I have seen is a male from Bayside, Texas (about longitude 96°, ASM), and also a male from Sumner Co., Kansas, longitude 100° (ASM). I have seen *placida* from Alberta, Manitoba and Saskatchwan, Canada (all CNC). In Mexico I have records from as far south as the Distrito Federal and also Baja California. The species is common in California and other western states.

Ammophila zanthoptera **Cameron**

Figures 38, 110, 183.

Ammophila zanthoptera Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:8. Holotype: female, Calderas, Guatemala (BMNH). Type studied.

Ammophila trichiosoma Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:11. Holotype: female, Capetillo, Guatemala (BMNH). Synonymy by Menke 1966a:2392. Type studied.

Ammophila xanthoptera Cameron, 1900. Biologia Centrali-Americana, Hymenoptera 2:xi, emendation.

Recognition: The black erect head setae and white erect mesosomal setae in both sexes, and amber or yellowish wings in the female are distinctive. The propodeal enclosure has erect setae (fig. 110). The male genitalia are also diagnostic (fig. 183). Female length is 20-27 mm, males are 17-26 mm.

Geographic range: *Ammophila zanthoptera* is primarily a Mexican insect occuring as far south as Guatemala. The species also occurs at higher elevations (5800-7000 feet) in Arizona, New Mexico and Colorado. It is possible that the species occurs in Texas. Fernald (1934) recorded *zanthoptera* from California but this record is almost certainly a misidentification of *placida*.

Ammophila zapoteca Menke, new species

Figures 116, 184, 185.

Recognition: This Mexican species is known from a single female. The orange red venation and tegula are distinctive, as is the pleural pattern of silver setae (figs. 116, 184). The face is shown in figure 185. The mesopleural band of silver setae along the mesopleural suture extends to the top of the episcrobal area. In the somewhat similar *cora*, the episcropal area is asetose and shiny. The episternal sulcus is long in *zapoteca*, short in *cora*. The petiole sternum is red, which if common to the species, is a distinctive feature, but females of *cora* also have a red petiole.

Description:

Holotype female: Length 15 mm.

Color: Black; petiole and gastral segments I-II and base of III red, petiole tergum black along midline; tegula and venation orange red

Vestiture: Erect setae of head and mesosoma pale; face with appressed silver setae; mesopleuron with band of appressed silver setae along suture that extends to top of episcrobal area (figs. 116, 184); lower metapleuron with band of appressed silver setae (figs. 116, 184); propodeal enclosure asetose; pronotum laterally with appressed silver setae; all coxae with some silver setae.

Structure: Clypeus with prominent median lobe (fig. 185); labrum broadly rounded apically; meso and metapleuron dull; episternal sulcus long, ending ventrally; claws with small basal tooth.

Holotype female: MEXICO: Oaxaca, 1 mile NW Huajuapan, 5200', September 11, 1963. R. H. and E. M. Painter (KSU).

Etymology: The name honors the Zapotec people who once inhabited the region around Oaxaca.

AZTECA SPECIES GROUP

Diagnosis: The *azteca* group is similar to the *urnaria* group except that the episternal sulcus is long, ending in the ventral region. Color of long hair-like setae varies from pale to black, and the pronotal collar and scutum usually do not have cross ridging. The surface of the propodeal enclosure is shiny and covered by many transverse ridges. Most species have appressed silver setae mesally on the propodeal enclosure.

Included species: *Ammophila acuta* (Fernald), *azteca* Cameron, *breviceps* Smith, *californica* Menke, *evansi* Menke, *hallelujah* Menke, *harti* (Fernald), *karenae* Menke, *linda*

Menke, *mediata* Cresson, *moenkopi* Menke, *nancy* Menke, *peckhami* (Fernald), *pruinosa* Cresson, *regina* Menke, *strenua* Cresson and *varipes* Cresson.

Discussion: The color of erect setae, mesopleural patterns of appressed silver setae, body color, and the configuration of the pronotal collar are useful for species discrimination in this group. The penis valves of the male genitalia are distinct in only half of the species, namely *acuta*, *breviceps*, *californica*, *karenae*, *nancy*, *peckhami, pruinosa* and *regina.* The penis valves of the remaining species are similar to *Ammophila cleopatra* and *urnaria* in the *urnaria* group (figs. 101-102, 194).

One group of species has bluish black gastral segments IV or V-VI, and black erect setae on the head: *acuta*, *evansi, mediata, peckhami, regina*, and *strenua.* All of these taxa have a non-lamelliform metapleural flange, and they are obviously closely related.

The *azteca* group has groups of species that need further study. For example, the *Ammophila pruinosa* complex is now represented by four species that are very similar, and it is obvious that more species will be discerned in this complex. Species descrimination in the *pruinosa* complex is not easy. Penis valves are distinct in the four known species but it is unclear how much this structure varies within a species. There appears to be significant variation in the penis valve of *californica*.

Ammophila azteca, which has a very broad geographic range, also has tremendous morphological and color diversity. Further study may reveal it to be more than one species. *Ammophila strenua* is another puzzling species.

Distribution: The *azteca* group is represented throughout North America and south into Mexico. The ranges of *mediata* and *azteca* extend past the Arctic Circle in western Canada. These are the only North American species of *Ammophila* known to occur that far north. *Ammophila azteca* occurs at over 13,000 feet in the White Mountains of California/ Nevada.

Ammophila acuta **(Fernald)**

Figures 40, 138, 146.

Sphex acutus Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 150. Holotype: male, southern Arizona (USNM). Type studied.

Recognition: Females are most similar to *regina* but the collar is evenly rounded in *acuta*. In *regina* the collar is usually flattened on each side of the midline. Flagellomere I is longer than the width of the clypeal lobe in females of both species (6.2 to 4.8), but the lower metapleuron of *acuta* has a band of silver setae along the metapleural sulcus. This is absent in *regina*. The pleural setal patterns of the two species are shown in figs. 145, 146. The erect black setae on the head is an important feature, but it is shared with other species. Sometimes the collar has black erect setae, but the mesosoma in most females has pale erect setae and they may be very sparse. In males erect head setae are pale except black on the vertex and sometimes very sparse. Females have petiole tergum and gastral segments I-III or IV red. Males are similar in color but usually only gastral segments I-II or III are red, and tergum I usually has a black stripe. The female clypeal lobe projects and has sharp corners. The female faces of *acuta* and *regin*a are very similar. The male clypeus is reflexed, the apex slightly arcuate, sometimes slightly notched. Males of *acut*a have a distinct penis valve head (fig. 40). There is a basal projection which is lacking in males of *regina*. The collar in female *acuta* from Texas is cutoff at the streptaulus and

rimmed there. Erect head setae in these specimens is pale except for a very few black ones on the vertex. Male length varies from 11 to 21 mm. Females are 19-21 mm.

Geographic range: This species is known from Arizona, California, Nevada, Utah, Colorado, western Nebraska, and southern Texas. Records are mainly from mountainous areas.

Ammophila azteca **Cameron**

Figures 25, 26, 42, 51, 52, 64, 113, 121, 124, 125, Map 3.

Ammophila azteca Cameron, 1888. Biologia Centrali-Americana 2:17. Lectotype: female, Mazatlán, Mexico (BMNH), present designation. Lectotype studied.

Sphex pilosus Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 120. Holotype: female, Colorado (ANSP). Synonymy by Menke, 1965a:2392. Type studied.

Sphex aculeatus Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 145. Holotype: female, Owen's Lake, Colorado (USNM). Synonymy by Menke, 1965a:2392. Type studied.

Sphex pilosus var. *nudus* Murray, 1938. Annals of the Entomological Society of America 31:28. Holotype: male, Sawyer, Minnesota (UM). Junior primary homonym of *Sphex nudus* Fernald, 1903. Synonymy by Menke, 1965a:2392 (as *brevisericea*). Type studied.

Ammophila pilosa brevisericea Murray in Muesebeck, et al 1951. U. S. Department of Agriculture, Monograph 2:976. Replacement name for *nudus* Murray, 1938.

Ammophila shoshone Menke, 1967. Los Angeles County Museum Contributions in Science (123):5. Holotype: male, Horse Creek Camp, Wyoming (CUI). **New synonymy.**

Ammophila silvestris Kirkbride, 1982. Pan-Pacific Entomologist 57:457. Holotype: male, 21 mi. W. Lolo Pass, Idaho (UI). Type studied. **New synonymy**.

Recognition: *Ammophila azteca* is a highly variable species over its very broad range (northern Baja California to Yukon, Northwest Territory and Labrador). The main features that identify *azteca* are the lamelliform metapleural flange which may have a notch (figs. 64, 121), the pale erect head and thoracic setae, and the mesopleural band of appressed silver setae that usually ends at the lower edge of the episcrobal area (figs. 25, 26, 124, 125). The metapleural flange is not always lamelliform, however, and this variability can be seen in material from one location. The appressed silver setae of the mesopleuron also vary over the range. At higher elevations (10,000 feet or more in the west) the setae are essentially absent. The same is true for material in the northern United States and Canada. The metapleural flange is often narrowly lamellate in these specimens. Abdominal color varies in the same areas. Only female gastral tergum I is red at high elevations and in the eastern United States and Canada. The mesopleural band of silver setae extends on the episcrobal area in material from the Inyo Mountains in California, southern California and northern Baja California, and from Nebraska. The thoracic pleura and propodeal side are sometimes extensively covered with appressed silver setae in these specimens.

Description:

Male: Average length 15 mm, range 11-19 mm.

Color: Black; petiole tergum and gastral segments I-II red, but II black at high altitudes, III sometimes red ventrally, and terga often with black stripe, rarely entirely black (see below).

Vestiture: Erect setae of head and thorax pale; propodeal enclosure usually with erect setae (sometimes missing); mesopleuron with band of appressed silver setae along mesopleural sulcus, the band usually ending at bottom of episcrobal area, sometimes extending onto the episcrobal area, sometimes thoracic pleura and propodeal side with extensive appressed silver setae, appressed mesopleural setae absent at high elevations and in northern United States and Canada.

Structure: Apex of labrum broadly rounded; clypeus with rounded notch; scutum punctate, shiny, rarely with cross ridging laterally; metanotum punctate on basal half, longitudinally ridged apically; episternal sulcus short in occasional specimens; metapleural flange broadly lamelliform, the outer edge often notched, but flange sometimes narrowly lamelliform (figs. 25, 26, 64, 121); penis valve head (fig. 52).

Female: Average length 18 mm, range 14-22 mm.

Color: As in male, but gastral terga I-II or III red in the western United States. At high elevations and in eastern North America only tergum I red.

Vestiture: Face with appressed silver setae, but such setae sometimes missing or barely visible along inner orbits; band of appressed silver setae typically ending at bottom of episcrobal area (fig. 124), sometimes extending on to it, thoracic pleura extensively covered with appressed silver setae in some material from southwestern California.

Structure: Clypeal lobe often poorly delimited by lateral angles; scutum sometimes with cross ridging laterally, metapleural flange variable, broadly lamelliform, the edge sometimes notched (fig. 121), sometimes narrowly lamelliform, sometimes not lamelliform..

Variation: Vestiture and punctation vary in *azteca*, and Murray (1938) described *brevisericea* (as *nudus*) for those specimens in which there is very little appressed silver setae on the mesopleuron. Kirkbride's (1982) *silvestris* is the same thing and I synonymize it here. In the White Mountains of California there is altitudinal variation in appressed silver pleural setae and extent of red color on the gaster. Appressed silver setae on the pleura begin to disappear at 9,500 feet and red on the gaster is restricted to tergum I. I struggled with this variation thinking that the high altitude form was a different species (*brevisericea* or *silvestris*). But DNA study by Jeremy Field in England, based on material I collected at various places in the White Mountains, was inconclusive. So I decided that only one species was involved and that some factors at higher altitudes resulted in the loss of appressed silver setae and reduced red on the gaster.

Curiously, I have examined a male from Long Barn, Tuolumne Co., California, that I collected, which has an entirely black abdomen. Otherwise it is a typical *azteca*. I now regard my species *shoshone*, described from the Great Basin, to be a synonym of *azteca*. It falls within the range of variation in *azteca*. The abdomen in some males is entirely black. In the original description I compared *shoshone* with *barti* and *azteca*, but the supposed differences from *azteca* do not hold up.

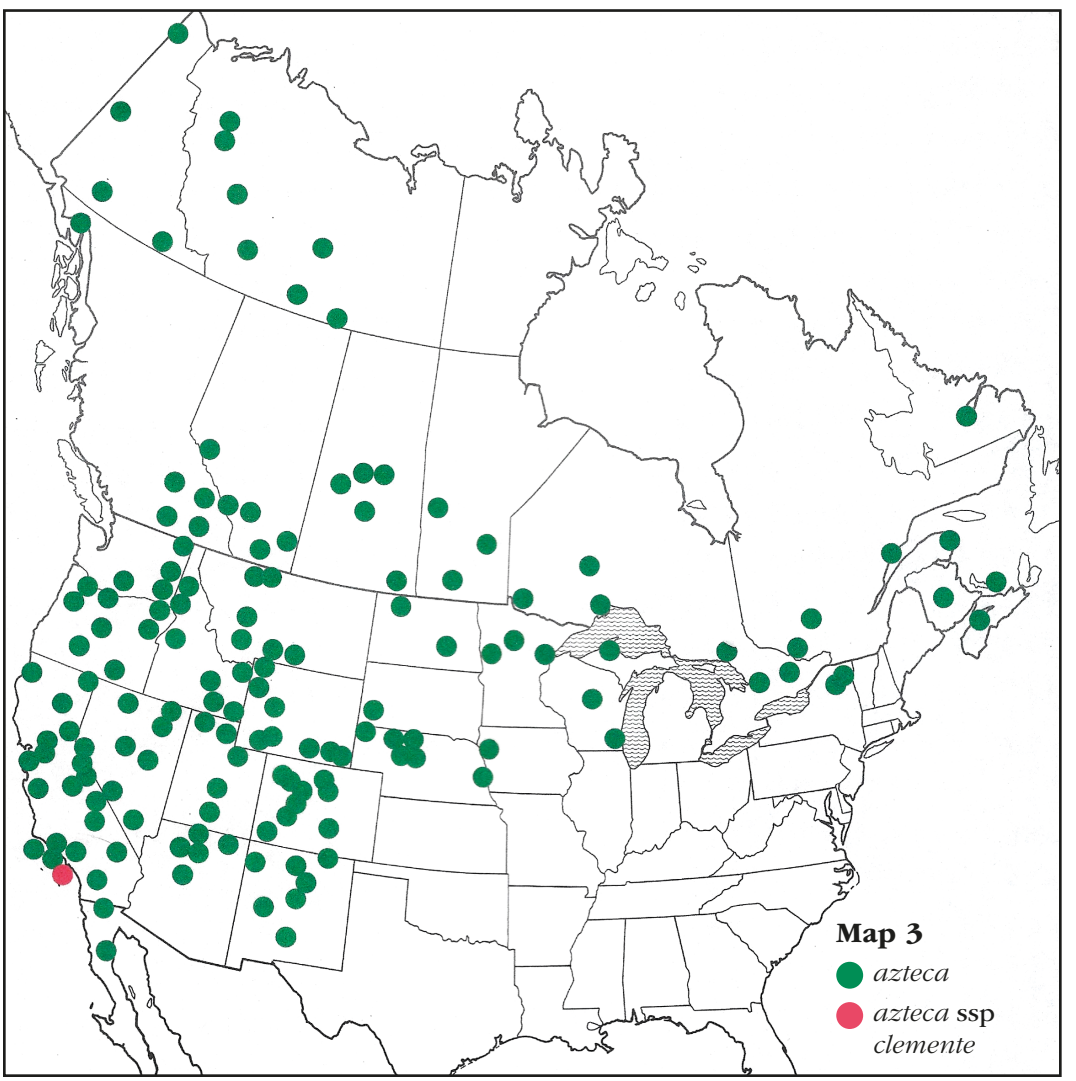
The extent of appressed silver setae becomes quite extensive on the thoracic pleura and propodeal side in some material from southern California. Erect pale setae on the propodeal enclosure are absent in some male specimens. Thus I have had to key out *azteca* in several places.

I have examined well over 2500 specimens of *azteca*, and long series of specimens have been collected at some localities. In such material the development of the metapleural flange varies from broadly lamelliform to nearly a simple carina as in specimens recently collected (2019) at Squaw Flat in the Inyo Mts. of California.

Ammophila azteca needs to be thoroughly studied since there is a possibility that it is actually a complex of species.

Geographic range (map 3): *Ammophila azteca* is probably the commonest and most widespread species of the genus in the western United States. East of the Rocky Mountains *azteca* is found in the northern states as far east as northern Michigan and northern New York. It is probable that it occurs as far east as Maine. The species is widespread in Canada. I have seen records from British Columbia to Labrador and Prince Edward Island. It ranges as far north as Rampart House, Yukon (north of the Arctic Circle), and Norman Wells in the Northwest Territories (see Steiner, 1973). In California *azteca* is very widely distributed. It ranges from the Pacific Coast (beach areas) up to 13,200 feet in the White Mts. The species is found in northern Baja California. Although the type of *azteca* supposedly came from Mazatlán, Mexico, I doubt the authenticity of the record since I have seen no material from Mexico except Baja California. The closest records are from northern Arizona (Prescott, Flagstaff) and New Mexico.

Ammophila azteca occurs on the Channel Islands off the coast of Southern California. The population on San Clemente Island is distinctive. The abdomen is completely black,



and I (Menke, 1967) recognized the population as the subspecies *clemente*. Typical *azteca* occurs on the islands of San Miguel, Santa Cruz and Santa Rosa.

Ammophila azteca **subspecies** ***clemente*** **Menke**

Ammophila azteca clemente Menke, 1967. Los Angeles County Museum Contributions in Science (123): 7. Holotype: male, San Clemente Island, California (LACM).

Recognition: The entirely black abdomen is the distinctive feature of *clemente*. It is common on San Clemente Island. Since *clemente* is isolated from all other populations of *azteca* it could be treated as a species.

Ammophila breviceps **F. Smith**

Figures 134, 136, Map. 3.

Ammophila breviceps Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 3:221. Holotype: female, "Mexico" (BMNH). Type studied.

Recognition: The transverse band of appressed silver setae along the posterior margin of the collar (fig. 136), the absence of erect setae on the propodeal enclosure, and the partially red legs identify *breviceps.* The mouthparts are short also.

Description: The legs in females are mostly red. Black is confined to the coxae and trochanters, and the dorsum of the hindfemur. The female gaster is largely red; tergum I has a black stripe, and IV has a large black spot basally. Sometimes the gaster is entirely red. The distinctive transverse band of appressed silver setae on the collar is weakly developed in specimens from northern California and farther north. The female mesopleuron is totally covered with appressed silver setae except asetose just posterior to the pronotal lobe to the level of the scrobe (fig. 134). In material from northern California and northward, the mesopleuron has reduced appressed silver setae such that there is mainly a silver band along the mesopleural suture. The female metapleuron has appressed silver setae by the hindcoxa and it continues across the metapleural sulcus on the propodeal side ending near the metapleural flange. In material from northern areas the amount of silver setae on the propodeal side is less. The scutal fossae have appressed silver setae, and the propodeal enclosure has appressed silver setae mesally but there are no long, erect setae there. Silver setae in northern specimens is diminished. The female face is covered with appressed silver setae except narrowly asetose on the clypeal lobe. The gena is broadly covered with appressed silver setae. The female labrum is rounded and often ends in a point. The mouthparts of *breviceps* are short. When folded, the galea only extends about half the distance to the base of the stipes. Males have darker legs, the red confined mostly to the front and middle legs beyond the base of the femur; the hindleg may be mostly black with red confined to the femur, or the hindleg may be largely red as in the female. Male gastral segments IV-VI are black and tergum I has a black stripe as in the female. Appressed silver setae in the male are like the female but the clypeus is completely silver. The mesopleuron in the male is often sparsely covered with appressed silver setae behind the pronotal lobe. The male labrum is rounded or almost truncate. Average length in females is 17 mm. Males average 15.5 mm in length.

Variation: The collar in some females, especially in Texas and Mexico, has an abrupt elevation at the streptaulus, mimicking *mescalero*, but the long episternal sulcus separates *breviceps* from that species. The collar is similarly modified in occasional males of *breviceps.*

Geographic range: *Ammophila breviceps* ranges from western Nebraska to British Columbia and south to Oaxaca, Mexico, and Baja California. It occurs over much of Texas and is common in California and Arizona. *Ammophila breviceps* is a very common species in the western US, and on my 4 acres in Bisbee, Arizona I have collected it every month of the year.

Ammophila californica **Menke**

Figures 10, 30, 34, 127, 130.

Ammophila californica Menke, 1964. Acta Hymenopterologica 2:18. Holotype: male, Mill Potrero, north side of Mt. Pinos, Kern Co., California (UCD).

Recognition: This species is a member of the *pruinosa* complex whose species all have the thoracic pleura uniformly covered with appressed silver setae. The mouthparts of *californica* are very long, and when folded the apex of the galea nearly attains or surpasses the base of the stipes (fig. 130). The penis valve head of the male (fig. 34) and strongly converging eyes of the female (fig. 127) are diagnostic.

I have 23 males and 12 females that I collected 10 miles NW of Parkfield, Monterey Co., California in May 1994 (ASM) which appear to be *californica* based on a long galea, but the penis valve head of some males resembles that of *pruinosa*. This suggests that there can be considerable variation in penis valve morphology in some *Ammophila*. In these same specimens male flagellomere I varies in length.

I have seen specimens from Arizona (ASU, UA), Texas (UCD) and Chihuahua, Mexico (UCD) that look like *californica* but the mouthparts are short like *pruinosa* and *nancy* and the penis valve is different. They are probably an undescribed species.

Geographic range: *Ammophila californica* has been taken at scattered localities in the western United States (Idaho, Oregon, Nevada, Utah, northern Arizona (Coconino Co. Tonalea), but most records are from California.

Ammophila evansi **Menke**

Figures 32, 44, 186.

Ammophila evansi Menke, 1964. Acta Hymenopterologica 2:20. Holotype: male, Colebrook, Connecticut (MCZ).

Recognition: The elongate collar that is cut off at the streptaulus (fig. 44) and the black erect setae on the head and anterior half of the mesosoma are diagnostic features of *evansi.* This species is similar to *strenua*.

Description:

Male: Average length 18 mm, range 16-22 mm.

Color: Black except gastral segment I red, tergum with narrow black stripe.

Vestiture: Face with dense appressed silver setae; gena with some appressed silver setae next to outer orbit; mesopleuron with band of appressed silver setae along mesopleural suture, band ending at level of scrobe; head, pronotum, and anterior portion of

scutum with long, black erect setae; erect setae pale on rest of mesosoma; propodeal dorsum without appressed silver setae, but with some erect setae.

Structure: Labrum broadly rounded or truncate; clypeal apex with large notch; collar elongate in profile, cutoff at streptaulus (fig. 44); mesosoma densely punctate except collar more sparsely punctate; penis valve head (fig. 32).

Female: Average length 21 mm, range 20-22 mm.

Color: As in male but petiole tergum red apically, gastral segment I red, segments II-VI with bluish tinge.

Vestiture: As in male except head without appressed silver setae; mesopleural band of appressed silver setae less developed than in male, sometimes evanescent.

Structure: Labrum broadly rounded, or truncate; clypeal lobe broad, well defined by lateral angle (fig. 186), width equal to flagellomere I; punctation of mesosoma variable, dense as in male, or sparser, scutum sometimes with transverse rugae.

Variation: The single male from the Guadalupe Mountains of Texas has more extensive silver setae on the pleura. The silver band along the mesopleural suture extends on the episcrobal area, and the metapleuron has a band of silver setae along the metapleural sulcus. The erect mesosomal setae in this specimen are pale, as are most of the erect head setae. Black setae occur on the vertex of this specimen. A female from Colorado has appressed silver setae on the face and has bands of pleural setae as just described for the Texas male. The erect setae of the head are black, but those on the mesosoma are pale. In a male from Monroe Canyon, Sioux Co., Nebraska (UN) the erect scutal setae are pale.

Nomenclature: Fernald (1934) included *evansi* and several other species under *procera* Dahlbom. Murray (1938) restricted the name *arvensis* to the species I later described as *evansi* (Menke 1964a). Menke (1964b) demonstrated that *arvensis* was a Palearctic species.

Geographic range: *Ammophila evans*i occurs from eastern Colorado to the Atlantic Coast. In Canada it occurs in Ontario, Quebec, and Nova Scotia. The species is found in the Guadalupe Mountains. of western Texas.

Ammophila hallelujah **Menke, new species**

Figures 43, 54, 111, 140, 187.

Recognition: The narrow face of the female is distinctive with the inner orbits converging below (fig. 187). The reddish tint of the mid and hind tarsi immediately identifies most *hallelujah*, although occasional specimens have black tarsi. The pattern of silver setae on the pleura (fig. 140), and the non-lamelliform metapleural flange are also distinctive.

Description:

Holotype male: Length 12.5 mm.

Color: Black; Petiole tergum and gastral segments I-III red, petiole tergum with black stripe, gastral tergum I with elongate black spot; mid and hind tarsi faintly reddish.

Vestiture: Face including clypeus covered with appressed silver setae; collar, scutum anteriorly and scutal fossa with appressed silver setae; propodeal dorsum with appressed silver setae mesally; pleura with sparse appressed silver setae, but with dense band along mesopleural suture, the band weakly extending onto episcrobal area; metapleuron with patch of dense setae near midcoxa; erect setae of head and mesosoma pale.

Structure: Flagellomere I length less than least interocular distance (14:19); clypeal outline an obtuse angle, with small apical notch; labrum broadly rounded apically; apex of folded galea ending at about the midpoint of the stipes; scutum smooth, shiny, moderately

punctate (about 2-3 diameters apart); metapleural flange not lamelliform; penis valve head with long spine at base (fig. 54).

Male variation: Length varies from 12-14 mm. The degree of appressed silver setae on the scutum varies. The fossae sometimes lack silvery setae. The clypeal notch is sometimes absent. Mesopleural band sometimes extends to top of episcrobal area. Gastral tergum III is sometimes largely black. The mid and hindtarsi are sometimes black.

Female: length 14-15 mm.

Color: Like male but gaster red, terga III-IV largely black, V totally red or black basally, red apically; sometimes III totally red; mid and hindtarsi sometimes black; hindtibia red dorsally in one specimen.

Vestiture: As in male except edge of clypeus asetose, scutum largely asetose, and band of appressed silver setae along mesopleural suture extends to top of episcrobal area.

Structure: Flagellomere I length less that least interocular distance (16:26); inner orbits converging below (LID 26:UID 32) (fig. 187); clypeal lobe narrow (fig. 187); labrum truncate or rounded; mouthparts longer, apex of folded galea extending about three quarters the distance to base of stipes; scutal punctation about as in male.

Female variation: The hindtibia of one of the Kings River Valley females is red above. Two other females from the same place are typically colored as in the description.

Type material:

Holotype male: Hallelujah Junction, Lassen Co., California, June 22, 1964, F. D. Parker (UCD).

Paratypes: CALIFORNIA: Four males, nine females, Hallelujah Junction, Lassen Co., June 22, 1964, F. D. Parker, R. M. Bohart (UCD). Two males, 5.5 mi. E Cedarville, Modoc Co., June 25, 1963, V. L. Vesterby (UCD). One male, Said Valley Res., Lassen Co., July 2, 1981, W. J. Pulawski (CAS). Four males, Sattley, Sierra Co., June 26, 1954, M. E. Irwin (UCR). NEVADA: One male, Wine Cup Ranch, Elko Co., June 16, 1958, F. D. Parker (UCD). One female, 11 mi. SW Winnemucca, Humboldt Co., June 6, 1961, F. D. Parker (UCD). One female, 5 mi. W. Carlin, June 5, 1961, G. E. Bohart (UCD). One female, 9 mi. W. Orovada, Humboldt Co., Nevada, June 3, 1962, F. D. Parker and L. A. Stange (UCD). Five males and two females: Orovada, Humboldt Co., June 6, 9, and 16, 1960-1961, F. D. Parker, R. C. Bechtel, G. E. Bohart (UCD, LOGAN). One male and two females, Kings River Valley, Humboldt Co., June 7, 1961, F. D. Parker (UCD). One female, Beowawe, Eureka Co., June 21, 1958, R. C. Bechtel (UCD). OREGON: one female, 37 kms N. Fields, July 23-August 23, 2018, Malaise trap, M. E. Irwin and G. R. Ballmer (ASM). One male, 9.8 km ESE Summer Lake, Lake Co.,May 6-June 11, 2018, M. E. Irwin and G.R. Ballmer (ASM).

Geographic range: This is a Great Basin species known from a few scattered localities.

Etymology: The species name is based on the type locality of Hallelujah Junction. It is a noun in apposition.

Ammophila harti **(Fernald)**

Figures 120, 123, 188.

Ammophila argentata Hart, 1907. Bulletin of the Illinois State Laboratory of Natural History 7:266. Lectotype: female, Devil's Neck, Illinois (INHS), designated by Frison, 1927, p. 230. Junior primary homonym of *Ammophila argentata* Lepeletier de Saint Fargeau, 1845.

Sphex harti Fernald, 1931. Annals of the Entomological Society of America 24:450. Replacement name for *Sphex argentatus* (Hart), a junior secondary homonym of *Sphex argentatus* Fabricius, 1787.

Recognition: *Ammophila harti* is one of three species in the *azteca* group with a lamelliform metapleural flange, the others being *azteca* and *moenkopi*. The metapleural flange is very large with a notch in *harti* (fig. 120) and *moenkopi* (fig. 50), and these two species are similar. However, *harti* has black legs and appressed silver setae on the outer surface of the forefemur (fig. 188). *A. moenkopi* has red legs and lacks silver setate on the forefemur. The yellowish wing veins are distinctive in *harti*. The metapleural flange in *azteca* is highly variable, and the pleura are not densely silvery setose. The pleura in *harti* (fig. 123) and *moenkopi* are rather densely silvery setose. Males of *harti* range between 14-18 mm. in length. Females are 17-21 mm. long.

Nomenclature: I have not seen the type of *argentata* Hart but a homotype made by H. T. Fernald has been examined.

Geographic range: *Ammophila harti* occurs from northern Arizona and northern Texas to Alberta, and eastward through the northern states and southern Canada to Maine and New Brunswick. I have seen material from Louisiana, Tennessee and North Carolina in the southeastern US. Sand dunes are the favored habitat.

Ammophila karenae **Menke**

Figures 53, 139.

Ammophila karenae Menke, 1964. Acta Hymenopterologica 2:21. Holotype: male, 13 mi.S. Olancha, California (CIS).

Recognition: This species is one of the few in the *azteca* group that have partially red legs, a silver band along the mesopleural suture, and no erect setae on the propodeal dorsum. Also the metapleural flange is not lamelliform. The only similar species are *breviceps* and *varipes*, but *breviceps* has a strong transverse band of appressed silver setae along the hind margin of the collar. In contrast, females *karenae* have a uniformly pubescent collar, as do the males. The propodeal dorsum of *varipes* has erect setae. Some specimens of *karenae* have black legs. The penis valve head is distinctive in males of *karenae* (fig. 53).

Description:

Male: Average length 14 mm, range: 10-17.5 mm.

Color: Head and thorax black; tegula black or red; petiole sternum black or red; petiole tergum red with black stripe, gastral segments I-III red, sometimes only I-II red, sometimes I-IV red, tergum I usually with black stripe; legs black or legs red except for coxae, trochanters and bases of femora.

Vestiture: Face densely covered with appressed silver setae; gena very sparsely to densely covered with appressed silver setae; collar and scutum sparsely covered with appressed silver setae, or such setae very sparse or lacking especially on collar; propodeal enclosure with appressed silver setae mesally, setae inclined anterad, and no erect setae; mesopleuron usually with appressed silver setae, setae dense along mesopleural suture, the band extending to top of episcrobal area; metapleuron with broad patch of appressed silver setae between coxae, which often extends onto the propodeal side and may reach propodeal spiracle, however, the propodeal side sometimes has very little silver setae; head and thorax with abundant pale erect setae.

Structure: Clypeus with small, round notch; labrum rounded or truncate; scutum punctation variable, punctures less than a diameter apart or 2 or 3 diameters apart; pleural puntation similar to scutum; metapleural flange not lamelliform; penis valve head as in fig. 53.

Female: Average length 16 mm, range 10-18 mm.

Color: As in male; tegula black if legs are black, red if legs are bicolored; in specimens with bicolored legs often only coxae and trochanters are black; petiole and gaster red with gastral terga III-IV or IV only largely black, V sometimes black; petiole sternum often black; petiole and gaster sometimes entirely red, especially in red-legged specimens.

Vestiture: Face with appressed silver setae except for lower edge of clypeus; gena as in male; collar and scutum similar to male, but often very feebly silver setose; pleural setation as in male but mesopleural band and metapleural patch strongly formed (fig. 139); erect setae pale, those of thorax less dense than in male.

Structure: Clypeus with prominent lobe; inner orbits converging below (UID 41: LID 33); labrum as in male; scutum with punctation like in male, but usually some cross ridging or rugae present.

Variation: Leg color in both sexes varies from black to black and red and specimens of both types have been taken at the same locality. About 50% of males have black legs. The percentage of red-legged females is a bit higher. The scutum of females varies from smooth and punctate, to transversely ridged and punctate.

Nomenclature: This is one of several species that Fernald (1934) included under the names *pruinosa* Cresson and *breviceps* Smith.

Geographic range: This species occurs in the western United States: Washington, Idaho, Montana, Wyoming, Colorado, Oregon, Utah, Nevada, California, Arizona, New Mexico and Texas. In Mexico it occurs in Baja California, Chihuahua, Coahuila, Puebla, and Hidalgo. *A. karenae* occurs over wide range of elevations from low desert areas to higher elevations in the Great Basin, the Sierra Nevada Mts., and the Inyo Mts. of California

Ammophila linda **Menke, new species**

Figures 29, 132, 189, 190.

Recognition: This *pruinosa* complex species has long mouthparts similar to *californica*. The galea nearly reaches the base of the stipes although in some females it may be slightly shorter. The male clypeus projects apically, is reflexed, and the shape is distinctive (fig. 29). The clypeal apex varies. It may have a shallow emargination or a V-shaped notch. The free margin is broadly curved with a small notch in males of *californica*. The female clypeus has a distinct lobe bounded laterally by rounded angles (fig. 189). In *californica* the female clypeal lobe is less distinct and the face is narrower (fig. 127).

Description:

Holotype male: Length 15 mm.

Color: The following are black: head, mesosoma, front coxa, midcoxa and trochanter, hindcoxa, trochanter and dorsum of femur and petiole sternum; petiole tergum orange red with black dorsal stripe, gaster orange red except tergum I with black stripe, IV-VI black; tegula orange red, legs mostly orange red; wings clear, veins brown.

Vestiture: Head and mesosoma including coxae, with dense erect white setae; the following densely covered with appressed silver setae: face (except vertex), gena, pronotal lobe, meso- and metapleura, coxae; mesosomal dorsum sparsely covered with appressed

silver setae; propodeal enclosure with appressed silver setae mesally (and also erect white setae).

Structure: Flagellomere I length 0.72 X LID, and 1.36 X flagellomere II length; free margin of clypeus projecting and reflexed, with shallow median notch (fig. 29); labrum rounded apically; apex of folded proboscis nearly attaining base of stipes; scutum smooth, with fine, scattered punctures, several diameters apart; apex of penis valve head spine curving outward (fig. 190).

Male variation: Length varies from 11.5-17 mm.

Female: Length 12.5-15 mm.

Color: Similar to male except hindleg sometimes nearly all black; gastral tergum I sometimes all red, rest of gaster red except for black spots of varying size on terga III-IV;

Vestiture: Similar to male except lower part of clypeus usually asetose; erect setae much shorter than in male.

Structure: Inner orbits converging ventrad (fig. 189); clypeal disk tumescent, clypeal lobe prominent but bounded laterally by rounded angles (fig. 189); width of clypeal lobe 0.60-0.63 X LID; flagellomere I length 0.51-0.53 X LID; flagellomere I length 1.45 X II length; labrum broadly to narrowly rounded apically; folded proboscis 3/4 X length of stipes or nearly attaining its base (fig. 132); punctation of scutum coarser and denser than male, punctures one or two diameters apart, laterally scutum usually with some very fine transverse ridges.

Female variation: As indicated above, the galea varies in length. Most of the females I have seen show considerable wear of the clypeus and mandibles which suggests they nest in hard soil.

Type material:

Holotype male: Tanbark Flat, Los Angeles Co., California, June 19, 1956, R. M. Bohart (UCD). Paratypes: CALIFORNIA: Los Angeles Co., four males, eleven females, Tanbark Flat, California, various dates and collectors in June and July (UCD, CIS); two males, 10 mi. W Ravenna, Soledad Canyon, May 16, 1979, A. S. Menke (ASM); one female, 2.5 mi. S. Pearblossom, May 14, 1978, R. W. Brooks (UCD). Orange Co., one female, Trabuco Canyon, Dece;mber 26, 1961, M. E. Irwin (UCR). Riverside Co., San Jacinto River, 4000', May 30, 1940 (UCD); one male, 1 mi. N. Murrieta, April 18, 1950, J. MacSwain (UCD); one male, 10 mi. SE Temecula, April 18, 1950 (UCD); one male, Riverside, April 20, 1954, J. C. Hall (UCD). San Bernardino Co., one female, Mesquite Springs road north of Twenty Nine Palms, May 6, 1982, Karl Krombein (USNM);. one female, Little Morongo Heights, May 6, 1982, Karl Krombein (USNM);. four males, three females, Phelan Road, 1 mi. W state highway 395, May 12, 1982, Karl Krombein (USNM); one female, Verdemont, San Bernardino Co., May 25, 1948, A. L. Melander (UCR); one male, same location, May 1, 1946, A. L. Melander (UCR); one male, "Mojave Desert" May 9, 1937, N. Hardman (UCD); one male, 2 mi. NW Yucca Valley, May 14, 1975, G. Egstrom (UCD); one male, Lucerne Valley, April 11, 1960, H. K. Court (UCD). San Diego Co., one female, Oak Grove, September 5, 1945, A. L. Melander (UCR); one male, Campo, April 27, 1939, R. M. Bohart (UCD). Santa Barbara Co., one male, Goleta, June 25, 1965, M. R. Gardner UCD, two males, July 4 and 9, 1959, R. M. Bohart (UCD). MEXICO, 9 km NW Rancho Sta. Ines, Baja Norte, April 6, 1985, Clarke and Blom (UCD).

Geographic range: This species occurs in the coastal mountains of southern California and fringing areas, and also northern Baja California.

Etymology: I lovingly dedicate this species to my wife Linda Rosenfield. The name is a noun in apposition.

Ammophila mediata Cresson

Figures 37, 191.

Ammophila mediata Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:459. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916:94. Lectotype studied.

Recognition: Over most of the range of *mediata*, there is no appreciable appressed silver setae on the head and thorax of the female. Even the pronotal lobe lacks silver. And the mesopleuron is shiny and sparsely punctate. This is true for males also although the clypeus is densely silvery setose in this sex (fig. 37). The female clypeal lobe is prominent and very broad (fig. 191). The length of flagellomere I is slightly less than the width of the lobe (28:30). In specimens from the coast ranges of California the female clypeus is sparsely silvery setose and the pronotal lobe is silver. The mesopleuron of these specimen has a small silver patch near the midcoxa. But these specimens still have the shiny mesopleuron. Males are similar. All specimens of *mediata* have black erect setae on the head and anterior portion of the thorax. Erect setae on the rest of the thorax are white. The free edge of the male clypeus is usually not emarginate, and it is usually somewhat reflexed. Occasional males have a small clypeal notch. Females are 16-20 mm long, males are 13-18 mm.

Nomenclature: Fernald (1934) synonymized *mediata* with "arvensis Dahlbom".

Geographic range: *Ammophila mediata* occurs at higher elevations throughout the western United States including Alaska. East of the Rocky Mountains it is found in the northern states as far east as Michigan. The species ranges across Canada from British Columbia to Quebec, New Brunswick and Labrador. I have seen specimens from Dawson, Whitehorse, and Rampart House, Yukon. This last locality is north of the Arctic Circle. I have seen material from the Northwest Territories (Fort Simpson, Hay River). *Ammophila mediata* occurs in the coast ranges of California: Wagon Road Canyon, Ventura Co., the La Panza Mts., San Luis Obispo Co., 10 mi. N of Parkfield, San Luis Obispo Co., Big Basin State Park, Santa Cruz Co., Sespe Canyon, Ventura Co. These specimens are atypical as noted in the Recognition paragraph.

Ammophila moenkopi **Menke**

Figure 50.

Ammophila moenkopi Menke, 1967. Los Angeles County Museum Contributions in Science (123):3. Holotype: male, 4.5 mi. E Moenkopi, Arizona (USNM).

Recognition: This species is easily identified by the red legs, the densely silvery setose pleura (fig. 50) and the broadly foliacious metapleural flange (fig. 50) which is also reddish. The tegula and venation is also light colored. The female abdomen is usually completely red, although the petiole tergum sometimes has a black stripe, and gastral tergum IV may be black. The pronotal collar slopes up gradually from the streptaulus in profile (fig. 50). *Ammophila moenkopi* is a small species. Females range from 12.5-16.5 mm and males from 12-15 mm. *Ammophila harti* also has a broadly lamelliform metanotal flange but that species has black legs and a more rounded collar.

Geographic range: This species is known from northeastern Arizona (Coconino Co.), and southern Utah (Coral Pink Sand Dunes, Kane Co.; Calf Creek Falls, Garfield Co.; Little Gilson Butte, Emery Co.).

Ammophila nancy Menke

Figures 9, 30, 31, 36, 129.

Ammophila nancy Menke, 2007. Zootaxa (1546):32. Holotype: male, Geronimo Trail, milepost 19, east of Douglas, Arizona, Nancy Menke, (USNM).

Recognition: This species is one of the four red-legged species in the *pruinosa* complex in which the pleura are completely covered with dense appressed silver setae, and the metapleural flange is not lamelliform. The truncate labrum common to both sexes (fig. 31), the elongate flagellomere I in the female (fig. 129), at least 0.56 X the LID), and the sinuate ventral spine of the penis valve head (fig. 36) separate *nancy* from the very similar *pruinosa*. The labrum of *pruinosa* typically is more elongate, and rounded apically, and flagellomere I is shorter in the female (fig, 128, 0.47-0.53 X LID). The ventral spine of the penis valve head of *pruinosa* forms a diagnostic C-shape in lateral view (fig. 35). The short mouthparts of *nancy* (and *pruinosa*) separate the species from *californica* and *linda* (compare figs. 30, 31). The clypeus of male *pruinosa* generally has a narrower emargination than that of *nancy*.

Description:

Male: Average length: 18 mm, range 13-20 mm.

Color: The following are black: head including antenna, mesosoma, coxae, trochanters, and petiole sternum; mandible brownish red at middle, scape with small brownish red area apically; tegula orange red; forewing veins orange red at base, and anal vein this color to end of subbasal cell, other veins extensively largely brown; forefemur, tibia and tarsus orange red; midfemur black dorsobasally, but remainder orange red, as are midtibia and tarsus; hindfemur black dorsally almost to apex, this color less extensive ventrally, remainder of femur orange red, hindtibia and tarsis orange red (distal tarsomeres darker); petiole sternum sometimes orange red ventally or entirely orange red, petiole tergum black above, orange red laterally; gaster orange red except as follows: gastral tergum I with black middorsal band that ends three quarters distance to apex; gastral terga IV-VI largely black; sternum VI black.

Vestiture: Head and mesosoma including coxae with erect silver setae; foretrochanter and femur with setal fringe ventrally; the following densely covered with appressed silver setae: face (except vertex), gena, pronotal lobe and thoracic pleura, coxae and trochanters of mid and hindlegs; ventral surface of trochanter, femur and tibia of foreleg with appressed silver setae; thoracic dorsum less densely covered with appressed silver setae, integument somewhat visible, propodeal dorsum glabrous laterally.

Structure: Flagellomere I length 0.77-0.86 X LID and 1.23 to 1.41 X flagellomere II length; free margin of clypeus broadly, shallowly emarginate; labrum rectangular, apex straight; apex of folded proboscis ending about at midpoint of stipes; length of galea from apex to palpal socket 0.73 -0.85 X galea length (as much as 0.94 X galea length in tiny specimens); scutum smooth, with scattered shallow punctures (ca. 2-3 diameters apart); ventral process of penis valve head long, extending basad (fig. 36).

Female: Average length: 19 mm, range: 11-21 mm.

Color: As in male except clypeal free margin red brown to black at center, and legs more extensively orange red: only coxae, hindtrochanter and dorsum of hindfemur black; gaster orange red except tergum I with stripe as in male, and IV with large basal black spot; spot on IV sometimes absent or reduced to two small maculae.

Vestiture: As in male except clypeal lobe asetose.

Structure: Inner orbits converging ventrad; clypeal disk moderately swollen, lower part asetose, shiny; clypeus with narrow lobe, usually defined by poorly formed angles that tend to be rounded (lateral angles or teeth rarely sharp and projecting), edge of lobe essentially straight, sometimes with shallow median notch, lobe width 0.51-0.58 X LID, usually ca. 0.58 X; flagellomere I length 0.55-0.64 X LID; flagellomere I length 1.45-1.61 X flagellomere II length (fig. 129); labrum apex almost straight, but lateral corners more rounded than male, sometimes with weak apical angle; apex of galea when folded ending slightly beyond middle of stipes; length of galea from apex to palpal socket less than length of stipes (0.68-0.8 X length of stipes); scutum with scattered punctures (0.5 -3 diameters apart), sometimes weakly rugose laterally.

Variation: I have seen males from various localities with a smaller penis valve spine, combined with an apically arcuate labrum. While these variants may be *nancy*, I have identified them as *nancy* with a question mark. For example, Nancy and I collected 12 males at 4.5 mi. E of Tecopa, Inyo Co., California (ASM). Six are typical *nancy* with a long penis valve spine, and a truncate labrum. The remaining six have a smaller spine and the labrum apex is rounded. These last six may be conspecific with the typical males, or they could be a separate taxon.

Geographic range: *Ammophila nancy*, largely a desert dweller, occurs from central Texas (San Antonio), south Texas (Big Bend National Park) to Colorado, southern Utah, New Mexico, southern Nevada and the southern half of California. In Mexico it occurs as far south as San Luis Potosi and also northern Baja California.

Ammophila peckhami **(Fernald)**

Figures 27, 33.

Sphex peckhami Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 93. Holotype: male, Meadow Valley, Mexico (USNM). The type locality is 6 mi. S Colonia Garcia, Chihuahua. Type studied.

Sphex willistoni Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 91. Holotype: female, Meadow Valley, Mexico (USNM). Synonymy by Menke, 1966a and 1967. Type studied.

Recognition: *Ammophila peckhami* is one of several *azteca* group species (*acuta, evansi, mediata, regina*, *strenua*) with black erect setae on the vertex, and black areas of the gaster that are bluish black. The profile of the collar is diagnostic for both sexes of *peckhami* (fig. 27). Additionally there are prominent silver bands along the mesopleural suture and metapleural sulcus (fig. 27). The length of female flagellomere I is slightly less than the width of the clypeal lobe. The female mesopleuron is smooth, shiny and moderately punctate. The mesopleural silver band sometimes extends onto the episcrobal area. The male clypeus is reflexed apically and shallowly notched. The penis valve head is distinctive (fig. 33). Occasional males lack black erect setae on the vertex, but the penis valve is diagnostic. Males are 14-20 mm long and females are 18-20 mm.

Geographic range: *Ammophila peckhami* is known from Wyoming, Utah, Colorado, New Mexico, Arizona and western Texas (Guadalupe National. Park). I have one male from Lake Harris, New York (ASM) that seems to be *peckhami* but I have seen no other eastern material. The species also occurs in Mexico: Chihuahua and Mexico DF (10 km N of Agua Bendita, 10,000 feet, MCZ). The species is found in mountainous habitats (5,000-10,000 feet).

Ammophila pruinosa **Cresson**

Figures 35, 126, 128, 131.

Ammophila pruinosa Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:455. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916, p. 94. Type studied.

Recognition: The dense appressed silver setae which uniformly covers the mesosomal pleura and most of the dorsum will readily identify *pruinosa* (fig. 126) and the three other species in this complex: *californica*, *linda* and *nancy*. The spine on penis valve head forms a C-shape (fig. 35), and will separate males from *californica, linda,* and *nancy*. The projecting clypeus of males of *linda* indentifies that species (fig. 29). Females are more problematic. The mouthparts are long in *californica* reaching the base of the stipes when folded (fig. 30). The galea in *linda* almost reaches the base of the stipes when folded (fig. 132). The mouthparts of *pruinosa* and *nancy* are shorter (fig. 31). Female flagellomere I is shorter than in *nancy* as indicated in the key to species (fig. 128). The female clypeus is shown in fig. 131. Female length ranges from 14-20 mm. Males are 12-17 mm.

The *pruinosa* complex: Three other species, *californica, linda* and *nancy*, are nearly identical with *pruinosa* and I call this assemblage the *pruinosa* complex. It is apparent to me that there are probably several other undescribed species. The Bohart Museum in Davis, California, has about 5 drawers of specimens in the *pruinosa* complex. Male genitalia of material from Warner Springs, Sespe Canyon, and Davis, all California locations, differ slightly from *pruinosa* and *nancy*. In some specimens from Davis and other California locations, the scutum has prominent cross ridging. In most of this material the pleural setation is less dense than in *pruinosa*, *nancy* and *californica*. More *pruinosa* complex material is in the Canadian National Collection in Ottawa, the American Museum of Natural History, New York and Cornell University. This is a frustrating complex and someone will have to study it thoroughly.

Nomenclature: Fernald (1934) considered *pruinosa* as a subspecies of *breviceps*.

Geographic range: This species ranges from Washington and Wyoming to South Dakota, Nebraska and Kansas, and south to California, Arizona, and Texas. It also occurs over the central plateau of Mexico, and northern Baja California.

Ammophila regina **Menke**

Figures 39, 145.

*Ammophila regin*a Menke, 1964. Acta Hymenopterologica 2:25. Holotype: male, Strawberry, California (UCD).

Recognition: This species is very similar to *acuta* but the flattened areas on the side of the collar are diagnostic for *regin*a. However, in some females the flattened areas are

barely evident. *A. regina* shares the same pleural setal patterns of *acuta*. However females of *regina* lack a silver band on the lower metapleuron (fig. 145). Females of *acuta* typically have a silver band there, as does *peckhami* (compare figs. 145-146). Males of *regina* have a silver band on metapleuron along the metapleural sulcus. Abdominal color is the same as *acuta*. Female flagellomere I is obviously longer than the width of the clypeal lobe. The male clypeus is reflexed apically and not notched. The penis valve head is distinctive (fig. 39).

Description:

Male: Average length 20 mm, range: 14-21 mm.

Color: Head, mesosoma, petiole, sternum, and legs dull black; petiole tergum and gastral segments I-III or IV red, but tergum I with black stripe; costa and subcosta of forewing black, other veins light brown, membrane clear.

Vestiture: Face with dense appressed silver setae, and also along outer orbits; erect setae on head pale except black on vertex; flat areas of collar often with appressed silver setae; scutum often with appressed silver setae anteriorly and along midline; propodeal enclosure with long erect pale setae that are inclined anterad; mesopleuron and lower metapleuron usually with some appressed silver setae, but with dense bands of setae along mesopleural suture and metapleural sulcus, the mesopleural band reaching top of episcrobal area.

Structure: Clypeus reflexed, not notched; collar flattened laterally; scutum and scutellum smooth, sparely punctate; metapleural flange not lamelliform; penis valve as in fig. 39.

Female: Average length 18.5 mm, range 14-24 mm.

Color: Same as male except gastral segments I-III all red.

Vestiture: Erect hair of head and collar black, mesosoma with only traces of appressed silver setae, except with dense band along mesopleural suture as in male, mesopleural silver band extends onto episcrobal area (fig. 145); lower metapleuron without silver band (fig. 145).

Structure: Clypeal lobe projecting, with sharp corners, width of lobe much less than length of flagellomere I (4.5 vs. 5.5); lower area of mesopleuron moderately punctate, usually rugose.

Geographic range: *Ammophila regina* occurs at higher elevations from California to British Columbia and Idaho. The species is found also in Nevada and Utah.

Ammophila strenua **Cresson**

Figures 45, 137, 143.

Ammophila strenua Cresson, 1865. Proceedings of the Entomological Society of Philadelphia4:459. Holotype: female, Colorado Territory (ANSP). Type studied.

Sphex dubius Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 139. Holotype: male, Colorado (ANSP). Junior secondary homonym of *Ammophila dubia* Kohl, 1901. Synonymy by Menke, 1967:3. Type studied.

Ammophila denningi Murray, 1951. Replacement name for *Ammophila* dubia (Fernald), 1934.

Recognition: This species is very similar to *peckhami* as the length of female flagellomere I is slightly less than the width of the clypeal lobe in both species. The female face is shown in fig. 137. The shape of the pronotal collar differs between the females of the two species. In profile, it slopes up from the streptaulus in a gradual arc in *strenua*

(fig.143). The collar of *peckhami* more rounded in profile (fig. 144). The collar is strikingly different between males of the two species, and the penis valves are diagnostic (figs. 33, 45). The male clypeus has a large apical notch. Gastral segments I-II are red in females, and sternum III may be also. Occasionally segments I-III are red as well as sternum IV. Females range from 18-24 mm in length, males are 14-25 mm.

Variation: In a few Arizona males the episternal sulcus is short (ASM, USNM). The observed variation in *strenua* indicates the need for further study of the species.

Geographic range: *Ammophila strenua* occurs throughout western North America: British Columbia to California and eastward to Montana, Wyoming, Nebraska, and Texas. In Mexico it is known as far south as Michoacán, Puebla, and Morelos. *Ammophila strenua* is a commonly collected species.

Ammophila varipes **Cresson**

Figure 133.

Ammophila varipes Cresson, 1965. Proceedings of the Entomological Society of Philadelphia 4:457. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916, p. 95. Type studied.

Ammophila comanche Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:19, plate 1, fig. 14. Holotype: male, northern Sonora (BMNH). Synonymy by Menke, 1967: 3. Type studied.

Recognition: *Ammophila varipes* is most similar to *breviceps* but it lacks the transverse silver band on the collar of the latter species. A big difference from *breviceps* is the presence of long erect pale setae on the propodeal enclosure (fig. 133). These are absent in *breviceps.* The scutal fossae in *varipes* rarely have the appressed silver setae seen *breviceps*.

Nomenclature: *A. comanche* and *varipes* were considered synonyms of *breviceps* by Fernald (1934).

Geographic range: This species has a broad range. I have records from Alberta, Canada south to Arizona. Eastward *varipes* occurs in the Dakotas, Nebraska, Kansas, and lowa. It occurs in Utah, Colorado, New Mexico, and Texas and south Puebla and Hidalgo, Mexico. I have a single record from Guatemala (AMNH) and another from Shenandoah, Virginia (USNM). Curiously, I have seen no material from the west coast states (California to Washington and Nevada).

URNARIA **SPECIES GROUP**

Diagnosis: This group contains species with a short episternal sulcus, and a non-ridged pronotal collar. Long hair-like setae are always pale or white, and the propodeal dorsum usually has appressed silver setae mesally. The propodeal enclosure typically has close set diagonal cross ridges laterally that may reach the midline. The lone exception is *leoparda* which has a different arrangement of coarse rugae. It is the only species in the group that has a foliaceous metapleural flange. Inclusion of *leoparda* suggests that the *urnaria* group could be paraphyletic.

Primary characters are: Free margin of male clypeus emarginate (except in *aberti* and *bellula*); hypostoma in male simple, without a process; collar and scutum usually without strong transverse ridges (except in *cleopatra*); propodeal enclosure diagonally ridged (*leoparda* an exception), sometimes irregularly rugosopunctate mesally; episternal

sulcus short, ending about opposite pronotal lobe; metapleural flange not lamelliform (except in *leoparda*, sometimes *kennedyi,* and *aberti* rarely); spine of penis valve head basal, generally directed toward base of penis valve stalk (except in *bellula*); base of gonocoxite not dorsoventrally elongate.

Secondary characters are: clypeus and frons with appressed silver setae (except females of *kennedyi* and *urnaria*), male clypeus usually completely covered by appressed setae, obscuring underlying sculpture (except *kennedyi*, *picipes*, and some *hermosa* and *urnaria*), female clypeus glabrous anteromedially; pronotal lobe and propodeum adjacent to petiole socket covered with appressed silver setae (lobe of female *urnaria* with dense setae only posteriorly); long hairlike setae pale; psammophore pale (sometimes partially brownish in *dysmica, juncea, kennedyi, picipes* and *urnaria*); length of flagellomere I in male less than least interocular distance and greater than length of flagellomere II; mid-tibia with two well developed apical spurs (except in some *aberti* and *dysmic*a); forewing with three submarginal cells.

The *urnaria* group is represented throughout the New World, and it is the predominant group in South America. The *urnaria* group appears to have no Old World allies.

Included species: North and Central American species are: *Ammophila aberti* Haldeman, *aellos* Menke, *aucella* Menke, *bella* Menke, *bellula* Menke, *cleopatra* Menke, *dejecta* Cameron, *dysmica* Menke, *gracilis* Lepeletier de Saint-Fargeau, *hermosa* Menke, *juncea* Cresson, *kennedyi* (Murray), *leoparda* (Fernald), *mescalero* Menke, *parkeri* Menke, *picipes* Cameron and *urnaria* Dahlbom. Other New World species belonging to the *urnaria* group but not dealt with in this paper are: *arechavaletai* Brèthes, *hevans* Menke, *laeviceps* Smith, *lampei* Strand, *platensis* Brèthes, *rufipes* Guérin-Méneville, (see Appendix p. 158-159), *ruficosta* Spinola, and *suavis* Burmeister (all South American). *Ammophila cybele* Menke from Cuba also belongs here.

Discussion: The *urnaria* group is a difficult one because most of the species are similar. Also, the male genitalia display specific differences only in a few species: *aberti*, *bellula* and *kennedyi*. The penis valve head of *urnaria* is quite variable (figs. 101, 102, 194) and the following species have the same general configuration: *cleopatra, dysmica, hermosa, juncea, leoparda, mescalero, parkeri* and *picipes*. Of prime importance for species discrimination in the *urnaria* group is the pattern of appressed setae on the mesosoma, particularly the pleural region. Unfortunately, old or worn specimens make setal patterns difficult to use, and often it is impossible to identify material in this condition without a thorough knowledge of the group. Some species have characteristic markings on the abdomen and a few have bicolored legs or other chromatic peculiarities. Structurally the *urnaria* group is fairly homogeneous with nearly all species having similar punctation, etc. Some differences are found in the shape of the labrum but here also there is variability. Clypeal structure is sometimes distinctive. The possibility of using various head measurements in species diagnosis has not been fully explored in the *urnaria* group. Comparisons of the lengths of flagellomeres I and II and also of the least interocular distance versus the length of flagellomere I seem to have no value, at least for the distinction of difficult species. Other measurements might be made in search of better species criteria: overall head width, eye width, length of head and degree of eye convergence, for example.

The six species that are the most difficult to identify can be divided into two clusters of black-legged species. In one assemblage, the mesopleural band of appressed setae ends at the bottom of the episcrobal area (*dysmica, kennedyi* and *urnaria*). In the second the band extends to the top of the episcrobal area (*cleopatra, juncea,* and *picipes*). A few species in the *urnaria* group seem not to have close allies: *Ammophila aberti*, *bella*, *bellula*,

leoparda and *mescalero*. The females of *bella* and *bellula* currently cannot be separated even though the males are quite different, and the two species occur together in Arizona.

The *arvensis* group proposed by Fernald (1934) contained species belonging to the *urnaria* group and the *azteca* group. Fernald's concept included *pilosa* (Fernald) (= *azteca* Cameron), *arvensis* Dahlbom (an Old World name used in error for *mediata* Cresson, *evansi* Menke and possibly other species), *floridensis* (Fernald) (= *urnaria* Dahlbom), *urnaria* Dahlbom (Fernald confused *kennedyi* and possibly other species with *urnaria*), and *leoparda* (Fernald) as a variety of *urnaria*. The similar pleural pubescence pattern exhibited by these species was apparently the only criterion used by Fernald for this unnatural assemblage of species.

Ammophila aberti **Haldeman**

Figures 88, 171, 192, Map 4.

Ammophila urnaria Lepeletier de Saint-Fargeau, 1845, Histoire Naturelle des Insectes, Hyménoptères 3:381. Holotype: female, "Brésil" (TURIN). Junior primary homonym of *Ammophila urnaria* Dahlbom, 1843. Type studied.

Ammophila aberti Haldeman, 1852, Exploration and Survey of the Valley of the Great Salt Lake of Utah, p. 368. Holotype female (apparently): Great Salt Lake Valley, Utah (ANSP, lost or destroyed). **Neotype**: female, Flowell, Millard Co., Utah (ANSP), **present designation.**

Ammophila tarsata Smith, 1856, Catalogue of Hymenopterous Insects in the Collection of the British Museum 3:219. Replacement name for *urnaria* Lepeletier de Saint-Fargeau, 1845.

Ammophila yarrowi Cresson, 1875, Report upon Geographical and Geological Explorations and Surveys West of the One Hundredth Meridian, 5:713. Lectotype: male, "Colorado" (ANSP), designated by Cresson, 1916. Synonymy by Fernald, 1931:449. Type studied.

Sphex transversus Fernald, 1834, The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 141. Holotype: male, Beaver Valley, Utah (USNM) Synonymy by Murray, 1938:41. Type studied.

Recognition: The large size and reddish legs will nearly always identify female *aberti*, but the appressed silver setae in the scutal fossae is a basic recognition feature. The projecting clypeal lobe in the female is distinctive The propodeum of *aberti* is more elongate than in other species of the *urnaria* group, giving the mesosoma a distinctive elongate appearance (fig. 171). The most distinctive features in male *aberti* are the penis valve head (fig. 192) and the non-emarginate clypeus (fig. 88).

Description:

Male: Average length 22 mm, range: 15-25 mm.

Color: Black; tegula orange to black; tergum I black above, red laterally, or entirely black; gaster varying from black to nearly all red with black areas on terga II-V; legs varying from black to mostly red; wings clear, veins brown becoming yellowish or reddish brown basally.

Vestiture: Gena with dense appressed silver or sometimes golden setae; mesosoma with long hairlike setae; mesosomal appressed setae silver to golden, variable in extent: collar, scutum anteriorly and fossae, mesopleuron, lower metapleuron and propodeal side completely covered, sculpture obscured, or at the other extreme appressed setae

restricted to posterior transverse band on collar, to scutal fossae, and to narrow bands along mesopleural suture, and metapleural sulcus.

Structure: Labrum rounded or truncate; clypeal free margin usually entire, nearly straight for most of its width (fig. 88); scutum and pleura smooth, shining, moderately to densely punctate, scutal punctures fine; scutellum moderately to densely and rather coarsely punctate, longitudinally ridged posteriorly; metapleural flange sometimes very narrowly lamelliform; midtibia usually with one apical spur, the second much reduced if present; penis valve head as in fig. 192.

Female: Average length 25 mm, range: 18.5-30 mm.

Color: As in male except tegula usually orange; abdomen variable; entirely red or petiole sternum and terminal gastral terga and sterna black; legs usually red except for black coxae and trochanters.

Vestiture: About as in male except mesosoma usually without long, hairlike setae.

Structure: Labrum acuminate; clypeal disk slightly tumescent, moderately, shallowly punctate, clypeal lobe projecting, its margin represented by angles at juncture of median and lateral free margins; inner orbits moderately converging below; midtibia usually with two apical spurs, rarely only one.

Variation: Color and the amount of appressed mesosomal setae varies considerably in *aberti*. In the description the observed extremes have been given. Most specimens display intermediate color and vestiture patterns. There appears to be no correlation between this variation and geographic distribution. Occasional females have the pronotal lobe, mesosternal region and part of the propodeal side red. Males from Panamint Valley, California (USNM) are completely black. The loss of one tibial spur is common in the male but infrequent in the female. Occasionally, the male clypeal margin is slightly, shallowly emarginate.

Nomenclature: The type locality for *urnaria*, Brazil, is certainly an error in labeling as *aberti* is not known to occur south of Mexico City. Apparently the type of *aberti* no longer exists since it could not be located in the Philadelphia Academy of Sciences, the depository for most of Haldeman's collection. Probably, Haldeman's specimen was collected in Utah but no definite locality was given in the description. In order to positively identify the name it seems desirable to designate a neotype. Accordingly, I have selected a female from Flowell, Utah. This specimen is deposited in the Philadelphia Academy of Sciences. The neoparatypes with the same data are in the Bohart Entomological Museum of the University of California, Davis.

Geographic range (map 4): This common wasp occurs throughout the western half of the United States, southern Canada and Baja California. *A. aberti* occurs as far south as the states of Jalisco and Hidalgo in Mexico. The single Iowa record is based on material collected at Ames (USNM).

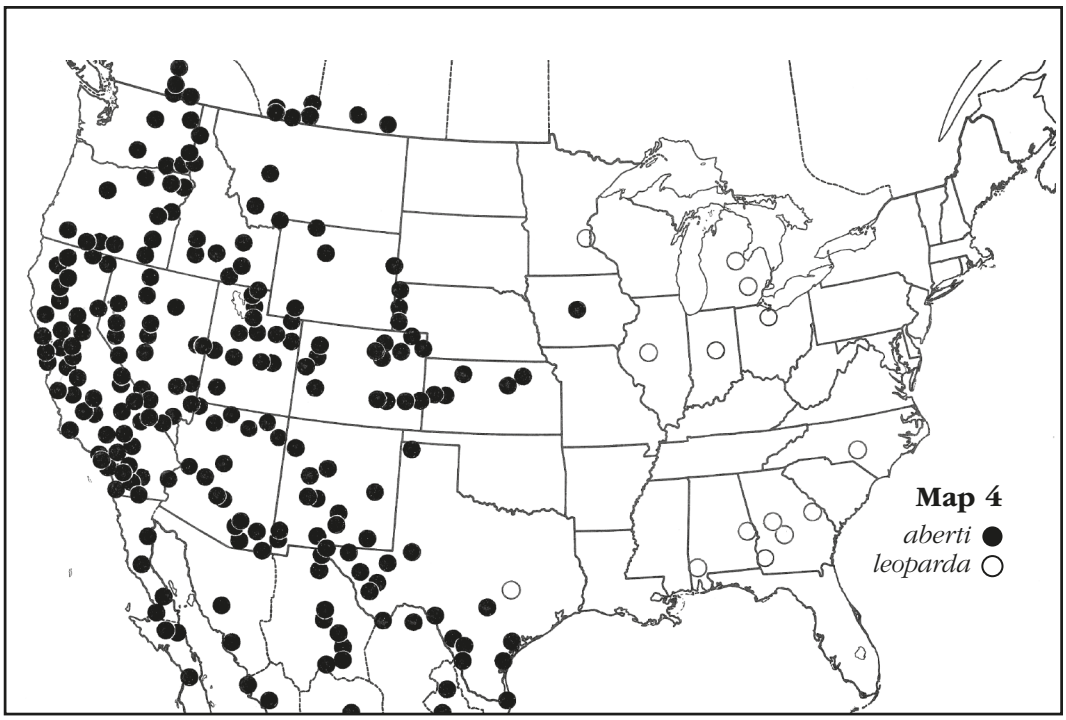
Ammophila aellos **Menke**

Figures 169, 193, Map 5.

Ammophila aellos Menke, 1966, Proceedings of the Biological Society of Washington 79:26.

Holotype: male, 8 mi. S Guadalajara, Mexico (UCD).

Recognition: The extensively red legs and golden appressed setae on the mesosoma are features that identify females of this Mexican species. Males have partially red legs also but the appressed setae are silver. The patch of silver setae on the lower metapleuron



crosses onto the propodeal side and extends toward the spiracle in both sexes (fig. 169). In the male gastral tergum II is red basally, and broadly black apically.

Description:

Male: Length 18 mm.

Color: Black; tegula reddish; petiole tergum red laterally, black above; gastral segments I-II red, tergum I with median black stripe, II broadly black posteriorly; front and midfemora apically and tibiae red; wings clear, veins brown.

Vestiture: Face with appressed silver setae which are sparse by clypeal notch; gena along outer orbit with sparse appressed silver setae; collar with sparse appressed silver setae along hind margin; mesopleuron with band of appressed silver setae from base of midcoxa to top of episcrobal area; lower metapleuron with patch of appressed silver setae that crosses metapleural sulcus and extends weakly onto propodeal side; propodeal enclosure with appressed silver setae mesally.

Structure: Labrum truncate; collar in profile curving up from streptaulus; collar and scutum densely punctate; scutellum densely punctate with linear ridging posteriorly; pleura and propodeal side densely punctate; penis valve head as in fig. 193.

Female: Length 18 mm.

Color: Tegula, petiole, and gastral segments I-II red, and terga III-IV red laterally; first and midlegs red beyond trochanters, distal half of hindfemur red, tibia and tarsus red.

Vestiture: Face with appressed gold setae, but clypeal edge asetose; pronotal collar with appressed gold setae along hindmargin; scutum with posteromedian patch of gold setae, fossae with some appressed gold setae; pleural setae gold and denser than in male; patch on lower metapleuron crosses metapleural sulcus and extends past propodeal spiracle to base of propodeal dorsum; propodeal enclosure with appressed gold setae mesally.

Structure: labrum truncate but with median projection; clypeal lobe projecting, defined by an angle; asetose area above lobe sparsely punctate; inner orbits moderately converging below.

Variation: In some males red color on the front and midlegs is restricted to a small spot on the femoral apex and no red on the tibiae.

Geographic range (map 5): This Mexican species is known from Jalisco: Guadalajara; Guerrero: Chilpancingo, Taxco; Morelos: Atlatlahucán, and Xochicalco Pyramid.

Ammophila aucella **Menke**

Figures 97, 176, Map 5.

Ammophila aucella Menke, 1966, Proceedings of the Biological Society of Washington 79:27. Holotype: male, 3 mi. SE Plan de Barrancas, Mexico (UCD).

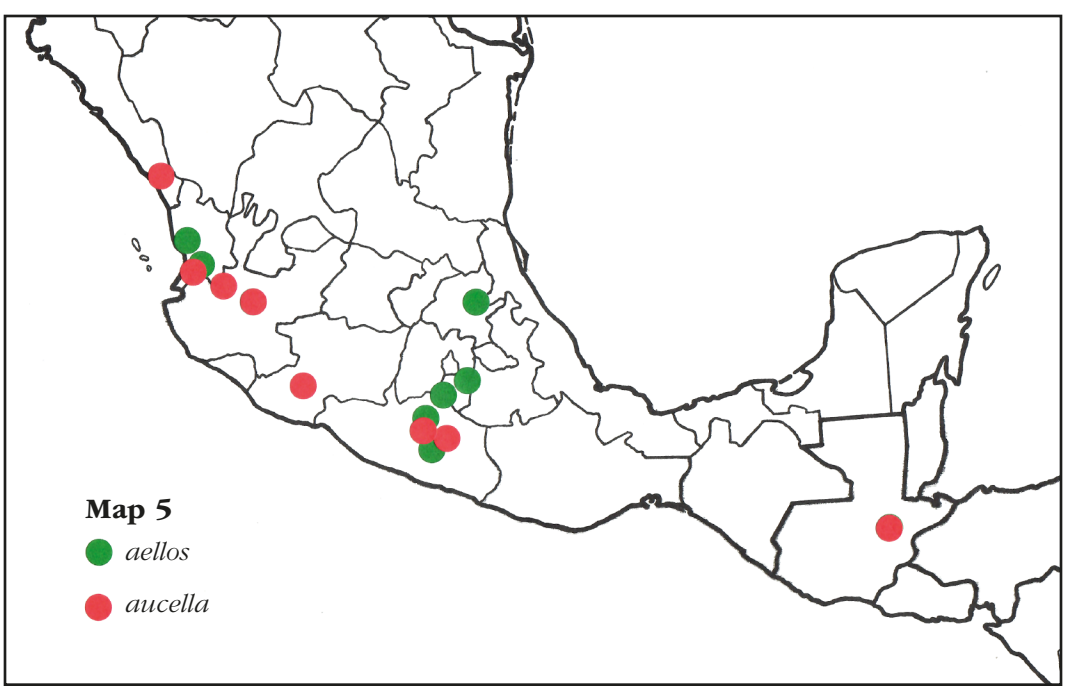
Recognition: The pattern of appressed silver setae on the pleura is distinctive (fig. 176). The absence of significant appressed silver setae on the gena, and the presence in the female of silver setae on the scutal fossae help identify *aucella*. The extensively black female gaster with red tergum V is another identifying feature. The penis valve head of *aucella* helps identify the male (fig. 97).

Description:

Male: Length 22.5 mm.

Color: Black; tergum I red laterally; gastral segment I red, tergum with elongate median black spot; wings clear, veins brown.

Vestiture: Face with appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to top of episcrobal area; lower metapleuron with broad patch of appressed silver setae that crosses metapleural



sulcus and extends across propodeal side past the spiracle and ends at base of propodeal enclosure; propodeal dorsum with appressed silver setae mesally and also long semierect pale setae; head and mesosoma with long, hairlike, pale setae.

Structure: Labrum broadly rounded apically; mesosoma densely punctate, punctation of collar less dense; scutellum punctate; penis valve head as in fig. 97.

Female: Average length 23 mm, range 20-23 mm.

Color: As in male except gastral segments I-II red, tergum II black on distal half, tergum V red.

Vestiture: Gena with very sparse silver setae along inner orbit; pronotal collar with sparse appressed silver setae along hindmargin; scutal fossa with appressed silver setae and some silver setae along midline of scutum posteriorly.

Structure: As in male except labrum with median projection; clypeal lobe projecting, delimited by an angle, clypeus tumescent, asetose above lobe and moderately punctate there; inner orbits moderately converging below.

Geographic range (map 5): This species occurs from southern Sinaloa, Mexico to Guatemala.

Ammophila bella **Menke**

Figure 86.

Ammophila bella Menke, 1966. Proceedings of the Biological Society of Washington 79:27.
Holotype: male, 3 mi. N Petlalcingo, Puebla, Mexico (UCD).

Recognition: This Mexican species has a striking arrangement of appressed silver setae on the pleura (fig. 86) although females of *bellula* are identical in this respect. In the United States *bella* is known from three extreme southern Arizona locations. One is near Nogales and I have collected many male specimens of *bella* there. *A. bellula* is strikingly similar and it occurs commonly at the same location. Males of the two species are easily separated by the shape of the clypeus. In *bella* the clypeal margin is notched but in *bellula* it is not notched (fig. 87). Also the mesosoma of male *bella* is covered with abundant long, hair-like setae. These are absent in *bellula* and also in females of both species. Females of the two species seem inseparable.

Description:

Male: Average length 17.5 mm, range 16-18 mm.

Color: Black, tergum I red laterally, black above; terga II-III red, II with median black stripe, III black on apical one half or one third, sometimes a narrow median black stripe basally; femora, tibiae and tarsi of front and midlegs reddish, or this color reduced to just the outer surface of the foretibia and apex of forefemur; hindfemur reddish on outer surface, hindleg completely black; tegula sometimes red; wings clear, veins brown.

Vestiture: Gena with appressed silver setae along outer orbit; mesosoma with long, pale, hair-like setae; collar with narrow band of appressed silver setae along posterior edge; scutum with posteromedian band of appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture, the band broadening toward the pronotal lobe, band ending at bottom of episcrobal area; lower metapleuron with small patch of appressed silver setae by midcoxa, propodeal side with band of appressed silver setae along metapleural sulcus, the setae vertically oriented; propodeal enclosure with appressed silver setae mesally.

Structure: Labrum broadly rounded apically; clypeus emarginate; collar sparsely, finely punctate; scutum and pleura densely punctate; scutellum punctate, smooth; penis valve head is similar to *urnaria* (figs. 101-102).

Female: Average length 17 mm, range 15-19 mm.

Color: As in male except tegula red; abdomen red except terga IV-V with black spots; legs red except for coxae and trochanters, hindleg sometimes largely black, red restricted to femur and basal third of tibia.

Vestiture: As in male but appressed silver setae denser; mesosoma almost devoid of long, hair-like setae; collar often broadly covered with appressed silver setae; scutum often with broad area of appressed silver setae posteriorly; top rear of episcrobal area usually with patch of appressed silver setae that narrowly extend downward; lower metapleuron with large patch of appressed silver setae next to midcoxa which often extends along mesopleural suture.

Structure: Labrum as in male but apex sometimes with minute projection; clypeal lobe projecting, delimited by an angle or tooth; clypeus tumescent, asetose above lobe, weakly, sparsely punctate there; inner orbits moderately converging below; scutum moderately to densely punctate; pleura and propodeal side densely punctate.

Variation: The color patterns described above for females are based on Mexican specimens. Females from Arizona are darker.

Geographic range: Known from the following Mexican states (based on males): Puebla, Distrito Federal, Guerrero, Sinaloa, Sonora. In the United States the species is known from three locations in Santa Cruz Co., Arizona: Sycamore Wash in the Patagonia Mts. This location is on Duquesne Road (road 61, a dirt road) which goes eastward from Arizona road 82 at Beyerville. Sycamore Wash is 7.2 miles from Beyerville. The accompanying photograph shows the site. Most *Ammophila bella* were collected along the edge



of the road where my late wife Nancy is standing. I have also seen one male from 2.5 mi. W. Peña Blanca Lake (UA), and one male from Sycamore Canyon near Ruby (UCD).

Ammophila bellula **Menke**
Figures 87, 168, 194, Map 6

Ammophila belllula Menke, 1964. Acta Hymenopterologica 2:17. Holotype: male, Madera Canyon, Santa Rita Mts., Arizona (UCD).

Recognition: The partially red legs and distinctive arrangement of appressed setae along the metapleural sulcus are good recognition characters for *bellula* whose females share the same pattern with *bella* (fig. 168). The non-emarginate, projecting clypeus (fig. 87) and lack of abundant long erect setae on the mesosoma are diagnostic features in the male. The penis valve is shown in fig. 194. *Ammophila bella* is a close relative and the females of *bella* and *bellula* seemingly do not differ, and they occur together in Arizona. Females of *bellula* possibly can be confused with *mescalero* but the pronotum of the latter is strongly cut off at the streptaulus.

The male penis valve drawing in my original description (Menke, 1964, fig. 10) is not accurate. I provide a photograph of it here (fig. 194).

Description:

Male: Average length 16.5 mm, range: 16-17 mm.

Color: Black; mandible, pronotal lobe, tegula, petiole sternum, front and middle leg



Ammophila bellula male

red; petiole tergum red laterally, black above; gastral sterna I-IV red, terga I-III red, I with elongate median black spot, tergum IV red laterally; hindcoxa, trochanter, and femur red below, black above, tibia and tarsus largely black; wings clear, veins brown to black.

Vestiture: Gena with appressed silver setae along outer orbit; collar and scutum covered with fine appressed silver or golden setae, scutum with posteromedian silver stripe, sometimes the fossae have appressed silver setae also; mesopleuron covered with appressed silver setae except anterior two-thirds of episcrobal area; lower metapleuron adjacent to hindcoxa with a patch of appressed silver setae, patch continuing on propodeal side of metapleural sulcus to superior metapleural pit, setae arranged perpendicular to plane of suture; erect body setae very sparse, short.

Structure: Labrum truncate or rounded; clypeus not emarginate, projecting and reflexed (fig. 87); scutum moderately to densely punctate; scutellum sparsely punctate, smooth; mesopleuron and lower metapleuron moderately to densely punctate; propodeal side densely punctate; penis valve head as in fig. 194.

Female: Average length 17 mm, range: 16-18 mm.

Color: As in male except tegula red or black; and petiole red or black, petiole tergum red or with black dorsal stripe; gaster largely red except tergum I with black spot, II sometimes with tiny black spot, III black apically, IV black.

Vestiture. As in male.

Structure: Labrum rounded but bearing small median projection; clypeal disk tumescent, moderately punctate, punctures large, clypeal lobe projecting, delimited by well formed angles, inner orbits slightly converging below.

Variation: The abdomen and legs vary in the degree of red color as noted in the description. One male from Cochise Co., Arizona, has reddish areas on the mesosoma (ASM).



Geographic range (map 6): *Ammophila bellula* is known only from southern Arizona, southern New Mexico, western Texas, and northern Sonora, Mexico. It is a fairly common species.

Ammophila cleopatra Menke

Figures 93, 177, 195, Map 7.

Ammophila cleopatra Menke, 1964. Acta Hymenopterologica 2:19. Holotype: male, Goleta, California (UCD).
Ammophila juncea of authors, not Cresson.

Recognition: This species can usually be recognized by the transverse rugae or ridges on the scutum. In addition, the perpendicular arrangement of the setae forming the band on the propodeal side along the metapleural sulcus is distinctive (figs. 93, 177). This latter characteristic is especially useful in separating *cleopatra* from *picipes* when the scutal rugae are ill defined. *Ammophila kennedyi* and *urnaria* are similar to *cleopatra* but the mesopleural band of appressed setae ends at the bottom of the episcrobal area in these two species. *Ammophila juncea* is similar to *cleopatra* but the former has a very smooth scutum which nearly always has a posteromedian silver stripe. The appressed silver setae on the metapleural area are also different in *juncea.*

Description:

Male: Average length 17.5 mm, range: 12-21.5 mm.

Color: Black; tegula brownish posteriorly; petiole sternum black, infrequently red or brownish; petiole tergum red with dorsal black stripe (western United States) or black (most specimens east of one-hundredth meridian); gastral segments I-II red, I with narrow black spot, sternum III basally and tergum III laterally red (western United States) or only segment I red with dorsal black spot (east of one-hundredth meridian); wings clear, veins brown to black.

Vestiture: Gena with dense appressed silver setae; collar and scutum with sparse brownish or silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to top of episcrobal area, mesopleuron anteriorly often with sparse appressed silver setae; lower metapleuron with band of appressed silver setae along metapleural sulcus from base of hindcoxa nearly to upper metapleural pit, band expanding onto propodeal side, these setae usually perpendicularly oriented with respect to plane of sulcus (fig. 93); lower metapleuron and propodeal side occasionally with sparse appressed silver setae.

Structure: Labrum acuminate or rounded; collar very sparsely punctate; scutum usually densely punctate laterally becoming strongly transversely rugosopunctate toward midline and the fossae, or scutum with strong transverse rugae or ridges laterally that may extend to midline; scutellum ridged, punctate; mesopleuron and lower metapleuron moderately densely punctate, metapleuron usually feebly rugose; propodeal side rugosopunctate; penis valve head as in fig. 195.

Female: Average length 20.5 mm, range: 14.5-24 mm.

Color: Black; tegula orange or brown, sometimes black anteriorly; abdomen red except for black gastral segment V and triangular black spot on tergum IV (western United States) or petiole sternum and most of tergum black and only gastral segment I red (east of one-hundredth meridian).

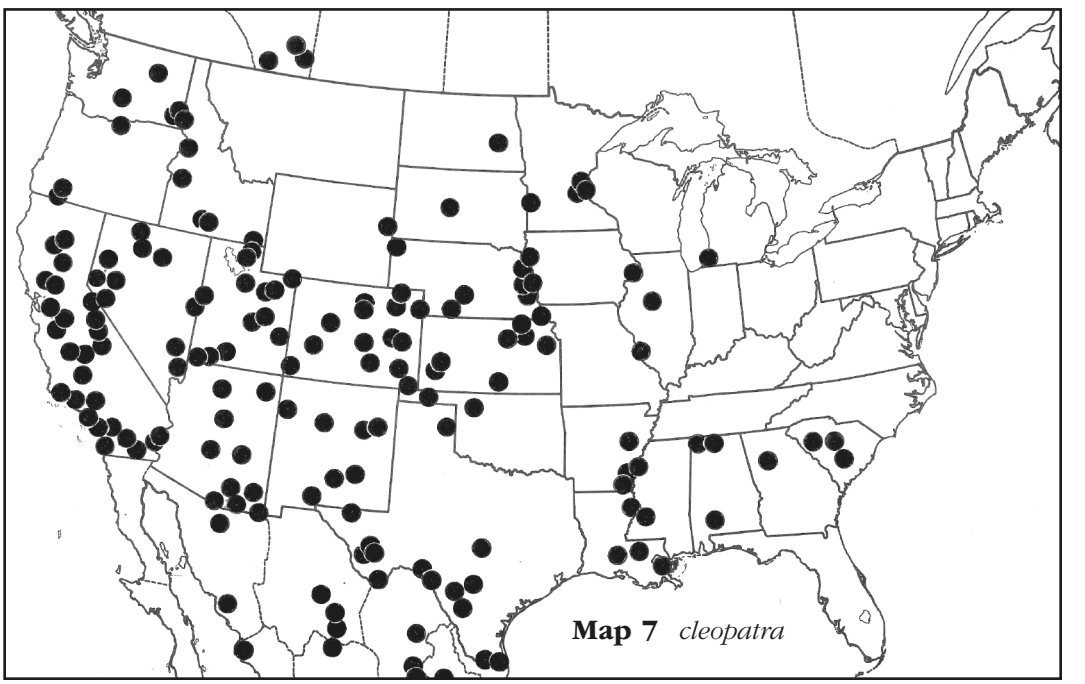
Vestiture: As in male but pleural bands more sharply defined (fig. 177); scutum frequently with a distinct posteromedian patch of appressed brownish to silver setae.

Structure: Labrum acuminate; clypeal disk tumescent, sparsely punctate, clypeal lobe produced, angles well developed; inner orbits slightly converging below; collar finely punctate; scutum dull, sparsely to moderately, shallowly punctate laterally becoming weakly to strongly transversely rugose medially, or with strong transverse rugae or ridges laterally that extend to midline or nearly so; mesopleuron moderately to densely punctate; lower metapleuron moderately to densely punctate, often feebly rugose; propodeal side rugosopunctate.

Variation: *A. cleopatra* is blacker east of the Rocky Mountains as indicated in the description. The transverse scutal rugae or ridges are sometimes feeble or lacking.

Nomenclature: Fernald (1934) confused this species with *juncea* Cresson. He also identified some of the eastern *cleopatra* as "arvensis".

Geographic range (map 7): *Ammophila cleopatra* occurs from the Pacific Coast to Minnesota, Michigan, Illinois, Missouri, Arkansas, Kentucky, Louisiana, Mississippi, Alabama, Georgia, and Florida (Gadsden Co., Madison Co., Alachua Co.). A few specimens have been seen from New Jersey, Virginia, and North Carolina. Thus this species occurs over most of North America, although I have seen little Canadian material (southern Alberta). More collecting is needed in the eastern Unites States to accurately determine the range of the species. *A. cleopatra* occurs over much of the north central plateau region of Mexico, but it is also known from Sonora, Sinaloa, Oaxaca, and Baja California.



Map 7 *cleopatra*

Ammophila dejecta Cameron

Figures 94, 98.

Ammophila dejecta Cameron, 1888, Biologia Centrali-Americana 2:14. Lectotype male: northern Sonora, Mexico (BMNH), present designation. Type studied.

Recognition: The partly red legs of most females helps identify them. The shape of the penis valve head and its long spine (fig. 98) are useful to separate males from the similar species *juncea*. The pleural setal patterns (fig. 94) also aid in identifying the species.

Description:

Male: Average length 18 mm, range 15-22 mm.

Color: Black, petiole tergum red laterally, black dorsally; gastral tergum I red with black stripe, II red basally, broadly black beyond, or entirely red; wings clear; veins brown.

Vestiture: Erect setae pale on head and mesosoma; face with dense appressed silver setae except sometimes lacking on clypeus near free margin; gena with some appressed silver setae next to eye margin; propodeal dorsum with erect setae mesally that are inclined anterad, sometimes with appressed silver setae mesally; collar sometimes with sparse appressed silver setae, scutum usually with median band of appressed silver setae; mesopleuron with band of appressed silver setae from base of midcoxa to top of episcrobal area; lower metapleuron with patch of appressed silver setae that extends about half way to superior metapleural pit, setae oriented horizontally, occasionally some silver setae cross over to the propodeal side.

Structure: Apex of labrum broadly rounded; clypeal surface near emargination impunctate, polished; collar sparsely punctate; scutum moderately to densely punctate; pleura and propodeal side densely punctate; propodeal enclosure with many diagonal ridges laterally that may extend to midline, ridges often give way to large, dense punctures mesally or the middle is rugosopunctate; penis valve head and spine as in fig. 98.

Female: Average length 21 mm, range 18-22 mm.

Color: As in male except inner side of forefemur and tibia, midfemur, and hindfemur reddish, or foretibia and midfemur reddish at apex, or foretibia reddish; legs completely black in some Arizona specimens; gastral terga I-II all red, III-IV red laterally only; gastral sterna red.

Vestiture: As in male but pleural silver bands more sharply defined; erect mesosomal setae shorter, sparse; propodeal dorsum usually with appressed silver setae mesally.

Structure: Labrum with median triangular projection; clypeus moderately tumescent, with an asetose area above the clypeal lobe that is shiny and has few scattered punctures; clypeal lobe projecting, lateral angles distinct; inner orbits almost parallel.

Variation: Leg color in females varies as indicated in the description. Two females from Bisbee, Arizona have black legs. One male from Puebla, Mexico has only two submarginal cells (ASM).

Geographic range: Oaxaca, Mexico north to southeastern Arizona and Davis Co., Texas. In Arizona *dejecta* has been collected in the Patagonia Mts., the Santa Rita Mts., the Huachuca Mts., the Catalina Mts., Sonoita, and Bisbee. The Texas record is 23 mi. S of Kent (ASM).

Ammophila dysmica Menke

Figures 100, 174.

Ammophila dysmica Menke, 1966, Proceedings of the Biological Society of Washington 79:30. Holotype: male, Sagehen Creek, California (UCD).

Recognition: The silver face and minutely roughened pleura will usually separate females of *dysmica* from the similar females of *kennedyi* and *urnaria*. Males of *dysmica* are very similar to *urnaria*, *kennedyi* and black-legged males of *parkeri*. The gastral sterna of male *parkeri* are red while the terminal sterna are black in *dysmica*. Another feature of *parkeri* is the appressed silver setae on the gena which is absent in *dysmica*. The completely red first gastral tergum of *kennedyi* males will usually separate this species from *dysmica*. In addition, the penis valve of *kennedyi* is distinctive (fig. 100). The separation of males of *dysmica* and *urnaria* is more difficult. Most specimens can be identified on the basis of distribution since the ranges of the two species are different. However, material from the eastern Rocky Mountains will be difficult because of overlapping ranges. As far as known, males of *urnaria* only have red on gastral segment I, whereas males of *dysmica* have red on both I and II. The roughened, rather dull pleura of d*ysmica* is distinctive but variable. However, the pleura of *urnaria* males is shiny, not roughened and is rather evenly punctate. The clypeus of male *urnaria* is rather sparsely covered by appressed setae and the setae are usually absent anteromedially. In contrast the clypeus of *dysmica* is usually uniformly densely setose.

Description:

Male: Average length 15 mm, range 11-18 mm.

Color: Black; petiole tergum and gastral segments I-II red with elongate dorsal black spots; wings clear, veins dark brown.

Vestiture: Gena without appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to bottom of episcrobal area (see female fig. 174).

Structure: Labrum obtusely acuminate; collar moderately punctate; scutum rather dull, densely micropunctate, punctures tending to elongate transversely, moderately macropunctate, spaces between punctures somewhat roughened, fossae transversely rugose; scutellum sparsely punctate, nearly completely ridged; mesopleuron moderately punctate; lower metapleuon moderately punctate, interspaces smooth anteriorly becoming roughened posteriorly; propodeal side rugosopunctate.

Female: Average length 18 mm, range: 13-20 mm.

Color: As in male except petiole tergum and gastral segments I-II completely red, tergum III red laterally and sternum red.

Vestiture: As in male with addition of a poorly defined patch of appressed silver setae on lower metapleuron adjacent to metapleural sulcus near hindcoxa (fig. 174); femoral psammophore often brownish.

Structure: Labrum acuminate; clypeal disk moderately tumescent, sparsely to moderately punctate, clypeal lobe projecting, teeth well formed; inner orbits slightly converging below; collar sparsely punctate; scutum sparsely to moderately punctate, scutal fossa with transverse microridges and few larger rugae; mesopleural surface generally covered by irregular microsculpture, becoming finely, vertically microridged anteriorly, sparsely to moderately punctate; lower metapleuron with irregular microsculpture which tends to

form vertical microridges, especially posteriorly, sometimes irregularly rugose, sparsely punctate; propodeal side weakly, vertically rugosopunctate with microridges between rugae.

Variation: The labrum of males of *dysmica* varies from acuminate to rounded. Occasionally, one of the midtibial spurs is greatly reduced or lacking in the male. Sometimes in females the band of appressed silver setae along the mesopleural suture extends onto the episcrobal area. The mesopleural surface is sometimes shiny.

Geographic range (map 6): *Ammophila dysmica* apparently occurs over much of North America west of the Rocky Mountains, and the species is found primarily at elevations above 4,000 feet.

Ammophila gracilis **Lepeletier de Saint-Fargeau**

Ammophila gracilis Lepeletier de Saint-Fargeau, 1845. Histoire Naturelle des Insectes. Hyménoptères. 3:381. Holotype: female, "Mexico" (TURIN). Type studied.

Ammophila mutica Dahlbom, 1845. Hymenoptera Europaea praecipue borealia, p. 431. Holotype: gynandromorph, Brazil (LUND). Synonymy by Menke, 1966a:2392. Type studied.

Ammophila moneta Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 4:219. Lectotype: female, "Brazil" (BMNH). Designated by Menke 1964b:149. Synonymy by Menke 1964b:149 and 1966a:2392. Type studied.

Ammophila fragilis Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 4:219. Lectotype: female, "Brazil" (BMNH), designated by Menke 1964b:149. Synonymy by Menke 1966a:2392. Type studied

Ammophila alticola Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:10, plate 1, fig. 9. Holotype: male, Volcan de Chiriquí, Panama (BMNH). Type studied. **New synonymy**.

Ammophila volcanica Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:17, plate 1, fig. 19. Holotype: female, Volcan de Chiriquí, Panama (BMNH). Type studied. **New synonymy.**

Ammophila chiriquensis Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:18. Holotype: female, Volcan de Chiriquí, Panama (BMNH). Type studied. **New synonymy.**

Recognition: *Ammophila gracilis* is very similar to *picipes* but they appear to be distinct species. In South America this taxon is a common, widespread species. It varies in color and scutal sculpture and it is possible that it is a species complex. In Central America *Ammophila gracilis* occurs in Panama and Costa Rica. The clypeus is uniformly setose in *gracilis*. In *picipes* the male clypeus is asetose above the free edge and the surface is shiny (fig. 83). The mesosomal appressed setal patterns are identical in the two species and females are identical. The appressed setae of *gracilis* often have a golden tinge.

Nomenclature: Originally I synonymized Cameron's species with *picipes* (Menke 1966a), but I now realize that was wrong. *Ammophila suavis* Burmeister and *arechavaletai* Brèthes were listed by me as possible synonyms of *gracilis* (Menke, 1976:152), but these taxa need further study.

Ammophila hermosa Menke

Figures 164, 170.

Ammophila hermosa Menke, 1966. Proceedings of the Biological Society of Washington 79:31. Holotype: male, Black Lake, Mono Co., California (UCD).

Recognition: *Ammophila hermosa* can usually be identified by the reddish legs and posteromedian silver scutal stripe. Also the largely red propodeal side (fig. 170) and abdomen of females is distinctive. *A. juncea* and *mescalero* are similar to *hermosa*. *Ammophila juncea* has black legs, however, and *mescalero* has a distinctive truncate collar. *Ammophila hermosa* appears to be most closely allied with *juncea*.

Description:

Male: Average length 18 mm, range 15-20 mm.

Color: Black; gastral tergum I with median black stripe, tergum II red, terga III-IV red laterally; femur red below, black above, foretibia red, middle and hindtibiae red below, black above; wings clear, veins black.

Vestiture: Appressed silver setae of clypeus uniform, or sometimes extreme apex asetose; gena along outer orbit with dense appressed silver setae; collar and scutum with sparse silver to brownish appressed setae; scutum with posteromedian stripe of appressed silver setae; mesopleuron largely covered with appressed silver setae, densest along mesopleural suture forming band from midcoxa to top of episcrobal area; lower metapleuron with poorly defined patch of appressed silver setae near hindcoxa; propodeal dorsum with long, erect setae that are inclined anterad, mesally with appressed silver setae.

Structure: Clypeus with broad emargination, tumescent near tentorial pits; labrum obtusely acuminate, nearly truncate; collar moderately punctate; scutum moderately finely punctate, shining; scutellum sparsely punctate; pleura moderately punctate; propodeal side densely punctate; propodeal dorsum with many cross ridges that meet at midline; penis valve head similar to *cleopatra* (fig. 194).

Female: Average length 19 mm, range: 14-22 mm.

Color: As in male except: mandibles and clypeal margin sometimes red; pronotum sometimes with small reddish spot just above streptaulus laterally; tegula usually red; lower metapleuron and propodeum red, or only propodeal side red, mesosoma infrequently entirely black; abdomen red, gastral terga II-IV occasionally with small black spots; legs vary from nearly all red to coxae, and trochanters black and femora partially black.

Vestiture: As in male except pleural bands denser, more clearly defined; clypeus above lobe without appressed setae.

Structure: Labrum rounded but with median projection (fig. 164); clypeal disk slightly tumescent, moderately punctate, clypeal lobe produced, teeth well formed; inner orbits very slightly converging below; scutum sparsely, finely punctate; scutellum smooth, sparsely, finely punctate; propodeal side finely rugose.

Variation: The metapleuron and propodeum are usually red in the female but sometimes only partially so and infrequently they are black. The tegula is often red in the male. One male seen has faint reddening on the propodeal side. The labrum in the male varies from rounded to truncate and occasionally it is obtusely acuminate. Mesosomal sculpture in both sexes is usually fine, giving the surface a very smooth appearance. The scutellum sometimes is not at all ridged and very finely punctate. Sometimes the male clypeus is sparsely covered with appressed silver setae anteromedially or glabrous.

Geographic range (map 8): *Ammophila hermosa* is known from Arizona, California, Colorado, Nevada, and Texas. It occurs in northern Mexico also: Baja California, Sonora and Chihuahua. The scattered records indicate a possible wide distribution over the southwestern United States.

Ammophila juncea **Cresson**

Figures 95, 99, 178, Map 9.

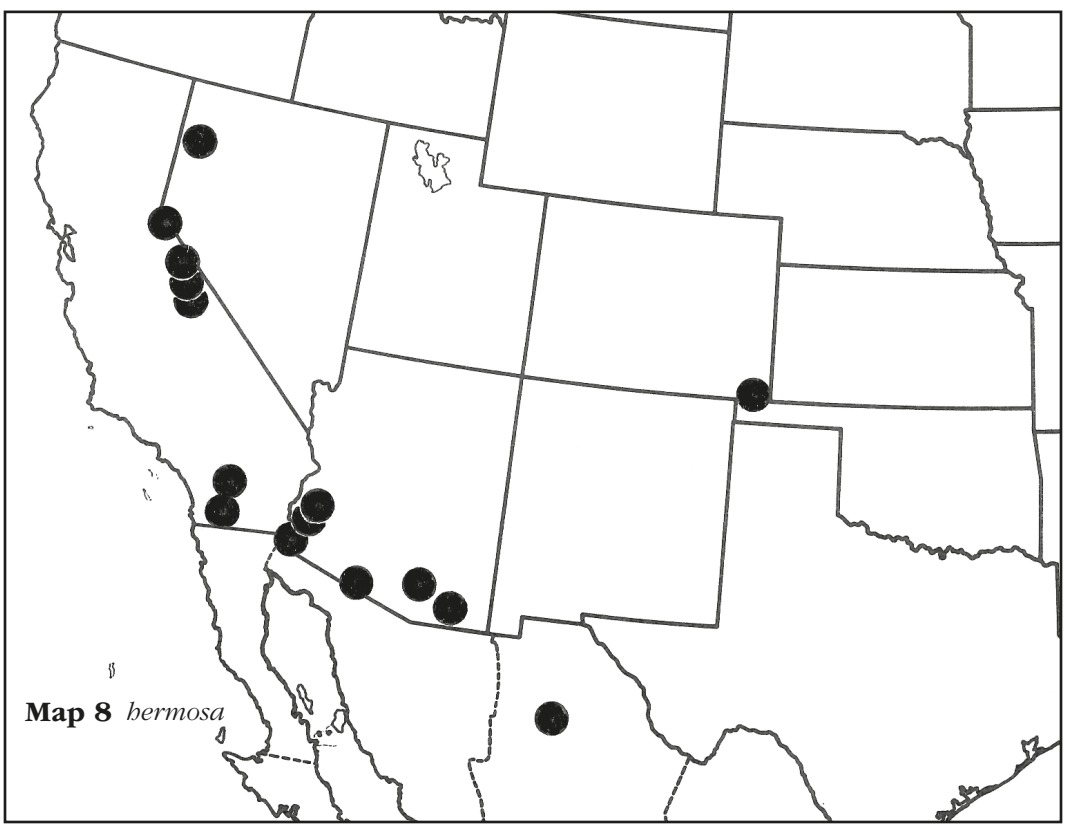
Ammophila juncea Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:460. Holotype: male, Colorado Territory (ANSP). Type studied.

Ammophila montezuma Cameron, 1888. Biologia Centrali-Americana, 2:13. Holotype: male, northern Sonora, Mexico (BMNH). Synonymy by Menke, 1966a:2392. Type studied.

Recognition: The posteromedian silver scutal stripe and black legs generally offer a quick means of identifying *juncea*. *Ammophila hermosa* has this stripe also but differs from *juncea* in having red legs. A female from The Dalles, Oregon, lacks the silver scutal band, and the gena has barely a trace of silver setae. The Mexican species *Ammophila dejecta* occurs in southeastern Arizona and males are very similar to *juncea*, differing primarily in the penis valve head. Comparison of figures 98, 99 shows the differences.

Description:

Male: Average length 21 mm, range: 15-25 mm.

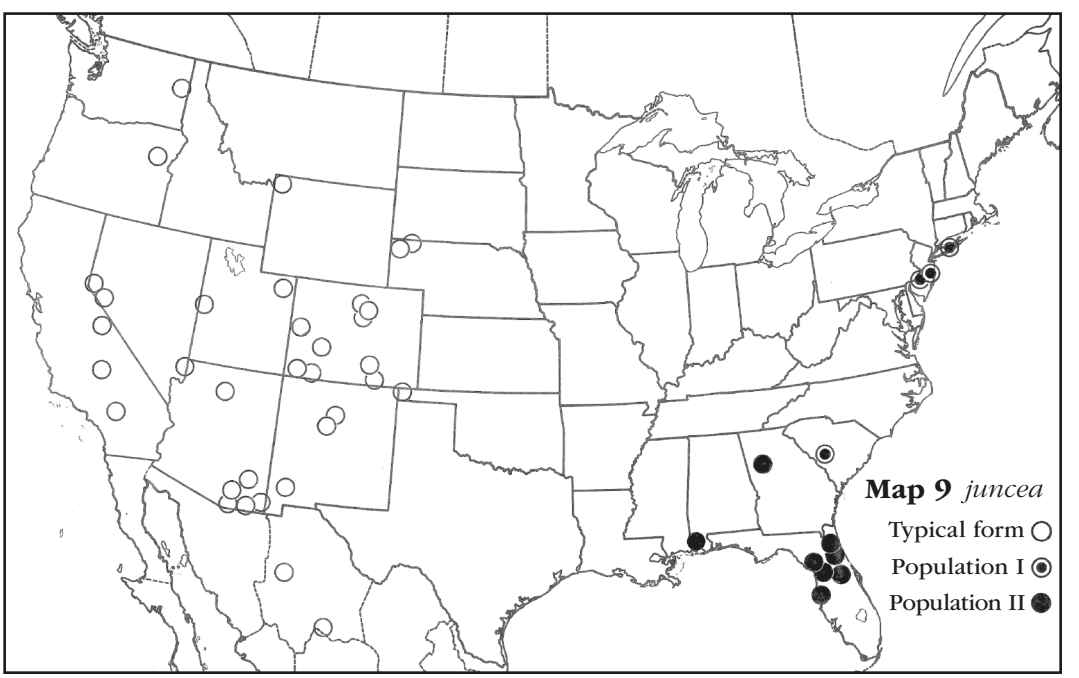


Map 8 *hermosa*

Color: Black; petiole tergum red laterally, black above (western United States and some Floridian specimens) or entirely black (eastern United States); gastral segments I-II and sternum III, red, tergum I with elongate median black spot (western United States), gastral segments I-IV and most of V red, tergum I with black spot (California), or only gastral segment I red with dorsal black stripe (eastern United States), gastral segment I sometimes without dorsal black stripe (Florida); wings clear or slightly infumate (Florida), veins brown to black.

Vestiture: Gena with dense appressed silver setae (sometimes sparse or lacking in eastern specimens); collar and scutum with silver or brownish microsetae (often absent in Floridian specimens); scutum with posteromedian longitudinal band of appressed silver setae; mesopleuron with band of appressed silver setae from base of midcoxa to top of episcrobal area; mesopleuron sparsely covered with appressed silver setae anteriorly (western United States); lower metapleuron near hindcoxal base and adjacent to metapleural sulcus with band of appressed silver setae, band extending along sulcus nearly to upper metapleural pit, setae generally parallel to plane of sulcus or vertical, and crossing sulcus in heavily setose specimens, sometimes reaching nearly to metapleural flange (fig. 95), propodeal setae usually diagonal to sulcus, rarely perpendicular; lower metapleuron usually weakly covered with appressed silver setae anteriorly (western United States); erect mesosomal setae extremely short in Floridian specimens; propodeal dorsum with long hairlike setae that are inclined anterad; same area usually with appressed silver setae.

Structure: Labrum truncate or slightly rounded; collar sparsely, shallowly, finely punctate; scutum moderately shallowly to densely punctate, or scutum coarsely rugosopunctate (Florida); scutellum sparsely to moderately punctate anteriorly, feebly ridged posteriorly, or rugosopunctate (Florida); mesopleuron, lower metapleuron, and propodeal side, moderately punctate, or pleura coarsely rugosopunctate (Florida); propodeal dorsum with many



diagonal cross ridges that usually reach midline, mesal area sometimes rugosopunctate; penis valve head as in fig. 99.

Female: Average length 21.5 mm, range: 16.5-23.5 mm.

Color: As in male except petiole tergum usually completely red, rarely black (South Carolina, New Jersey); gaster completely red (California, Nevada), or terga III-V largely black (Arizona, Utah to Nebraska), or only segment I red (eastern United States).

Vestiture: As in male except pleural bands more distinct; the silver setae on propodeal side along metapleural sulcus are often vertically oriented (New Jersey) resembling *cleopatra*.

Structure: Labrum rounded but with median projection; clypeal disk slightly tumescent, moderately punctate, clypeal lobe projecting, teeth blunt, rounded; inner orbits slightly to moderately converging below.

Variation: The only significant variation in western *juncea* is color and this has been adequately covered in the description. Material from the eastern Seaboard can be divided into two populations: population I (New York, New Jersey, and South Carolina) is very similar to western *juncea* except for less red on the abdomen and sparser appressed genal setae. Population II (Alabama, Florida, and Georgia) differs from both population I and typical *juncea* in having a rugosopunctate mesosoma. In addition the wings are lightly infumate and the erect mesosomal setae are very short and sparse in population II. The genal appressed setae are also sparse in population II. Because of the lack of material from the states between populations I and II it is not known whether II is a distinct entity or one that grades into I. However, since other species (*urnaria* for example) undergo similar, although admittedly less pronounced, changes in sculpture in the southeastern United States, I have decided to consider population II as conspecific with *juncea*. When the *Ammophila* fauna of the eastern United States is better known, especially in the southeast, it may be necessary to re-evaluate population II.

Nomenclature: Fernald (1934) used the name *juncea* primarily for the species now known as *cleopatra*. Examination of Cresson's type, however, established the correct identity of *juncea*. Murray (1951) synonymized *montezuma* with *aberti*, but the type of *montezuma* is clearly a junior synonym of *juncea*. At least one of Fernald's paratypes of *Ammophila floridensis* is the same as population II of *juncea.* The type of *floridensis* is a synonym of *urnaria*.

Geographic range (map 9): *Ammophila juncea* has a peculiar disjunct distribution. The typical form occurs from the western great plains to California, Oregon, and Washington and southward just into northern Mexico (Cananea, Sonora; Santa Barbara, Chihuahua). An eastern, darker colored form of *juncea* occurs along the Atlantic Coast from New York to Florida and Alabama. This eastern form is separated by a large gap from the typical western form of the species. Whether or not this split distribution is natural or the result of insufficient collecting remains to be seen. As discussed in the paragraph on variation, the eastern form of *juncea* can be divided into two populations. Population I is represented by circles with black centers on the distribution map. Population II is shown as solid circles. The typical western form of *juncea* is represented by open circles. The material studied in populations I and II is listed below.

Population I: NEW JERSEY, Burlington Co.: Medford Lakes, on *Clethra ainifolia* (CUI & ANSP), Oswego Lake (ASM). Ocean Co.: Lakehurst (AMNH), west of Whiting (ASM, USNM); Wranglebrook, Lakehurst (CUI). NEW YORK, Suffolk Co.: Yaphank, Long Island (AMNH). SOUTH CAROLINA, Aiken Co. (CNC).

Population II: ALABAMA, Mobile Co.: Mobile (CAS). FLORIDA, Clay Co.: Gold Head Branch State Park (USNM). Hillsborough Co.: Tampa (USNM). Levy Co.: "Levy Co." (USNM). Marion Co.: Dunnellon (USNM); Orlando (LACM). Putnam Co.: Welaka (CUI). GEORGIA, Fullton Co.: Atlanta (UCD), Stone Mountain (ANSP).

Ammophila kennedyi (Murray)

Figures 90, 100, 198.

Ammophila vulgaris Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:458. Lectotype: female, Colorado (ANSP), designated by Cresson, 1916:95. Junior primary homonym of *Ammophila vulgaris* Kirby, 1798. Type studied.

Sphex kennedyi Murray, 1938. Annals of the Entomological Society of America 31:36. Replacement name for *Ammophila vulgaris* Cresson, 1865, nec Kirby 1798.

Recognition: The lack of silver facial setae, and uniformly setose pronotal lobe will usually separate females of *kennedyi* from similar species. The normally brown veins and often narrowly lamellate metapleural flange are subsidiary recognition features in *kennedyi.* Males of this species can usually be identified by the entirely red first gastral segment, and the distinctive clypeus (fig. 90). The broad spine of the penis valve head is also diagnostic (fig. 100). See discussion under systematics of *dysmica* and *urnaria* for differences between these species and *kennedyi.*

Description:

Male: Average length 16.5 mm, range: 15-18.5 mm.

Color: Black; tegula often brownish posteriorly; petiole sternum reddish brown to black; petiole tergum red but often suffused with brown dorsally; gastral segment I red (east of Rockies), or I-II red with black spot posteriorly on II (west of Rocky Mountains); wings clear or slightly infumate (Florida), veins light brown to nearly black.

Vestiture: Appressed clypeal setae often thinning toward free edge, exposing sculpture; gena sometimes with sparse appressed silver setae along outer orbit; mesopleuron with band of appressed silver setae from base of midcoxa to bottom of episcrobal area; propodeal dorsum without appressed silver setae, but with pale erect hairlike setae that are inclined anterad.

Structure: Labrum truncate; clypeal disk moderately to strongly bulging, sparsely punctate, shiny; clypeus with broad, apical emargination (fig. 90); collar moderately punctate; scutum shining, moderately to densely punctate; mesopleuron and lower metapleuron shining, moderately punctate; propodeal side shining, densely punctate or rugosopuncatate; metapleural flange sometimes narrowly lamelliform; penis valve head as in fig. 100)

Female: Average length 17 mm, range: 13-23 mm.

Color: As in male except petiole tergum entirely red with black basodorsal spot; gastral tergum II completely red in western form.

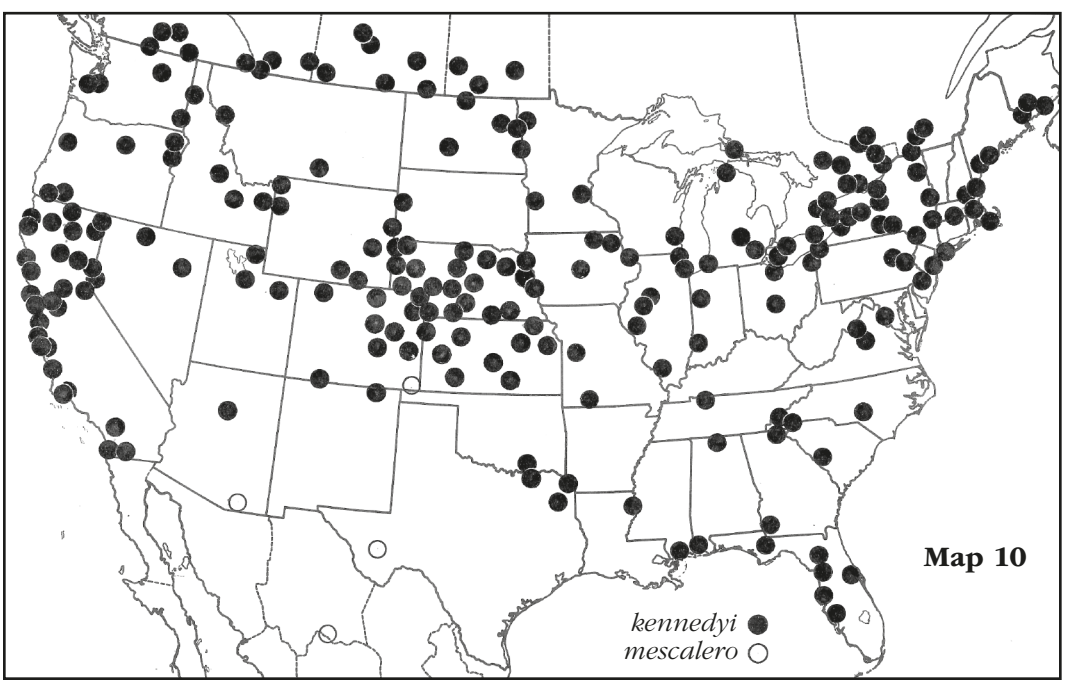
Vestiture: Clypeus, frons, gena, collar, and scutum with sparse appressed brownish setae, facial setae infrequently partly silver; mesopleuron with band of appressed silver setae from base of midcoxa to bottom of episcrobal area, occasionally band extends to top of episcrobal area; lower metapleuron sometimes with small poorly defined patch of appressed silver setae near hindcoxa, patch occasionally crossing metapleural sulcus diagonally and extending onto propodeal side; psammophore brownish (eastern United States) or pale (western United States).

Structure: Labrum acuminate; clypeal disk moderately to strongly tumescent, moderately punctate, clypeal lobe projecting, broad, teeth well developed (fig. 198); inner orbits slightly converging below; collar sparsely, finely punctate; scutum subshining, moderately punctate; scutellum moderately punctate, ridged; other details as in male.

Variation: This species exhibits east-west geographic variation with respect to vestiture and color. The Rocky Mountains form an approximate line between the western form of *kennedyi* and the typical eastern form. Eastern *kennedyi* have only gastral segment I red and females usually have a brownish psammophore. Western specimens have the second gastral segment partially red as well as segment I and the psammophore is pale. In addition, the appressed pleural setae are often denser and the bands somewhat broader in western examples. In densely pubescent specimens the mesopleural band of setae may extend nearly to the top of the episcrobal area. Occasional females have some appressed silver setae on the face. The clypeus of eastern *kennedyi* males is often more strongly tumescent and more highly polished than the western material. *Ammophila kennedyi* from Florida and adjacent regions have lightly infumate wings and males sometimes have a narrow black stripe on gastral tergum I.

Nomenclature: Fernald (1934) confused *kennedyi* (cited as *vulgaris*) with *urnaria*. Murray (1938) was the first to show that the two were distinct. One of Fernald's paratypes of *Ammophila floridensis* is actually *kennedyi* (USNM).

Geographic range (map 10): *Ammophila kennedyi* is transcontinental in the United States and southern Canada. The species does not appear to occur in the southwestern desert areas.



Ammophila leoparda (Fernald)

Figures 61, 165, 199, Map 4.

Sphex urnarius leopardus Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 125. Holotype: female, Georgia (USNM). Type studied.

Recognition: The very broad metapleural flange in both sexes, and the red mesosomal areas in the female make *leoparda* one of the most unusual members of the *urnaria* group. The female clypeus is also distinctive (fig. 165). The propodeal dorsum has a coarse, somewhat wavy ridge down the center, and laterally the surface is irregularly linearly rugose (fig. 199) rather than having the close set ridges seen in all other species of the *urnaria* group. Laterally the propodeal dorsum has pale semierect hairlike setae that are transversely oriented. The lamelliform metapleural flange is also diagnostic.

Description:

Male: Average length 15.5 mm, range: 15-17 mm.

Color: Black; tegula brownish posteriorly; pronotal lobe, pronotal side occasionally, metapleural flange, and sometimes gastral segment I, red; wings clear or slightly infumate, veins brown to black.

Vestiture: Gena without appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to bottom of episcrobal area, sometimes weakly extended to top of episcrobal area; lower metapleuron near base of hindcoxa with patch of appressed silver setae, setae continuing along metapleural sulcus as a band, ending near upper metapleural pit; propodeal enclosure laterally with pale semierect hairlike setae that are transversely oriented .

Structure: Labrum rounded; collar, scutum, mesopleuron, lower metapleuron and propodeal side moderately to densely punctate, punctures large; scutellum coarsely punctate, ridged; metapleural flange broadly lamelliform, width nearly twice diameter of peritreme, outer margin excised (fig. 61); propodeal enclosure with coarse wavy ridge mesally, and laterally with variable linear rugosities.

Female: Average length 17 mm, range: 16.5-17.5 mm.

Color: As in male except entire pleural region and petiole often red; tegula and gastral segment I usually red.

Vestiture: As in male except gena with appressed silver setae.

Structure: Labrum rounded; clypeal disk slightly tumescent, densely punctate, clypeal lobe not defined by angles or teeth, free edge broadly emarginate, or more or less straight (fig. 165); inner orbits moderately converging below, LID:GID (73:104).

Geographic range (map 4): Apparently *Ammophila leoparda* occurs over much of the eastern half of the United States, but judging by the scarcity of specimens in collections the species must occupy restricted habitats. In early June I collected a great many specimens at Camp Swift in Bastrop Co., Texas, in a pine barrens type habitat with sandy soil.

I have seen material from the following localities: ALABAMA, Lee Co.: Auburn, on *Cyanotis* (CUI). Washington Co.: Leroy (CUI). FLORIDA, Alachua Co. (ASM). GEORGIA, Crawford Co.: Roberta (USNM). Dooley Co.: Unadilla (CUI). Early Co.: Spring Creek (CUI). Richmond Co.: Fort Gordon (CIS, LACM). ILLINOIS, Mason Co.: Havana (AMNH). INDIANA, Co.?: Mineral Springs (CAS). MICHIGAN, Livingston Co.: E. S. George Reserve (USNM). Midland Co.: "Midland Co." (UCD). MINNESOTA, Washington Co.: "Washington Co." (UMSP, USNM). NEW YORK, Monroe Co., Powder Mills (USNM). NORTH CAROLINA,

Moore Co.: Southern Pines (AMNH). TEXAS, Anderson Co.: Salmon (ASM), Bastrop Co.: Camp Swift (ASM), McDade (UK). Guadalupe Co.: Dewville (5 mi. NW) (ASM).

Murray (1938) listed material from the following localities (all from the Univerity of Minnesota): MINNESOTA, Barden. Fort Snelling. OHIO, Sandusky Co.: Clyde.

Ammophila mescalero Menke

Figure 91.

Ammophila mescalero Menke, 1966. Proceedings of the Biological Society of Washington 79:33. Holotype: male, Cacaloapan, Puebla, Mexico (UCD).

Recognition: Although most similar to *hermosa*, *mescalero* can be recognized easily by the anteriorly truncate collar (above the streptaulus) (fig. 91). It is also very similar to *breviceps* which sometimes has a somewhat truncate collar, but the latter has a long episternal sulcus.

Description:

Male: Average length 16 mm, range 15-18 mm.

Color: Black; tegula brownish; petiole tergum red laterally, black above; gastral sterna I-III red, terga I-II red but with elongate median black spots, tergum III red laterally; front and middle femur and tibia red, hindfemur, tibia and tarsus largely black; wings clear, veins reddish brown.

Vestiture: Gena with appressed silver setae; collar and scutum sparsely covered with appressed silver setae; scutum with posteromedian longitudinal silver stripe; mesopleuron covered by appressed silver setae, setae densest along mesopleural suture; lower metapleuron with patch of appressed silver setae near base of hindcoxa, patch crossing metapleural sulcus and extending onto propodeal side as far as propodeal spiracle.

Structure: Labrum truncate; collar strongly truncate anteriorly, overhanging streptaulus (fig. 91), collar moderately punctate, shining; scutellum punctate, ridged posteriorly; mesopleuron, lower metapleuron and propodeal side densely punctate, shining; metapleural sulcus poorly defined.

Female: Average length 17.5 mm., range; 15-18 mm.

Color: About as in male, petiole as in male or all red, gaster red, tergum I with small black spot, III-IV with large black spots; wing veins reddish brown to dark brown.

Vestiture: As in male except mesopleural appressed setae forming distinct band along mesopleural suture.

Structure: Labrum rounded, sometimes with median projection; clypeal disk moderately tumescent, moderately to densely punctate, clypeal lobe projecting, teeth well formed; inner orbits moderately converging below; mesosomal sculpture as in male except propodeal side sometimes weakly rugosopunctate.

Variation: The male petiole sternum varies from black to red. Gastral tergum II may be all red.

Geographic range (map 10): In the United States *mescalero* is known from Arizona, New Mexico, Texas, and southeastern Colorado. *Ammophila mescalero* appears to be widespread in Mexico at higher elevations. I have seen specimens as far south as Oaxaca.

Ammophila parkeri Menke

Figures 71, 167, 196, Map 11.

Ammophila parkeri Menke, 1964. Acta Hymenopterologica 2:23. Holotype: male, Boca, California (UCD).

Recognition: The combination of reddish legs and distinctive abdominal color pattern are diagnostic in *parkeri.* In the female the gaster usually has narrow black spots on terga II-III (fig. 167). Males usually have a narrow black stripe on the petiole tergum which is continued on gastral terga I-II or III (fig 71). Some males have completely black legs but the gastral color pattern is diagnostic. They are similar to males of *dysmica* but gastral sterna V-VI are black in the latter.

Description:

Male: Average length 14 mm, range: 11-16 mm.

Color: Black; petiole tergum and gaster red but with continuous narrow black dorsal stripe which broadens and covers most of terga III-VI, sometimes gastral tergum I all red; legs varying from nearly all red to completely black; wings clear, veins black.

Vestiture: Gena with dense appressed silver setae along outer orbit; mesopleuron and lower metapleuron rather evenly covered with sparse, appressed silver setae, but forming band along mesopleural sulcus from midcoxa to bottom of episcrobal area; propodeal enclosure with pale, semierect hairlike setae that are inclined anterad.

Structure: Labrum truncate or rounded; scutum sparsely punctate, spaces between punctures somewhat roughened, sometimes with few weak transverse ridges; scutellum punctate, ridged posteriorly; mesopleuron and lower metapleuron moderately to densely punctate, interspaces micropunctate; propodeal side finely, vertically rugosopunctate; penis valve head as in fig. 196.

Female: Average length 17 mm, range: 14-19 mm.

Color: Tegula frequently orange; abdomen usually red except for elongate black spots on gastral terga II-IV, or sometimes with continuous black stripe from base of petiole sternum to apex of gaster, petiole sternum red or black; legs often red, or partially so, but legs sometimes all black.

Vestiture: As in male except appressed pleural setae denser; appressed setae of lower metapleuron extending onto propodeal side.

Structure: Labrum rounded apically, sometimes with tiny projection; clypeal disk slightly tumescent, sparsely punctate; clypeal lobe projecting, teeth well developed; inner orbits convergent below or nearly parallel; scutum sparsely to moderately punctate, smooth.

Variation: Leg color in male *parkeri* is variable as indicated above. The entire front leg, and the middle and hindtibae may be black. Rarely, all of the legs may be black. There is considerable variation in the least interocular distance. Usually the length of flagellomere I is obviously less than the least interocular distance, but occasionally the LID is so narrow that flagellomere I is nearly equal to it. Stylopized females may have black legs. Some females have the episcrobal area covered with dense appressed silver setae, and the scutum has cross ridging (Darwin Falls, Calif., ASM) The rear of the propodeum at the petiole in one female from Monterey Co., California is reddish (ASM).

Geographic range (map 11): Most specimens of *parkeri* have been collected in California but scattered records from Montana, Oregon, Nevada, and Arizona indicate a broader range. The species has been collected in Mexico: Coahuila and Baja California. *A. parkeri* is known from Santa Cruz Island and Santa Rosa Island off the coast of southern

California. It has been collected from near sea level to over 10,000 feet in the White Mountains of California.

Ammophila picipes **Cameron**

Figures 83, 103, 175, 197, Map 12.

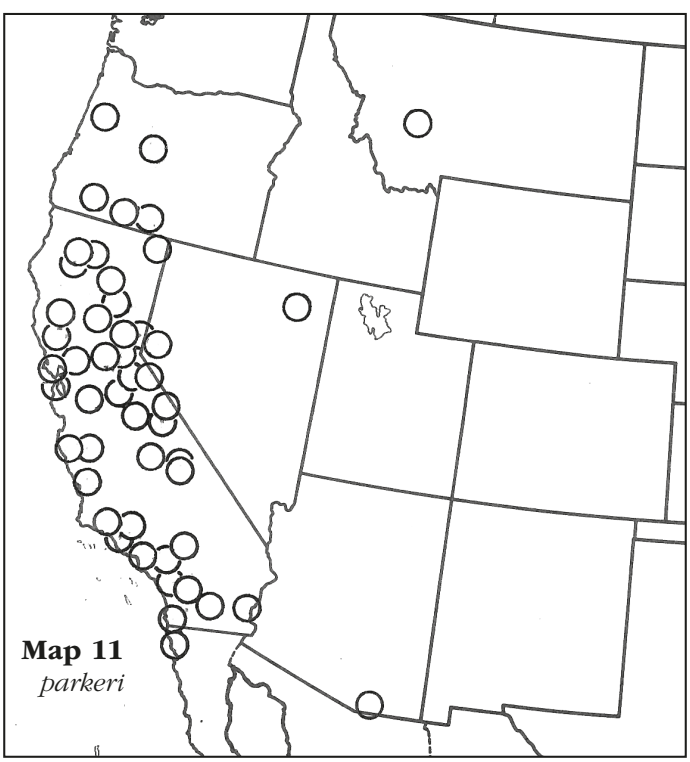
Ammophila picipes Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:11, plate2, fig. 4. Holotype: male, Temax, North Yucatán, Mexico (BMNH). All that is left of the type is a slide with genitalia.

Recognition: The partially glabrous clypeus of male *picipes* (fig. 83), and the patch of appressed silver setae on the propodeal side of both sexes (figs. 103, 175) are distinctive features. The smooth scutum will usually separate this species from the similar *cleopatra* which usually has a transversely rugose scutum. *A. urnaria* and *kennedyi* also resemble *picipes* but the mesopleural band of silver setae reaches the top of the episcrobal area in *picipes*. *Ammophila picipes* is very similar to the common South American *gracilis*, but I tentatively regard them as distinct. The male clypeus of *gracilis* is uniformly covered with appressed silver setae. But some males of *picipes* are likewise uniformly covered. Females of *picipes* and *gracilis* are essentially identical. DNA work should be done to determine if *picipes* and *gracilis* are different species.

Description:

Male: Average length 18 mm, range: 16.5-23 mm.

Color: Black; tegula usually brownish posteriorly; petiole sternum varying from red to black; petiole tergum red laterally, black above; gastral segment I red, tergum usually



with an elongate black spot medially; basal half of segment II red or segment entirely black; wings clear, veins brown to black.

Vestiture: Appressed clypeal setae thinning or absent near free edge; gena with sparse appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to top of episcrobal area; propodeal side adjacent to metapleural sulcus with patch of appressed silver setae, patch sometimes crossing sulcus diagonally and extending partially onto lower metapleuron near hindcoxa, setae of patch diagonally or horizontally oriented with respect to plane of sulcus (fig. 103).

Structure: Labrum acuminate; clypeal disk raised but flattened, very sparsely punctate, strongly shining; collar sparsely punctate, scutum moderately to densely punctate often grading to rugosopunctate toward scutal fossae; scutellum ridged, densely punctate between ridges; mesopleuron and lower metapleuron densely punctate with feeble rugae posteriorly, shining; penis valve head as in (fig. 197, holotype).

Female: Average length 20 mm, range: 17-25 mm.

Color: As in male except tegula often red; petiole tergum red with basodorsal black spot; gastral segments I-II red, III sometimes red laterally, or only basal one-half of segment II red, III completely black.

Vestiture: As in male but pleural bands more sharply defined; silver patch on propodeal side sometimes very small or absent; pronotum and scutum usually with fine brownish to silver micropubescence; femoral psammophore setae sometimes brownish.

Structure: Labrum acuminate; clypeal disk tumescent, sparsely to moderately punctate, clypeal lobe projecting, teeth well formed; inner orbits slightly converging below; collar minutely reticulate, very sparsely to moderately finely punctate; scutum dull or subshining, sparsely to rather shallowly punctate, sometimes feebly transversely rugose or ridged toward fossae; scutellum ridged, sparsely punctate; mesopleuron moderately to densely punctate often becoming vertically rugosopunctate anteriorly; lower metapleuron moderately punctate, often feebly rugose, especially posteriorly; propodeal side rugosopunctate.

Variation: The color varies as noted. The silver patch on the propodeal side in females is sometimes very small or absent. In the United States specimens of *picipes* average somewhat larger than specimens from Mexico and Central America.

Nomenclature: Unfortunately all that is left of the type of *picipes* is a slide of the genitalia which I have studied (fig. 197). However, a specimen in the University of Kansas collection bears the same data as the type of *picipes* (Yucatan, coll. Gaumer) and may have been part of the original series from which Cameron's type originated. In any case, the Kansas specimen agrees with the original description of *picipes* and the genitalia compare very well with the type slide. Cameron's species *alticola, volcanica* and *chiriquensis* were synonymized with *picipes* by me (Menke 1966a) but I now realize they are synonyms of *gracilis*. The sleeping behavior notes of Linsley (1962) for *A. volcanica* pertain to *picipes*.

Geographic range (map 12): *Ammophila picipes* is a common Central American insect, which ranges north from Costa Rica to southern Arizona, New Mexico, Oklahoma, and Texas.

Ammophila urnaria **Dahlbom**

Figures 101, 102, map 12.

Ammophila urnaria Dahlbom, 1843. Hymenoptera Europaea praecipue borealia. Tomus *Sphex* in sensu Linnaeano, 1 (fasc. 1):14. Lectotype: male, South Carolina (LUND), present designation.

Ammophila inepta Cresson, 1873. Transactions of the American Entomological Society 4:209. Lectotype: female, Texas (ANSP), designated by Cresson, 1916, p. 94. Synonymy by Murray 1938:30. Type studied.

Sphex floridensis Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 126. Holotype: female, Orlando, Florida (USNM). Synonymy by Menke 1976:154. Type studied.

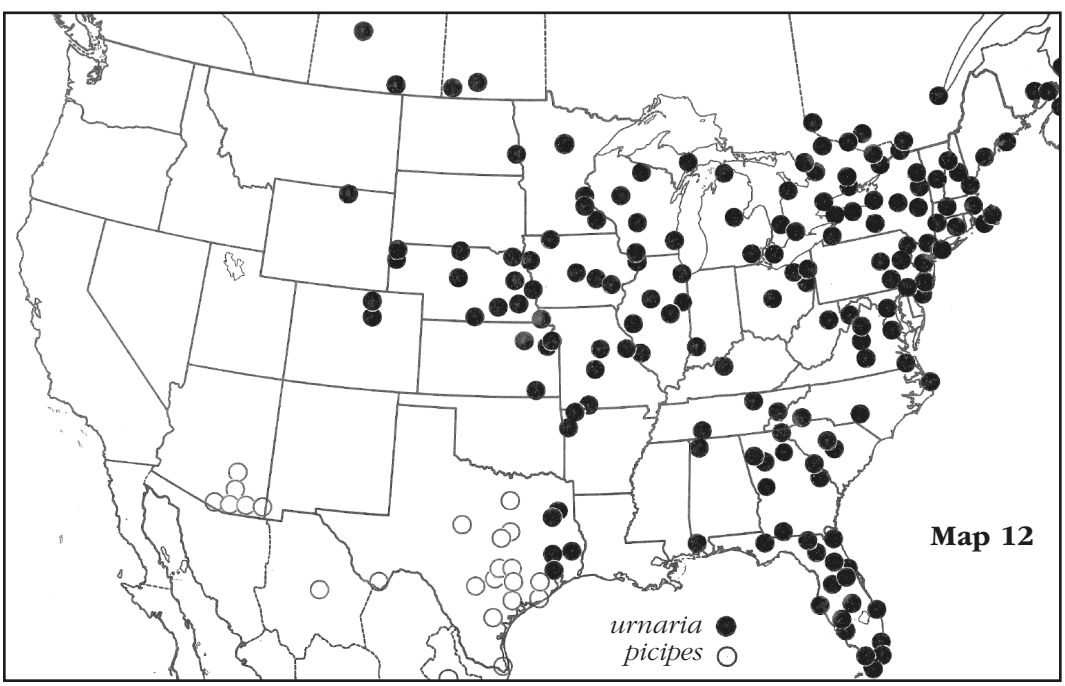
Recognition: *Ammophila urnaria* is similar to *kennedyi* and the two species are sympatric. The pronotal lobe of *urnaria* has silver setae only on its posterior half, whereas the lobe is entirely silver in *kennedyi*. This difference is sometimes difficult to appreciate. Silver facial setae are present on some females of *kennedyi*, but are never seen in *urnaria*. There are subtle differences in the wings of the two species. The wings of *urnaria* females are darker and the veins are dark brown or even black. The wings of *kennedyi* females are nearly clear with light brown veins. Males of *urnaria* differ primarily from *kennedyi* males in having a black stripe on gastral tergum I. The penis valve heads of the two species are also diagnostic (compare figs. 100, 101, 102). For differences between *urnaria* and *dysmica* see the latter species.

Description:

Male: Average length 17.5 mm, range: 16-24 mm.

Color: Black; tegula often brownish posteriorly; petiole tergum infrequently red (Florida); gastral segment I red but with longitudinal black stripe dorsally (stripe poorly defined or lacking in some New Jersey and Florida specimens); wings slightly to moderately infumate, veins black.

Vestiture: Clypeus covered by appressed silver setae, often reduced or absent at free edge; mesopleuron with band of appressed silver setae along mesopleural suture from



base of midcoxa to bottom of episcrobal area (rarely extending onto episcrobal area); metapleural sulcus sometimes with small linear patch of appressed silver setae.

Structure: Labrum rounded or acuminate; clypeal disk sparsely to moderately punctate; collar moderately punctate; scutum shining, moderately to densely punctate, sometimes partially transversely rugosopunctate, especially in Georgia and Florida, fossae with transverse ridges or rugae; scutellum coarsely rugosopunctate; mesopleuron shining, moderately to densely punctate or rugosopunctate, expecially anteriorly; lower metapleuron and propodeal side shining, densely punctate, often feebly rugose or rugosopunctate; penis valve head as in (figs. 101, 102).

Female: Average length 20 mm, range: 12-25 mm.

Color: As in male except petiole tergum occasionally partially red; gastral tergum I completely red.

Vestiture: Clypeus, frons, gena and collar with sparse appressed brownish setae; pronotal lobe with appressed silver setae posteriorly; psammophore and erect head setae varying from pale to brown, mesosomal erect setae sometimes brownish.

Structure: Labrum acuminate; clypeal disk moderately to strongly tumescent, moderately punctate, clypeal lobe produced, teeth well developed; inner orbits parallel to slightly converging below; collar moderately finely punctate; scutum subshining, densely punctate usually becoming transversely rugosopunctate toward fossae.

Variation: There is a tendency in this species for increase in body size, coarser mesosomal sculpture and darker wings in the southeastern part of its range. These changes become most pronounced in Florida where body length averages several millimeters more than the norm for *urnaria*. This type of variation is not peculiar to *urnaria*. It is seen in *kennedyi* and *juncea*. Some New Jersey and Floridian male *urnaria* have no black dorsal stripe on gastral tergum I.

Nomenclature: I have not seen the type of *urnaria*. However, R. M. Bohart took sufficient notes on it so that positive identification of Dahlbom's species is possible. Evidently, Dahlbom described *urnaria* from more than one specimen since he cited South Carolina and Pennsylvania as type localities. Fernald (1931) saw Dahlbom's material and found a male with the label "S. Carolina" and another specimen without locality data. Bohart's notes are on the South Carolina specimen and I am selecting it as lectotype. *Ammophila floridensis* is based on the large, dark winged type of *urnaria* found in the southeast. Murray (1938, 1951) recognized *floridensis* as a subspecies of *urnaria* but I do not feel this recognition is warranted. The "floridensis" form of *urnaria* grades into the normal condition of *urnaria*. At least one of Fernald's paratypes of *floridensis* is *juncea* Cresson.

Geographic range (map 12): *Ammophila urnaria* occurs from the eastern Rocky Mountains to the Atlantic Coast in the United States and southern Canada. It is one of the commonest species in the eastern part of North America.

PROCERA SPECIES GROUP

Diagnosis: The episternal sulcus is short and sometimes nearly absent in this group. Many species have cross ridging on the collar and scutum. The propodeal enclosure does not have any erect hairlike setae. However, there is often appressed silver setae mesally. The penis valve head has a similar shape in nearly all species (fig. 199). The spine on the penis valve head is directed ventrally. The penis valve head of *mimica* and i*mitator* is unusual, and is unlike the typical *procera* group penis valve (figs. 72, 73).

Included species: *Ammophila aphrodite* Menke, *boharti* Menke, *conditor* Smith, *ferruginosa* Cresson, *formicoides* Menke, *hurdi* Menke, *imitator* Menke, *macra* Cresson, *marsh*i Menke, *mimica* Menke, *monachi* Menke, *murrayi* Menke, *nearctica* Kohl, *novita* (Fernald), *parapolita* (Fernald), *polita* Cresson, *procera* Dahlbom, *stangei* Menke, *unita* Menke and *wrightii* (Cresson).

Discussion: The *procera* group is rather diverse, and several subgroups could be recognized. *Ammophila procera* and *macra* are very similar and do not appear closely allied with other species in the group. The ant mimics, *wrightii* and *formicoides*, are distinctive in possessing a low, flattened, pronotal collar, and the episternal sulcus is nearly absent. There is a tendency in *wrightii* for reduction or loss of the third submarginal cell. *A. formicoides* always has only two submarginals. *Ammophila monachi* is structurally intermediate between the ant mimics and the other species in the *procera* group. *Ammophila novita* and *unita* form a third assemblage. Both species have a long sloping pronotal collar which is rather sharply cutoff above the streptaulus. The collar lacks transverse ridges in *novita* and is only feebly transversely rugose in *unita*. *Ammophila nearctica* with its two submarginal cells and *aphrodite* with its smooth female pronotal collar represent two additional monotypic subgroups in the *procera* group. The unifying feature of all these subgroups and the remainder of the species in the *procera* group is the form of the penis valve head (fig. 199). The spine of the penis valve head generally projects outward from the head in a plane perpendicular to the main axis of the penis valve stalk. In addition, the teeth on the head are arranged in a row and pass the base of the spine (fig. 199). It is probable, therefore, that the *procera* group is a natural one in spite of the two aberrant species. The females of *novita, mimica* and *imitator* are nearly indistinguishable but the males have very different penis valves. Although *mimica* and *imitator* have unusal penis valves (figs. 72, 73), they appear to belong in the *procera* group based on their general morphology. Certain species in the *procera* group, e.g., *novita* and *unita*, show affinities with the *nefertiti* group. These affinities may be real and perhaps the *nefertiti* group should be included in the *procera* group. The *procera* group was established by Menke (1964a), and it appears to be restricted to the Nearctic Region. However, Kohl's (1906, p. 327) *clavus* group is an Old World counterpart of the *procera* group.

Ammophila aphrodite **Menke**

Figures 82, 200.

Ammophila aphrodite Menke, 1964, Acta Hymenopterologica 2:8. Holotype: male, 10 mi. E. White Water, California (UCD).

Recognition: The smooth, non-ridged pronotum and scutum combined with the largely red body readily distinguish female *aphrodite* from other species in the *procera* group. The appressed silver setae on the body and reddish legs are distinctive features of male *aphrodite*. Males of *aphrodite* resemble *Ammophila pruinosa* but the long episternal sulcus of the latter will separate the two species. Females of *Ammophila aphrodite* are among the most beautiful in the genus (see page 108).

Description:

Male: Average length 13.5 mm, range: 9-16.5 mm.

Color: Black; mandible, scape partially, pronotal lobe occasionally, and tegula red; petiole sternum red or black, tergum red; gaster red except for occasional black spots on terga V-VI; legs red except for dorsum of coxa, trochanter and femur; wings clear, veins brown with some basal yellowing.

Vestiture: Gena with dense appressed silver setae; mesosoma rather evenly covered with appressed silver setae.

Structure: Clypeal free margin reflexed; flagellomere I nearly twice length of II (38:20), length slightly less than least interocular distance (38:42); shape of collar as in fig. 82, ridges few or absent; very fine, not reaching streptaulus laterally; scutal ridges fine, restricted mainly to disk; metapleural flange not lamelliform; penis valve head (fig. 200).

Female: Average length 14.5 mm, range: 12.5-17 mm.



Ammophila aphrodite with caterpillar, Kelso Dunes, California, April 2008 (photograph courtesy Juan Kirchner)

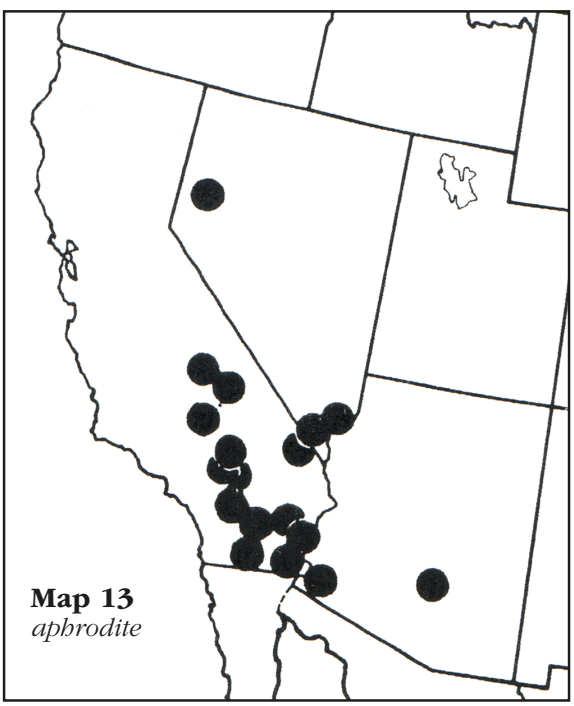
Color: Red; following areas black: ocellar triangle, flagellomeres II-X, pronotum along streptaulus laterally and collar posteriorly, scutum mesally, mesopleuron, lower metapleuron, propodeal side anteriorly and petiole sternum dorsally.

Vestiture: Appressed silver setae restricted to face, pronotal lobe, propodeal enclosure mesally, mesopleuron and lower metapleuron.

Structure: Clypeal disk slightly to moderately tumescent, clypeal lobe projecting slightly, teeth well developed; flagellomere I slightly more than twice length of II (50:22); inner orbits slightly converging below; collar smooth, shining, ridges absent; scutum smooth, shining, sparsely, finely punctate, some feeble ridges in fossae; propodeal side diagonally ridged.

Variation: The degree of mesosomal reddening in female *aphrodite* is variable. The scutum is sometimes all black and other areas are correspondingly darker in these individuals. I have seen one male of *aphrodite* in which the third submarginal cell is absent.

Geographic range (map 13): *A. aphrodit*e is found in the Mojave and Colorado deserts of California, and also Death Valley. It is widespread in western Arizona. There is a single record from Nixon in nothern Nevada. Mexican records include Sonora and Baja Norte. The main flight period is early spring in southern California (March-April) with a few records in May and June. The Nevada specimens were collected in June. The Mexican records are from February, March and April.



Map 13
aphrodite

Ammophila boharti Menke

Figures 65, 75, 76, 155, 200, 201, Map 14.

Ammophila boharti Menke, 1964. Acta Hymenopterologica 2:9. Holotype: male, Davis, California (UCD).

Recognition: The presence of dense appressed silver setae on the pronotal side and gena is distinctive in *boharti*. However, the pronotal side is variably setose. Sometimes the setae are sparse or nearly absent. This species and *ferruginosa* are very similar morphologically. The red head and mesosoma of female *ferruginosa* separates that species from the largely black females of *boharti*. The female collar in profile differs between the two species (figs. 155, 156). It has a longer profile in *ferruginosa.* Flagellomere I of male *boharti* is about equal to the least interocular distance. Flagellomere I in male *ferruginosa* is shorter. The ranges of *boharti* and *parapolita* are nearly identical and the species are fairly similar. The pronotal collar in *parapolita* is shorter in profile (fig. 158).

Description:

Male: Average length 15 mm, range: 12-18 mm.

Color: Black; tegula and metapleural flange often reddish; propodeum near petiole socket sometimes with small reddish spot; petiole occasionally red, tergum red laterally, black above or completely red; gaster red but with black spots on terga III-IV, -V, -VI, and sometimes on I-II; legs black or largely red beyond trochanter; wings clear, veins black.

Vestiture: Gena, pronotal side, scutal fossae, mesopleuron and lower metapleuron covered with dense appressed silver setae (fig. 65); propodeal enclosure with appressed silver setae mesally.

Structure: Flagellomere I longer than II (41:24), length nearly equal to least interocular distance (41:43); pronotal collar transversely ridged (fig. 65), ridges ending at streptaulus laterally; scutum ridged; propodeal side diagonally rugosopunctate or diagonally ridged (fig. 65); metapleural flange lamelliform, outer margin angulate; penis valve head as in fig. 75.

Female: Average length 18 mm, range: 14.5-23.0 mm.

Color: As in male except clypeal margin and following areas frequently red: tegula, subalar area, and propodeal side; petiole usually red but sternum sometimes black; gaster red except for occasional black spots on terga III-IV; legs usually extensively red, rarely completely black.

Vestiture: As in male; females from northern California and Oregon often have very little appressed silver setae on pronotal side.

Structure: Clypeal disk slightly tumescent or flattened, sparsely punctate, clypeal lobe not produced, marginal angles blunt (fig. 201); flagellomere I longer than II (57:30); inner orbits parallel; pronotal collar as in fig. 155, ridges restricted mainly to posterior half of collar or at least strongest posteriorly; propodeal side with many diagonal ridges (fig. 155).

Variation: The almost total absence of appressed silver setae on the pronotal side in many females from northern California and Oregon is perplexing. Males from the same places have the setae, so female identification may depend on associated males.

Nomenclature: *Ammophila boharti* was confused with *parapolita* by Fernald (1934) since at least one of his paratypes is *boharti*.

Geographic range (map 14): *Ammophila boharti* is known only from California, Oregon, western and northern Nevada, and northern Baja California.

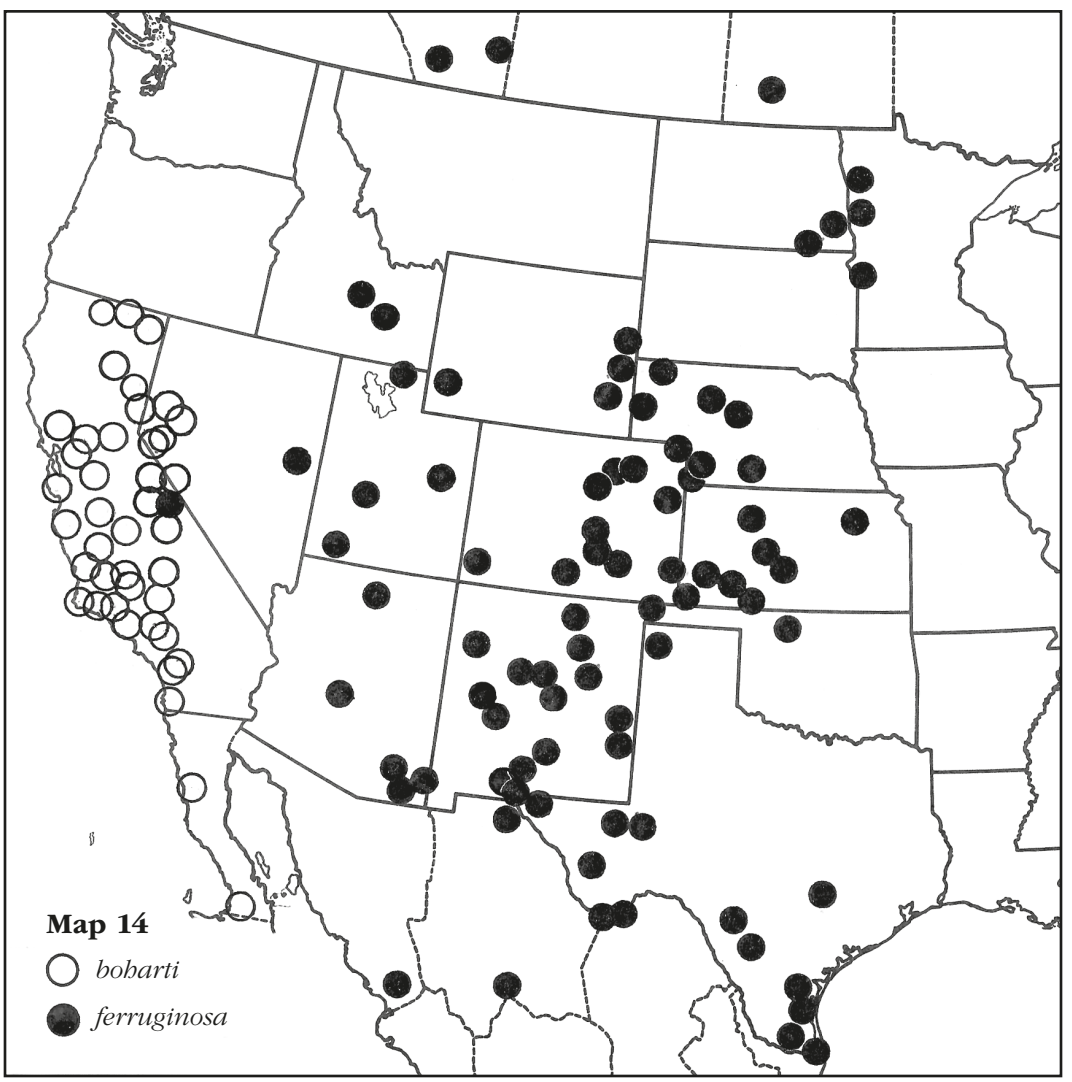
***Ammophila conditor* Smith**
Figures 147, 152, Map 15.

Ammophila conditor Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 4:223. Holotype: female, St. John's Bluff, Florida (BMNH). Type studied.

Recognition: The largely black body, angulate lamelliform metapleural flange, and lack of appressed silver setae on the gena and pronotal side are distinctive features of *conditor.* The only species occuring within the range of *conditor* that might be confused with it is *procera* which is much larger and does not have an angulate metapleural flange.

Description:

Male: Average length 15 mm, range: 15-16 mm.



Color: Black; petiole tergum red laterally, black above; gastral segment I red; wings clear, veins black.

Vestiture: Gena and pronotal side without appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to bottom of episcrobal area; lower metapleuron near hindcoxa with indistinct patch of appressed silver setae; propodeal enclosure with some appressed silver setae mesally; head and mesosoma (except propodeal enclosure) with pale erect setae.

Structure: Clypeus broadly, shallowly emarginate; flagellomere I longer than II (40:29), length less than least interocular distance (40:54); collar ridges not reaching streptaulus laterally, interspaces moderately punctate, especially laterally, pronotal side moderately punctate with few feeble ridges; scutum ridged, interspaces punctate; mesopleuron moderately to densely punctate, interspaces minutely etched; lower metapleuron moderately punctate anteriorly, densely so posteriorly; metapleural flange lamelliform, outer margin angulate; propodeal side moderately punctate, interspaces irregularly rugose.

Female: Average length 18 mm, range: 18-19 mm.

Color: As in male except tegula and metapleural flange brownish; petiole tergum red.

Vestiture: Appressed silver facial setae sparse.

Structure: Clypeal disk slightly tumescent near free margin, sparsely to moderately punctate, free margin a broad curve, lateral free margin broadly lamelliform, clypeal lobe weakly defined (fig. 152); flagellomere I longer than II (51:31); inner orbits slightly converging below; collar as in fig. 147, ridges mostly fine, interspaces sparsely punctate, pronotal side sparsely punctate; scutum smooth, moderately punctate, becoming punctatostriate toward scutal fossae, or scutum entirely ridged and punctate; thoracic pleura as in fig. 147; propodeal side as in male or with many diagonal ridges.

Nomenclature: Fernald (1934) incorrectly synonymized *conditor* with *procera*.

Geographic range (map 15): *Ammophila conditor* is poorly known. Less than 25 specimens have been seen and all but two are from New Jersey and Florida (April to July). FLORIDA, Bay Co.: St. Andrews State Park (FSDA); Clay Co.: Gold Head Branch State Park (USNM). Highlands Co.: Highlands Hammock State Park (FSDA), Lake Placid (ASM). Duval Co.: Jacksonville (USNM); St. John's Bluff [Jacksonville] (BMNH). Orange Co.: Conway (FSDA), Orlando (FSDA), Winter Park (FSDA). NEW JERSEY, Atlantic Co.: Weymouth (UCD). Burlington Co.: Browns Mills (UCD). Cumberland Co.: Manumuskin (CUI). Ocean Co.: Lakehurst, July (ASM).

I have seen two females simply labeled Texas, Fedor, May 17, 1904 (UCD, ASM) so the range of the species appears to be broader. It is an early flyer and hence not often collected.

***Ammophila ferruginosa* Cresson**

Figures 114, 156, 202, Map 14.

Ammophila ferruginosa Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:455. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916:94. Type studied.

Ammophila collaris Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:456. Holotype: male, Colorado Territory (ANSP). Synonymy by Fernald, 1931:449, and 1934:41. Type studied.

Sphex cressoni H. Smith, 1908. University of Nebraska Studies 8:329. Replacement name for *Sphex collaris* (Cresson), 1865, nec *Sphex collaris* Linnaeus, 1767.

Recognition: The extensively red mesosoma and lamelliform, angulate metapleural flange in both sexes (figs. 114, 156) coupled with the red head of the female will usually identify *ferruginosa*. The dark males from the northern and western parts of the range resemble *boharti* but the latter has a narrower least interocular distance. The length of flagellomere I is only about four-fifths the length of the least interocular distance in males of *ferruginosa*. In contrast these measurements are equal or nearly so in bo*harti*. Females of *ferruginosa* are similar to *boharti* and *hurdi*. *Ammophila hurdi* has a non-lamelliform metapleural flange. *Ammophila boharti* females have a flatter clypeus, a more steeply sloping pronotal collar and usually have a completely black mesosoma except for small reddish areas on the propodeum and a reddish tegula and metapleural flange.

Description:

Male: Average length 14.5 mm, range: 11-19.5 mm.

Color: Head black; mesosoma varying from nearly all red with black areas on scutum mesally, and propodeal enclosure mesally, to mostly black with only collar, tegula, metapleural flange, and propodeal side red (Nebraska, Kansas, Oklahoma, eastern Colorado, New Mexico, Arizona), or mesosoma black except for tegula (Idaho, Nevada), or black with any or all of the following red: pronotal lobe, tegula, metapleural flange, and spot adjacent to petiole socket (Utah, Wyoming, North Dakota, Minnesota, Canada, western Colorado, California); petiole sternum usually red, petiole tergum red; gaster red but with black spots on terga IV-VI; legs varying from nearly all black to nearly all red, but usually mostly red; wings clear, veins brown or black.

Vestiture: Gena, and pronotal side with dense appressed silver setae; scutal fossae with sparse appressed silver setae; mesopleuron and lower metapleuron covered with dense appressed silver setae, mesopleural setae densest along mesopleural suture; propodeal enclosure with appressed silver setae mesally.

Structure: Flagellomere I longer than II (41:26), length less than least interocular distace (41:50); ridges of pronotal collar ending at streptaulus laterally, interspaces shining; scutum ridged; propodeal side diagonally rugosopunctate; metapleural flange lamelliform, outer margin angulate.

Female: Average length 18 mm, range: 16-20.5 mm.

Color: Red; following are black: ocellar triangle, scutum often partially or completely, scutellum and metanotum frequently, propodeal enclosure partially or completely, and pleural region occasionally (typical color pattern over most of range), or vertex black, collar black mesally, scutum propodeal enclosure and most of pleura black (Alberta, Washington), or head and most of mesosoma black except for red on propodeal side (Great Sand Dunes National Monument, Colorado, MCZ), or head and mesosoma completely black except for tegula and metapleural flange (Nevada); abdomen usually red except for black spot occasionally on gastral tergum IV (typical color pattern), or petiole sternum black and gastral terga IV, or IV-V, black (Nevada, Great Sand Dunes Natl. Mon., Colorado); legs red except for trace of black on coxa and trochanter and sometimes hindfemur (typical color pattern), or legs black, sometimes femur and tibia partially red (Nevada); wings clear, veins yellowish brown to brown.

Vestiture: As in male but appressed silver setae very sparse except along mesopleural suture and metapleural sulcus.

Structure: Clypeal disk strongly bulging near free margin, sparsely punctate, clypeal lobe defined by lateral angles but not projecting (fig. 202); flagellomere I longer than II (55:29); inner orbits very slightly converging above; pronotal collar curving gradually to vertex in profile (fig. 156).

Nomenclature: Fernald's (1934) record of *ferruginosa* from California (Claremont) was a misidentification of *A. wrightii*.

Geographic variation: The single Nevada record is based on five males and four females collected at Charcoal Ovens State Park, White Pine. Co., on June 29 and July 5 to 8, 1960 (UCD). The females are atypically black. Only the tegula, legs and abdomen have any red color. The only red in the male is on the abdomen. The head measurements of the male indicate that these specimens are true *ferruginosa*. The California records on the map are based on two males collected at Batchelder Spring, Inyo Co. (about 10 miles NE. of Big Pine on Westgard Pass road), and one male collected at Squaw Flat, Inyo Mountains (ASM). The pronotal lobe, tegula, and a spot near the petiole socket are red and the head measurements are typical for *ferruginosa*. The legs are mostly red. A male from Okanogan, Washington (UCD) has similar coloration. The atypical color of these Nevada, Washington, and California specimens indicates the need for further collecting and study of the Great Basin wasp fauna. A female from Westgard Mine Road, White Mountains, Inyo Co., California, is typically colored but the mesopleuron and propodeal enclosure are black (ASM).

A series of six females and one male from Santa Elena Canyon, Big Bend National Park in Texas (CIS, CNC) possibly represent a new species closely allied with *ferruginosa*; or else they are atypical *ferruginosa*. The pronotal and scutal ridges are nearly obliterated in the females and the inner orbits are slightly converging below. The appressed head setae are more dense than in typical female *ferruginosa* and the mesosoma is completely black except for the tegula and metapleural flange. The single male is very greasy and appears teneral.

Geographic range (map 14): Great Plains to the Great Basin, north through southern Canada from Alberta to Manitoba, and south to Arizona and north central Mexico. California records are from locations in eastern Inyo Co. Many of the Great Plains records are from sand dune areas, suggesting that this species has a preference for this habitat in some areas.



Fig. 203 *Ammophila formicoides* with noctuid caterpillar, photography by Robert Parks

Ammophila formicoides Menke

Figures 20, 106, 200, 203, Map 21.

Ammophila formicoides Menke, 1964. Acta Hymenopterologica 2:10. Holotype: male, Rodeo, New Mexico (CAS).

Recognition: *A. formicoides* is similar to *wrightii* but is darker, has infumate wing tips, a dark spot at the apex of the median cell, and a pale spot basad of the stigma (fig. 20). Also there are only two submarginal cells. The less strongly converging eyes and pair of clypeal bulges will separate males from *wrightii*. The smooth mesopleuron, especially the episcrobal area, will separate female *formicoides* from *wrightii*.

Description:

Male: Average length 9.5 mm, range: 9-12.5 mm.

Color: Reddish brown (sometimes orange or very dark reddish brown); ocellar triangle, terminal flagellomeres, and mesosternal area black; gastral terga usually with dark transverse bands posteriorly; wings clear in cellular area except for infumate spot at apex of median cell, apex of wing infumate, veins black except for clear spot basad of stigma.

Vestiture: Body essentially glabrous except for some sparse appressed silver setae on mesosternal area; propodeal enclosure asetose.

Structure: Clypeal free margin entire, apex truncate, disk with pair of parallel vertical bulges; flagellomere I longer than II (28:23), length less than least interocular distance (28:46), eyes slightly converging below, LID:GID (46:56); collar elongate, flattened (fig. 106), surface with many fine ridges, ridges extending feebly onto pronotal side; scutum finely ridged; propodeal enclosure poorly defined, ridges continuous over propodeal side; mesopleuron including episcrobal area without ridges; lower and upper metapleuron faintly ridged or smooth; metapleural flange not lamelliform; propodeal enclosure with many fine cross ridges; forewing with two submarginal cells (fig. 20); penis valve (fig. 200).

Female: Average length 10.5 mm, range: 8.5-11.5 mm.

Color: As in male except ocellar triangle is black.

Vestiture: As in male.

Structure: Clypeal disk moderately bulging, bulge with slight vertical depression, free margin without teeth, clypeal lobe not defined ; flagellomere I longer than II (30:20); inner orbits parallel; mesopleuron (not including episcrobal area) sometimes faintly ridged along mesopleural suture (fig. 106).

Variation: In a series of specimens from Hidalgo del Parral, Chihuahua, Mexico (USU) the head and mesosoma are very dark red, almost black. Otherwise they are typical *formicoides*.

Behavior: This wasp is often found in association with the myrmicine ant genus *Pogonomyrmex*, and are often seen running across the ground among them. The small size and reddish color of *formicoides* makes them difficult to distinguish from the ants.

Geographic range (map 21): Known only from southeastern Arizona (Pima Co., Cochise Co., Santa Cruz Co.) and southwestern New Mexico (Hidalgo Co.). The species also occurs in Chihuahua and Sinaloa, Mexico.

Ammophila hurdi **Menke**

Figures 77, 200, Map 16.

Ammophila hurdi Menke, 1964. Acta Hymenopterologica 2:12. Holotype: male, Tesla, California (CAS).

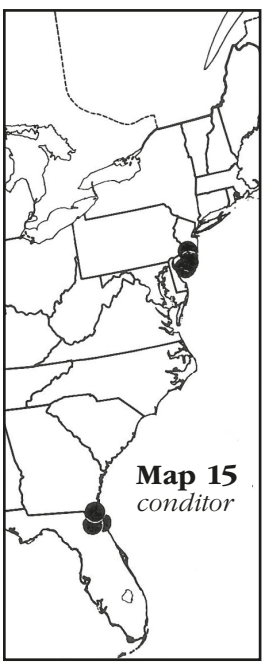
Recognition: *Ammophila.hurdi* superficially resembles *ferruginosa*, however, the non-lamelliform metapleural flange in both sexes of *hurdi* is diagnostic. The collar of male *hurdi* is sharply cut off above the streptaulus, and there is prominent transverse carina there as well (fig. 77). The somewhat similar males of *monachi* do not have a sharply cutoff pronotum or a transverse carina. Females of *hurdi* and *monachi* are very similar and associated males may be necessary for identification. The female propodeal enclosure of *hurdi* has no appressed silver setae, but these are present in *monachi.*

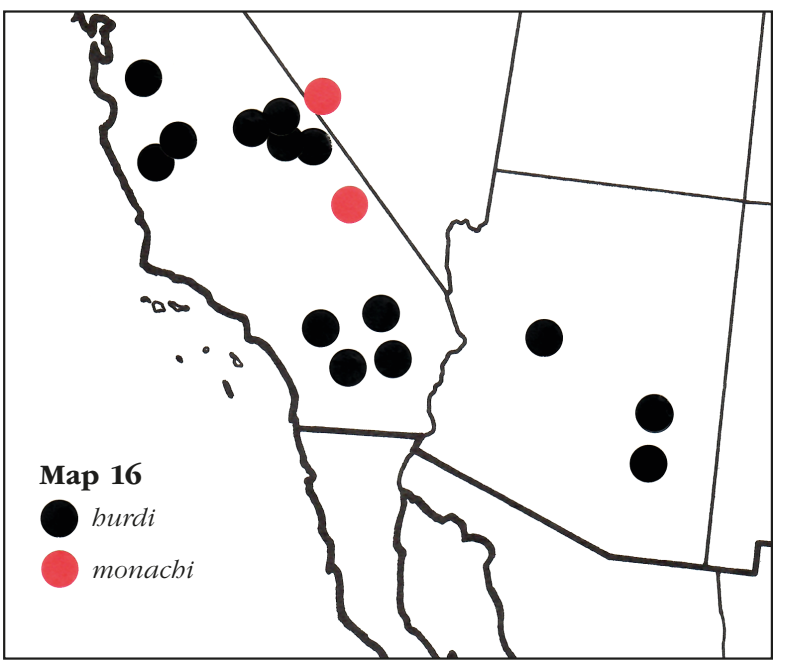
Description:

Male: Average length 16 mm, range: 13-17.5 mm.

Color: Black; following are red: mandible, apex of scape, pronotal collar rarely, pronotal side frequently, pronotal lobe, tegula, scutellum frequently, and pleura extensively; petiole red; gaster red, terga IV-VI usually black; legs red; wings clear, veins black.

Vestiture: Gena with dense appressed silver setae; pronotal side and mesopleuron covered with sparse appressed silver setae; propodeal enclosure with some appressed silver setae; erect setae restricted to head.





Structure: Flagellomere I longer than II (39:25), shorter than least interocular distance (39:44); pronotal collar elongate, cutoff sharply at streptaulus, truncation with prominent transverse carina dorsally (fig. 77), surface with mixture of fine and coarse ridges, ridges not reaching streptaulus laterally; scutum with many cross ridges that are interrupted only at median sulcus; lower metapleuron evenly, finely roughened; propodeal side roughened but with some strong ridges or rugae; metapleural flange not lamelliform; penis valve as in fig. 200.

Female: Average length 16.5 mm., range: 16-17.5 mm.

Color: Red; ocellar triangle and terminal flagellomeres black; costa of forewing yellowish.

Vestiture: Appressed silver setae very sparse, restricted to pronotal lobe and mesopleuron; propodeal enclosure without appressed silver setae.

Structure: Clypeal disk moderately tumescent, sparsely punctate, clypeal lobe slightly projecting, teeth small; collar profile similar to male but not cutoff anteriorly and lacking the marginal carina, ridges finer than in male, occasionally extending onto pronotal side; scutal ridges often obliterated anteriorly and laterally, surface next to median sulcus shiny, sparsely punctate; mesopleuron moderately punctate; lower metapleuron moderately punctate anteriorly, interspaces finely rugose or roughened, metapleuron smoother posteriorly; propodeal side strongly diagonally ridged, interspaces very sparsely punctate, shining.

Variation: Color varies to some degree in the male. The transverse carina on the collar is poorly developed in one male studied.

Geographic range: (map 16): *Ammophila hurdi* is known only from a few scattered localities in California and Arizona. The species is mainly a spring flyer (April-June), however, the holotype was collected in September.

Material examined: CALIFORNIA, Alameda Co.: Tesla (Corral Hollow Creek, approximately 10 miles E. Livermore), on *Eriogonum* (CIS). Inyo Co.: Big Pine Creek, 4000' (UCD). Fresno Co.: Auberry (UCD). Inyo Co.: Big Pine (UCD); Lone Pine (UCD). Los Angeles Co.: 10 mi. W Ravenna (ASM). Monterey Co.: Arroyo Seco Camp (UCD). Riverside Co.: Pinon Flat, San Jacinto Mountains, on *Eriogonum fasciculatum* (CIS, LACM, UCD). White Tank, Joshua Tree National Monument, on *Eriogonum* (UCD). San Benito Co.: Idria (CIS). San Bernardino Co.: Granite Mountains, 5000' (USNM); Indian Cove, Joshua Tree National Monument (USNM). ARIZONA, Gila Co.: 21 km S Globe (ASM); Pinal Co.: 2 km NE Oracle (ASM). Yavapai Co.: Yarnell (UCD, ASM).

***Ammophila imitator* Menke**

Figures 72, 204, 205, Map 26.

Ammophila imitator Menke, 1966. Proceedings of the Biological Society of Washington 79:37. Holotype: male, 6 mi. E Douglas, Arizona (CAS).

Recognition: Females of *Ammophila imitator* are seemingly identical to those of *novita* (Fernald) and *mimica* Menke, and associated males are the best way to identify them. Males of these species have very different penis valves which makes them easy to identify. The penis valve head is unique (fig. 72) and the base of the gonoforceps is dorsoventrally elongate (fig. 72). Also males of *imitator* have a prominance on the hypostoma next to the mandible socket (fig. 204), and males of *novita* and *mimica* do not have this. The male clypeus of *imitator* is shallowly emarginate, and the apex is reflexed (fig. 204). In both sexes of *imitator* the collar is smooth and the scutum transversely ridged (fig. 204). The

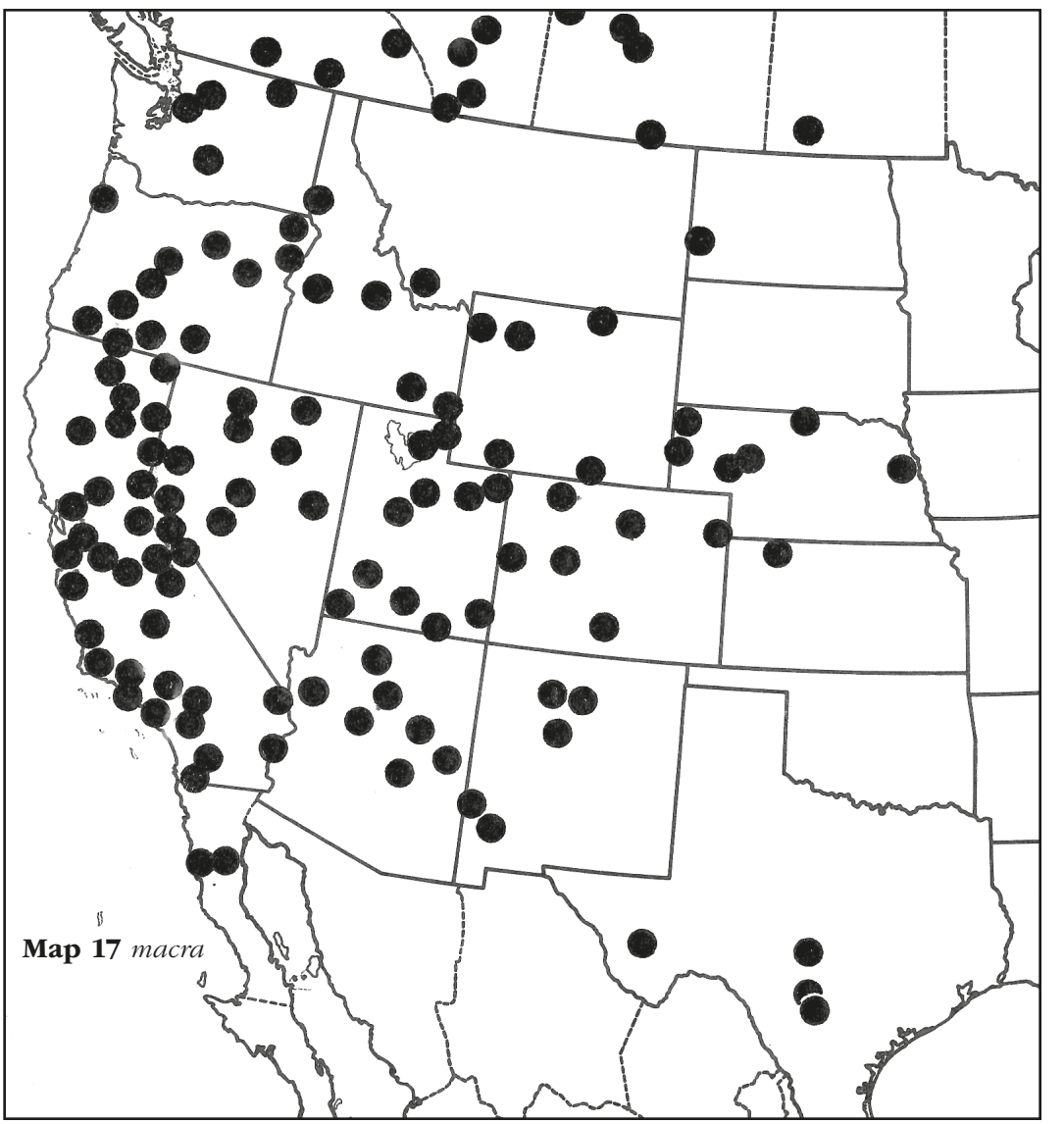
female was unknown when I described *imitator*, but I have collected both sexes on my 4 acres in Bisbee.

Description:

Male: length 16-21 mm.

Color: Black; following are red: mandible, pronotal lobe, tegula, subalar area, metapleural flange and propodeal side near petiole socket; sometimes red more extensive: pronotal lobe, subalar area; petiole tergum red laterally, black above; gaster red, tergum I with narrow black spot, terga III-V with large black spots; fore and midlegs mostly red, hindfemur red below; wings clear, veins brown.

Vestiture: Clypeus, frons, gena and pronotal lobe covered with dense appressed silver setae; collar and scutum anterolaterally sparsely covered with appressed silver setae; scutal fossae, propodeal enclosure mesally, meso- and metapleuron, and propodeal side



Map 17 *macra*

near petiole socket with dense appressed silver setae (fig. 205); metapleural setae densest along metapleural sulcus; head with erect pale setae.

Structure: Labrum truncate; clypeal free margin shallowly emarginate, broadly spatulate, reflexed; flagellomere I longer than II (43:26), length less than least interocular distance (43:50); pronotal collar elongate, flattened, abruptly rising at streptaulus, surface smooth except for very slight wrinkling on disk, sparsely punctate; scutum with coarse transverse ridges, interspaces punctate; scutellum longitudinally ridged; propodeal enclosure rugose medially, diagonally ridged laterally, interspaces shiny; metapleural flange lamelliform, outer margin angulate (fig. 205); propodeal side punctatostriate anteriorly grading to moderately punctate posteriorly; gonocoxite and penis valve head as in fig. 72.

Female: Length 17-19 mm.

Color: Edge of clypeus, labrum, and mandible red; mesosoma more extensively red than in male: pronotal side and collar laterally, episcrobal area, upper metapleuron and scutum laterally sometimes, propodeal side sometimes totally; gaster red but terga I, III-IV with black spots.

Vestiture: About as in male except appressed silver setae of collar and scutum somewhat denser.

Structure: Clypeal disk moderately convex, clypeal lobe delimited by prominent angles that are toothlike, width of lobe equal to length of flagellomere I.

Geographic range (map 26). Known only from Cochise County in southeastern Arizona, and the Mexican states of Sonora and Sinaloa.

Ammophila macra **Cresson**

Figures 58, 67, Map 17.

Ammophila macra Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:460. Lectotype male: Colorado (ANSP), designated by Cresson, 1916:94. Type studied.

Recognition: *Ammophila macra* is the largest North American species and, therefore, is not likely to be confused with any other except *procera*, which averages only slightly smaller and is very similar. Unlike *procera*, *macra* lacks appressed silver setae in the scutal fossae (fig. 58). Worn specimens of *procera* may be difficult to distinguish from *macra*. Males of the two species can be separated by examination of the penis valve head. In *macra* the row of teeth on the penis valve head do not extend as far basad as in *procera*. In addition the teeth in *macra* are protuberant basad (fig. 67). In contrast the row of teeth in *procera* form a uniform arc (fig. 66). Female differences between the two species are more subtle. Erect head setae in *macra* is totally black. Most female *procera* occuring within the range of *macra* have some pale erect head setae, and in California it is predominantly pale. The metapleural patch of appressed setae is rather poorly formed in *macra* in comparison with *procera*. Females of *A. macra* usually have no appressed silver setae on the gena while the reverse is true in *procera* from the western United States.

Description:

Male: Average length 25 mm, range: 18-31 mm.

Color: Black; petiole tergum red laterally, black above; gastral terga I-II red laterally, sterna I-II completely red (Rocky Mountains, Great Basin), terga I-IV red laterally, sterna I-V or VI red (California); wings clear or slightly infumate, veins black.

Vestiture: Gena along outer orbit with sparse appressed silver setae; pronotal side without appressed silver setae; mesopleuron with band of appressed silver setae along

mesopleural suture from base of midcoxa to bottom of episcrobal area; lower metapleuron with a feeble patch of appressed silver setae along metapleural sulcus near hindcoxa; erect head setae black, erect pronotal setae occasionally black anteriorly.

Structure: Labrum truncate to acuminate; flagellomere I longer than II (68:41), length of flagellomere I less than least interocular distance (68:80); pronotal collar as in *procera* except somewhat shorter and more strongly angulate anterolaterally; scutum and pleura including metapleural flange, about as in *procera* except mesosternal region rarely with pair of angulate prominences behind front coxae; penis valve head as in fig. 67.

Female: Average length 33 mm., range; 18-37 mm.

Color: As in male except gaster varying from all black with faint lateral reddening on tergum I (Canada), to nearly all red with small black spots on gastral terga II-IV (California); an intermediate color form in the Great Basin and Rocky Mountains with larger spots and tergum V all black.

Vestiture: As in male except clypeus and frons more sparsely covered with appressed silver setae; gena without silver appressed setae; psammophore black.

Structure: Labrum acuminate; clypeal disk moderately to strongly tumescent, moderately to densely punctate, clypeal lobe produced, teeth well formed; flagellomere I nearly twice length of II (96:56); inner orbits parallel; collar about as in female *procera*; mesosomal details as in male except scutal ridges frequently obsolescent anteromedially, and mesosternal region without angular prominences.

Variation: *Ammophila macra* is a fairly constant species with the main variation showing up in the color of the female abdomen as noted in the description.

Nomenclature: Fernald 1934:48 treated *macra* as a synonym of *procera*, but Menke 1966a:2392 recognized *macra* as a valid species.

Historical note: A female of *Ammophila macra* was the first species of the genus I collected. The date was July 17, 1952, and the location was in the San Bernardino Mountains. of southern California. I was 17 years old, and was quite thrilled because it was such a big wasp. I still have the specimen (ASM).

Geographic range (map 17): Western Great Plains to the Pacific Coast (including Canada, British Columbia to Saskatchewan). Texas records are from isolated mountain ranges. Mexican records are as far south as Jalisco and the Distrito Federal, and the species occurs in northern Baja California.

***Ammophila marshi* Menke**

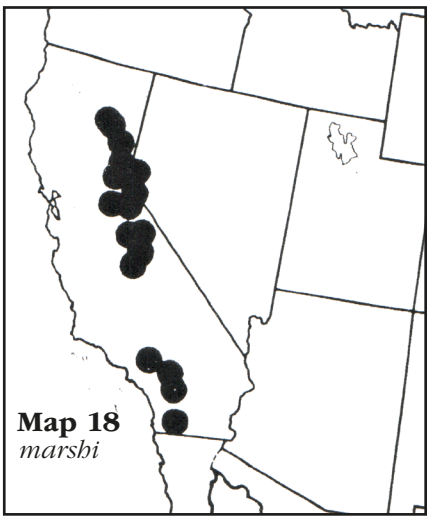
Figures 63, 69, 70, 112, 119, 151, 200, 206, 207, 208, Map 18.

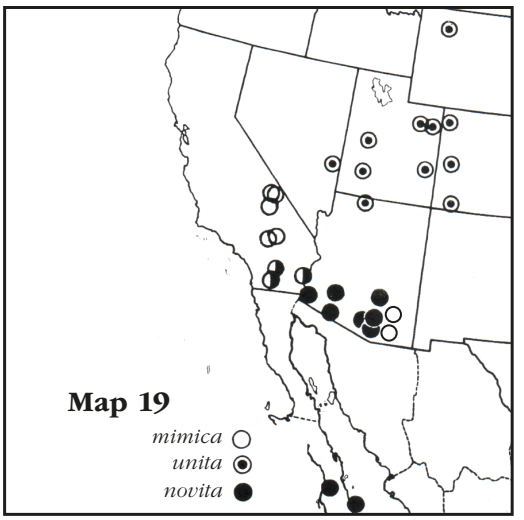
Ammophila marshi Menke, 1964. Acta Hymenopterologica 2:13. Holotype: male, Strawberry, California (UCD).

Recognition The narrow, angulate, metapleural flange (figs. 63, 119) and triangular black spots on the first two gastral terga (figs. 70, 208) are distinctive features of *marshi*. It is usually necessary to examine the flange under high magnification (50X) since the angulation is small and often obscured by the wings. The flange is rarely not lamelliform. Males of *marshi* are similar to *parapolita* but the profile of the collar differs between them (figs. 68, 69).

Description:

Male: Average length 14 mm, range: 13-15 mm.





Color: Black; petiole tergum red laterally, black above; gastral segments I-III red, terga I-II usually with triangular black spots, III largely or completely black (fig. 70); wings clear, veins black.

Vestiture: Gena and pronotal side without appressed silver setae; mesopleuron and lower metapleuron with sparse appressed silver setae which are denser along mesopleural suture and metapleural sulcus (fig. 69); propodeal enclosure with sparse appressed silver setae mesally (fig. 112); head and mesosoma (except propodeal enclosure) with pale erect setae.

Structure: Clypeal apex slightly reflexed, edge broadly, shallowly emarginate (fig. 206), or not; profile of collar as in fig. 69, ridges extending feebly onto pronotal side; scutum ridged; propodeal side irregularly rugose, sparsely punctate; metapleural flange narrowly lamelliform, about one-half width of peritreme, outer margin usually obtusely angulate posteriorly (fig. 70); penis valve head as in fig. 200.

Female: Average length 18 mm, range: 11.5-21.5 mm.

Color: As in male except petiole tergum and gastral segments I-II or I-III sometimes completely red; typical pattern as in fig. 208.

Vestiture: Face with appressed silver setae (fig. 207); mesopleuron with band of appressed silver setae along mesopleural suture, band ending at bottom of episcrobal area, lower metapleuron with similar band along metapleural sulcus (fig. 151); propodeal enclosure nearly asetose (fig. 112).

Structure: Clypeal disk moderately tumescent, sparsely punctate, clypeal lobe slightly projecting, teeth blunt (fig. 207); flagellomere I longer than II (45:27); inner orbits parallel; profile of collar as in fig. 151, ridges fine anteriorly, coarser toward vertex, often fading before reaching streptaulus; scutal ridges strongest in fossae, usually fading laterally.

Variation: Gastral terga I-II are completely red in some males. Female gastral terga I-II typically have small black spots distally, but occasional specimens are completely red.

Nomenclature This species was confused with *polita* Cresson by Fernald (1934).

Geographic range (map 18): *Ammophila marshi* is known only from high elevations in California and western Nevada. Records are primarily from the Sierra Nevada Mountains

and range from 4000 to 10,000 feet. Southern California material was collected in the San Bernardino, San Jacinto and Laguna Mountains.

Ammophila mimica Menke

Figures 73, 163, 209.

Ammophila mimica Menke, 1966. Proceedings of the Biological Society of Washington 79:36. Holotype: male, Cronise Valley, San Bernardino Co., California (CAS).

Recognition: The male penis valve is immediately diagnostic (fig. 73). However the female of *mimica* is nearly identical with *imitator* and *novita*. The female gaster has a small black spot on tergum I, and III-IV are broadly black. The gaster is entirely red in *novita*.

Description:

Male: Length 16-17 mm.

Color: Mandible black; tegula, metapleural flange, and spot at side of petiole socket, red; petiole tergum red laterally, black above; gaster red, tergum I with elongate black spot; terga III-V largely black; femur red apically, front and midtibiae red, tarsus brownish; wing clear, veins black.

Vestiture: Clypeus, frons and gena with dense appressed silver setae; scutal disk, propodeal enclosure laterally and propodeal side along metapleural sulcus covered with dense appressed silver setae; head and mesosoma with pale erect setae.

Structure: Labrum truncate; clypeus rounded apically, shallowly emarginate; flagellomere I nearly twice length of II (39:21) and equal to least interocular distance (39:39); collar abruptly rising at streptaulus, surface arcuate in profile, smooth, sparsely punctate; scutum transversely ridged, interspaces punctate; scutellum longitudinally ridged; propodeal enclosure laterally with diagonal ridges, interspaces shiny, impunctate; propodeal side striatopunctate; metapleural flange lamelliform, outer margin strongly angled; penis valve head as in fig. 73.

Female: Length 16-20 mm.

Color: As in male except clypeal free margin and gastral tergum V red; scape, pronotal side, mesopleuron, propodeal side, and legs often extensively red.

Vestiture: As in male.

Structure: Labrum truncate; clypeal disk slightly tumescent, surface shiny, sparsely punctate, clypeal lobe projecting, bounded by two teeth; flagellomere I slightly more than twice length of II (53:26); flagellomere I length slightly less than to slightly more than width of clypeal lobe; inner orbits parallel (fig. 209); collar curving up gradually from streptaulus in profile (fig. 163).

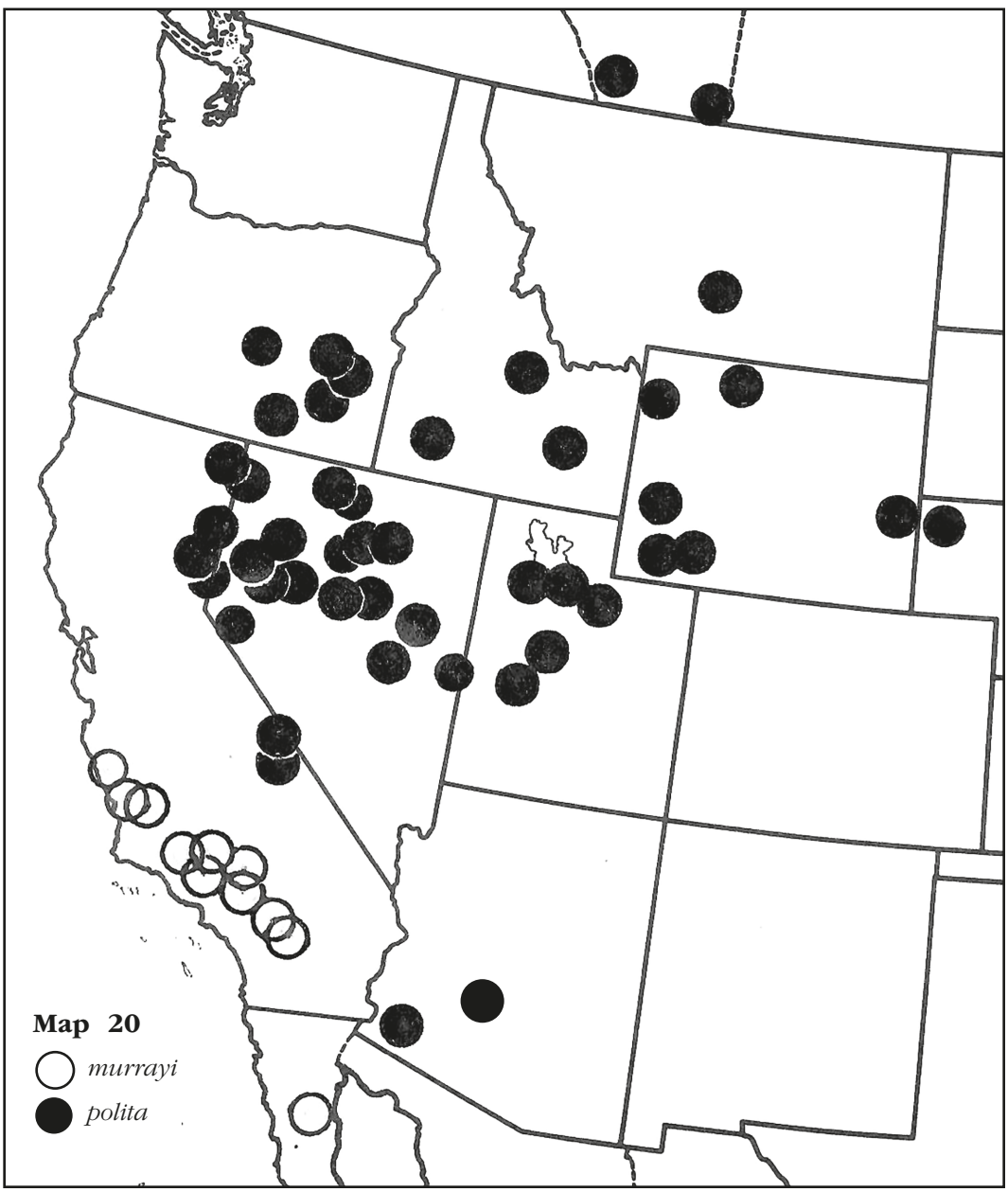
Geographic range: This species is an inhabitant of the Mojave and Colorado deserts of California, but it also occurs in desert areas of southern Arizona as far east as Graham Co. and Cochise Co. *Ammophila mimica* is also known from northern Baja California. It is a spring flyer and thus not commonly collected.

Ammophila monachi Menke

Figures 80, 105, 107, 210, 211, 212, Map 16.

Ammophila monachi Menke, 1966. Proceedings of the Biological Society of Washington 79:34. Holotype: male, Mount Montgomery, Mineral Co., Nevada, 7000' (UCD).

Recognition: Females of *monachi* are largely red and very similar to females of *wrightii* except for the more humped pronotal collar and normal venation. Males of *monachi* are less like the ant mimic males since they are largely black and have a narrower face. Female *monachi* resemble *hurdi* females to some degree but the latter does not have ridges on the lower metapleuron. In *monachi* the ridging on the propodeal side extends onto the lower metapleuron (fig. 107). Males of *hurdi* differ from male *monachi* in having the collar sharply cutoff anteriorly and carinate. Males of *monachi* also resemble male *polita* but



the latter have largely black legs and the apex of the abdomen is black. In addition, male *polita* do not have a red propodeal side.

Ammophila monachi bridges the gap between the highly specialized ant mimics, *wrightii* and *formicoides*, and the other members of the *procera* group. Of these, *hurdi* and *nearctica* perhaps represent the nearest relative of *monachi*. The ant mimics have a strongly flattened pronotum (fig. 105), are largely or entirely red in both sexes, and have reduced wing venation.

Description:

Male: length 10-11 mm.

Color: Black; following are red: mandible, labrum, tegula, peritreme, upper metapleuon, metapleural flange, and propodeal side; petiole tergum and gaster red except terga V-VI; legs red except coxa, trochanter and femur above; wings clear, veins black.

Vestiture: Face, gena and pronotal side with dense appressed silver setae; pronotal collar and scutum with very sparse appressed silver setae except fossae often densely silvery; meso- and metapleuron with dense appressed silver setae; propodeal enclosure with appressed silver setae mesally; erect setae restricted to head.

Structure: Labrum truncate or rounded apically, clypeus broadly, shallowly emarginate; flagellomere I longer than II (29:19), length less than least interocular distance (29:36); profile of collar as in fig. 80, surface with many fine cross microridges; scutum with many fine microridges; propodeal side diagonally ridged, ridges continued on lower metapleuron (fig. 210); metapleural flange not lamelliform.

Female: Average length 12.5 mm.

Color: Red; following black: ocellar triangle, streptaulus area of pronotum, propodeal enclosure, mesosternal region and lower metapleuron near hindcoxa; gastral terga I-IV with large black areas; dorsal surface of mid and hindcoxae, trochanters, and femora black, or hindfemur and tibia completely red.

Vestiture: Appressed silver setae restricted to anteroventral region of mesopleuron, area next to petiole socket, and propodeal enclosure.

Structure: Clypeal disk moderately tumescent, surface sparsely punctate, clypeal lobe slightly projecting, teeth absent (fig. 211); flagellomere I longer than II (41:24); inner orbits very slightly converging above; pronotal collar as in male but more evenly arcuate in profile, cross ridging sometimes nearly obliterated; scutal ridges stronger than in male, obliterated along midline; mesopleuron along mesopleural suture smooth, sparsely punctate; episcrobal area and upper metapleuron with horizontal ridges; propodeal side closely, diagonally ridged, ridges continuous over lower metapleuron (fig. 212).

Variation: The subalar area is black in some males.

Geographic range (map 16): The type locality, Mount Montgomery, is in pinyon pine-juniper desert at 7000 feet. *Ammophila monachi* has also been collected 15 mi. SW of Mina in Mineral Co., Nevada May 25, 1986, collected on *Tetradymia*. All these specimens were collected by Richard Bohart (UCD). The Mount Montgomery specimens were collected June 21, 1942. I also have seen one male from 4 mi. W of Stove Pipe Wells in Death Valley taken June 1, 1980 (UCD).

Ammophila murrayi **Menke**

Figures 78, 200, 213, Map 20

Ammophila murrayi Menke, 1964. Acta Hymenopterologica 2:14. Holotype: male, Tanbark Flat, San Gabriel Mts., California (UCD).

Recognition: The short pronotum (fig. 78), lack of appressed silver setae on the pronotal side, and the non-lamelliform metapleural flange identify *murrayi.* The strongly acuminate labrum in the female is also distinctive.

Description:

Male: Average length 13.5 mm, range: 12-15.5 mm.

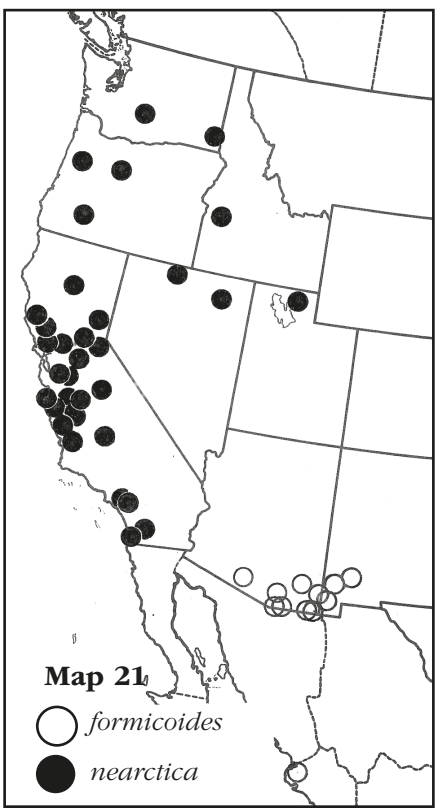
Color: Black; petiole tergum red laterally, black above; gaster red, gastral terga I-II with narrow black spots, III-VI with broad black spots; III-VI with broad black spots; wings clear, veins black.

Vestiture: With sparse appressed silver setae on gena but none on pronotal side; mesopleuron and lower metapleural area posteriorly with appressed silver setae which are densest along mesopleural suture; propodeal enclosure with very sparse appressed silver setae, or none; head and mesosoma (except propodeal enclosure) with pale erect setae.

Structure: Labrum obtusely acuminate; clypeal free margin reflexed, shallowly emarginate; flagellomere I longer than II (38:23), length nearly equal to least interocular distance (38:42); collar in profile as in fig. 78, with fine ridges which extend more finely onto pronotal side; scutum ridged; lower metapleuron and propodeal side rugosopunctate; metapleural flange not lamelliform; penis valve head as in fig. 200.

Female: Average length 16 mm, range: 15.5-20.5 mm.

Color: As in male except petiole tergum and gastral segments I-II and V completely red, gastral terga III-IV usually with small black spots, gastral terga I and V sometimes with small black spots.



Vestiture: As in male except gena without appressed silver setae; appressed setae of mesopleuron forming a more distinct band along mesopleural suture.

Structure: Labrum acuminate; clypeal disk slightly to moderately tumescent, sparsely to moderately punctate, clypeal lobe projecting, teeth blunt (fig. 213); flagellomere I longer than II (58:33); inner orbits parallel; collar ridges stronger than in male, often obliterated at midline but extending onto pronotal side; scutal ridges largely obliterated except toward scutal fossae and laterally; ridgeless areas smooth, shining, sparsely punctate.

Geographic range (map 20): Apparently *Ammophila murrayi* is restricted to the coastal mountain ranges of southern California and northern Baja California.

***Ammophila nearctica* Kohl**

Figures 11, 81, 214, 215, Map 21.

Ammophila nearctica Kohl, 1889. Verhandlungen der kaiserlich-königlichen zoologisch botanischen Gesellschaft in Wien 39:18. Lectotype: male, Ellensburg, Washington (VIENNA), present designation.

Recognition: The black body and absence of a third submarginal cell (fig. 11) in the forewing make *nearctica* a distinctive species. *Ammophila wrightii* and *formicoides* are the only other North American species that normally have only two submarginal cells but their red bodies will separate them from *nearctica.* The shiny female face is also distinctive Essentially it is asetose.

Description:

Male: Average length 13 mm, range: 10.5-15 mm.

Color: Black; tegula sometimes red; petiole sternum infrequently red, tergum red; gastral segments I-II red, tergum II sometimes black posteriorly; wings clear, veins brown or black.

Vestiture: Frons and clypeus with appressed silver setae, none on gena and pronotal side, those of pronotal lobe sparse; none on mesosoma except for very weak band along mesopleural suture.

Structure: Flagellomere I longer than II (31:19), length less than least interocular distance (31:48); profile of collar as in fig. 81, surface evenly covered with fine ridges which continue over pronotal side; scutum finely ridged; mesopleuron with fine vertical microridges, sparsely punctate; lower metapleuron and propodeal side with fine diagonal microridges, sparsely punctate; metapleural flange not lamelliform; forewing with two submarginal cells (fig. 11).

Female: Average length 14.5 mm., range: 10-16.5 mm.

Color: As in male except tegula red and petiole sternum commonly red; wing veins often yellowish basally.

Vestiture: As in male except face lacks appressed setae; mesopleuron usually with distinct band of appressed silver setae along mesopleural suture (fig. 214).

Structure: Face shiny, sparsely punctate; clypeal disk moderately tumescent, free margin without teeth or defined lobe (fig. 215); scutal ridges often obsolescent along midline; mesopleuron minutely roughened, moderately punctate; ridges of lower metapleuon and propodeal side stronger than in male, especially on propodeal side.

Nomenclature: I have not seen Kohl's syntypes but R. M. Bohart studied them in 1960 and verified the identity of this species. Kohl described *nearctica* from two males, both of which are from "Wash. Terr." but one has an additional label, "Ellensburg". I am

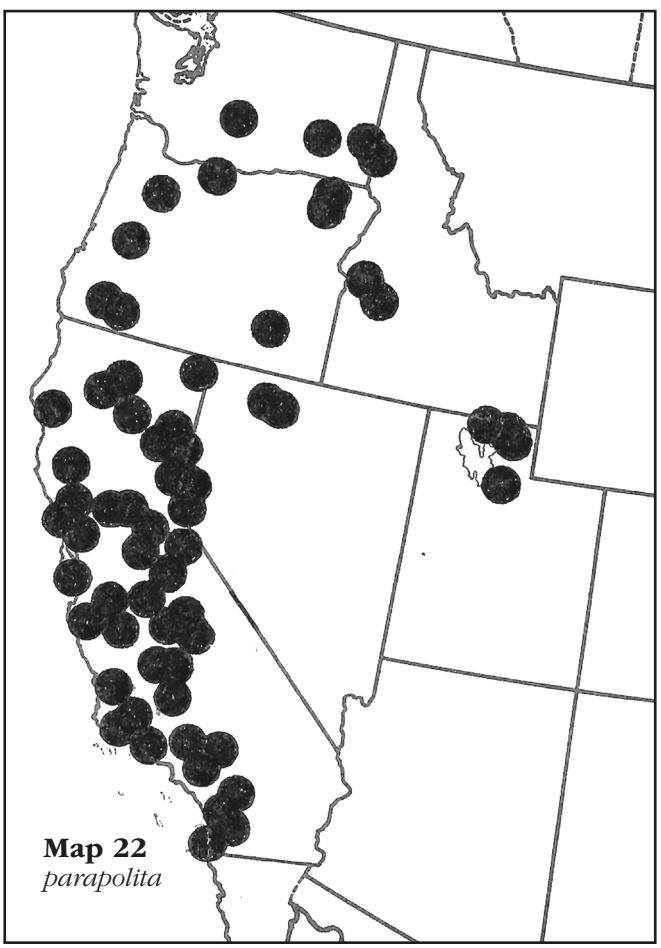
selecting the Ellensburg specimen as lectotype. Fernald (1931, 1934) lumped *nearctica* with *polita* even though he had seen the types of both species.

Geographic range (map 21): Southern California to Washington and Idaho, eastward through the Great Basin. The species occurs on Santa Cruz Island and Santa Rosa Island off the coast of southern California. *Ammophila nearctica* apparently has broad ecological tolerances because it is found in dry coastal foothills, inland valleys, high mountain areas and cold desert areas of the Great Basin. *A. nearctica* flies primarily in the spring months with some capture dates in late June and July in the cooler Great Basin areas.

***Ammophila novita* (Fernald)**
Figures 166, 216, 217, Map 19.

Sphex novitus Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 147. Holotype: female, Baja California (ANSP). Type studied.

Recognition: The elongate, smooth pronotum is distinctive in *novita* but *unita, imitator,* and *mimica* are similar. The male of *novita* has a pair of swellings or tubercles



Map 22
parapolita

on the mesosternal venter behind the forecoxae. These are much less developed in the other three species. And of course, the male penis valves of *mimica* and *imitator* are quite different from *novita*. Females of *novita* have a completely red abdomen (occasional specimens may have a small black spot on gastral tergum IV). Females of the other species have black spots on gastral terga I and III-IV and the petiole usually is partially black.

Description:

Male: Average length 16.5 mm, range: 13-21 mm.

Color: Black; mandibles often yellowish; tegula and metapleural flange often reddish; petiole tergum red laterally, black above; gastral segments I-III red, terga I and III with mesal black spots; femur and tibia black above, red below; wings clear, veins black.

Vestiture: Gena, pronotal side, scutal fossa, mesopleuron and metapleuron covered with dense appressed silver setae (fig. 216); collar and scutum sparsely covered with appressed silver setae; erect setae long on head, short or absent on mesosoma.

Structure: Labrum truncate, sometimes broadly emarginate; clypeus broadly emarginate; flagellomere I longer than II (41:26), length usually equal to least interocular distance (41:41); collar elongate, cutoff anteriorly above streptaulus (fig. 216), surface smooth, not ridged, sparsely finely punctate; scutum ridged, interspaces shining, mesosternum with pair of tubercles anteriorly behind forecoxae, propodeal side punctatostriate or rugosopunctate; metapleural flange lamelliform, outer margin strongly angulate (fig. 216).

Female: Average length 20 mm, range 17-22.5 mm.

Color: Differs from male in having clypeal lobe, scape, tegula, entire abdomen and legs red (gastral tergum IV rarely with small black spot); mesosoma often extensively red, especially pronotal side and lobe, subalar area and propodeal side.

Vestiture: As in male except erect setae usually lacking on vertex and mesosoma.

Structure: Labrum truncate; clypeal disk slightly tumescent near lobe, sparsely finely punctate, clypeal lobe slightly projecting, teeth well developed (fig. 217); flagellomere I longer than II (51:29); inner orbits parallel; pronotal collar only slightly cutoff anteriorly (fig. 166), surface smooth, sparsely, finely punctate; mesosternum not or only slightly projecting anteriorly.

Geographic range (map 19): Throughout the Colorado Desert in southern California. The distribution extends eastward through Arizona and Sonora, Mexico. The species occurs to the southern tip of Baja California. I have seen specimens from Isla San Jose, Baja California Sur (SDNHM). Records in the literature of *novita* from Utah probably refer to *unita*.

Ammophila parapolita **(Fernald)**

Figures 68, 218, 219, Map. 22.

Sphex parapolitus Fernald, 1934. North American and West Indian digger wasps of the Genus *Sphex* (*Ammophila* auct.), p. 51. Holotype female, Felton, Santa Cruz Mountains, California (CUI). Type studied.

Recognition: The lack of dense appressed silver setae on the gena and pronotal side combined with the angulate metapleural flange make *parapolita* a distinctive species. The largely red legs of the female is an additional feature. Males of *parapolita* are similar to those of *marshi* but the profile of the collar differs between them (figs. 68, 69).

Description:

Male: Average length 15 mm, range: 11-19.5 mm.

Color: Black; tegula brownish; petiole tergum red laterally, black above; gastral segments I-II red; wings clear; veins black or brown.

Vestiture: Gena without appressed silver setae or very sparse; pronotal side without appressed silver setae (sometimes with very sparse silver setae); propodeal enclosure asetose or appressed silver setae sparse; mesopleuron and lower metapleuron posteriorly with sparse appressed silver setae, setae often forming band along mesopleural suture (fig. 68).

Structure: Flagellomere I longer than II (44:25), length less than least interocular distance (44:50); clypeus shallowly emarginate (fig. 218); collar angulate anterolaterally, profile as in fig. 68, with fine ridges anteriorly, becoming coarse, stronger posteriorly, sometimes continuous over pronotal side; scutum with transverse ridges which are interrupted at midline; mesopleuron moderately punctate, interspaces closely, minutely etched; mesopleural venter behind forecoxae with pair of tubercles; lower metapleuron finely rugose or roughened; propodeal side similar to metapleuron but with some distinct ridges; metapleural flange lamelliform (lamella of variable width), outer margin angulate (fig. 68).

Female: Average length 18 mm, range: 14-20.5 mm.

Color: As in male except clypeal margin occasionally, mandible, tegula, metapleural flange, petiole, femur, tibia and tarsus, red; gaster sometimes entirely red, but usually with small black spots on terga III-IV.

Vestiture: As in male except pleural appressed setae often denser, especially along mesopleural suture and metapleural sulcus.

Structure: Clypeal disk slightly bulging, sparsely punctate laterally, moderately so medially, clypeal lobe slightly projecting, teeth small (fig. 219); flagellomere I nearly twice length of II (54:28); inner orbits slightly converging below; collar similar to *boharti* except slightly shorter, more steeply inclined in profile (fig. 68), ridges very fine anteriorly, continuous over pronotal side although sometimes feeble.

Variation: The metapleural flange may be very narrow in some males, and not angulate.

Geographic range (map 22): *Ammophila parapolita* occurs from southern California to Washington and eastward to northern Utah.

Ammophila polita **Cresson**

Figures 85, 149, 220, Map 20.

Ammophila polita Cresson, 1865. Proceedings of the Entomological Society of Philadelphia 4:458. Lectotype: female, Colorado Territory (ANSP), designated by Cresson, 1916:94. Type studied.

Recognition: The elongate collar in profile (fig. 85), the non-lamelliform metapleural flange, and the appressed silver setae on the pronotal side (fig. 85) are distinctive features of *polita*. Also both sexes have mesosternal tubercles behind the forecoxae (fig. 85). Many females have red legs which aids in identification.

Description:

Male: Average length 12.5 mm, range: 9-16.5 mm.

Color: Black; tegula frequently red; petiole sternum sometimes red below, petiole tergum red laterally, black above; gastral segments I-III red, terga I-II rarely with black spots, tergum III largely black; hindfemur and tibia occasionally partly red; wings clear, veins black.

Vestiture: Gena and pronotal side with dense appressed silver setae; mesosoma generally covered with appressed silver setae (fig. 85).

Structure: Flagellomere I longer than II (29:19), length less than least interocular distance (29:39); profile of collar as in fig. 85, ridges very fine, restricted to posterior part of collar; scutum finely ridged; metapleural flange not lamelliform; venter of mesopleuron behind forecoxae with pair of tubercles.

Female: Average length 15.5 mm, range: 11-17.5 mm.

Color: As in male except free margin of clypeus, mandible, and tegula red; petiole completely red or sternum black; gaster red but terminal terga sometimes with black spots; femur, tibia, and tarsus usually red, occasionally black.

Vestiture: As in male except genal appressed setae sparser; appressed silver setae on face very sparse in some specimens; mesopleuron with distinct band of appressed silver setae along mesopleural suture (fig. 149).

Structure: Clypeal disk moderately to strongly tumescent, sparsely punctate, clypeal lobe not defined, free margin with small median notch (fig. 220); flagellomere I longer than II (37:22); inner orbits moderately converging below, LID:GID (74:90); scutal ridges very fine, irregular, sometimes wrinkle-like; venter of mesopleuron behind forecoxae with pair of tubercles.

Variation: *Ammophila polita* has an interesting color polymorphism. Approximately twenty-five percent of the females studied have black legs. These black-legged individuals are commonly collected with red-legged females.

I have seen two females of *polita* from southern Arizona and they have extensive red on the mesosoma unlike specimens from the rest of the range of the species. A female from Wellton, Yuma Co. (CUI) is completely red except for the dorsal and posterior parts of the head and also the median area of the scutum. It was collected May 26, 1918. The other female from Arizona has red legs and the pleura and propodeal side are red. It was collected May 18-25, 2010, 8 km S Arlington, Maricopa Co., in the Gila River drainage (ASM). These records are about 400 miles from the rest of the population of *polita* and obviously more collecting needs to be done! I have seen one female from northern Nevada that has some reddening on the propodeal side (ASM). In some males from Nixon, Nevada (UCD) all legs are parially red, on others it is just the hindleg. In one male the legs are competely red. In a few specimens of *polita* the second and third submarginal cells are partially or completely fused.

Nomenclature: Fernald's (1934) interpretation of *polita* included such species as *stangei*, *nearctica* and *marshi* as revealed by his determination labels on specimens in various collections.

Geographic range (map 20): *Ammophila polita* is primarily a Great Basin species however, it ranges to eastern Nebraska and northward to Alberta. I have seen two females from southern Arizona which is a long way from the rest of the distribution.

Ammophila procera **Dahlbom**

Figures 57, 62, 66, 157, 159, 160, 221, Map 23.

Ammophila procera Dahlbom, 1843. Hymenoptera Europaea praecipue borealia. Tomus *Sphex* in sensu Linnaeano, 1 (fasc. 1), p. 15. Holotype: female, "N. America" (LUND). Sex not indicated in original description. R. M. Bohart examined the type for me in 1960.

Ammophila procera Lepeletier de Saint-Fargeau, 1845. Histoire Naturelle des Insectes. Hyménoptères. 3:376. Holotype: female, "Am. Sept." (TURIN). Junior primary homonym of *Ammophila procera* Dahlbom. Synonymy by Menke, 1966a:2392. Type studied.

Ammophila saeva Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 4:222. Lectotype: female, California (BMNH). Designated by Menke, 1976:153. Synonymy by Fernald 1934:44. Type studied.

Ammophila gryphus Smith, 1856. Catalogue of Hymenopterous Insects in the Collection of the British Museum 4:222. Lectotype: female, Charleston (South Carolina) (BMNH), designated by Menke, 1976:153. Synonymy by Fernald 1934:44. Type studied.

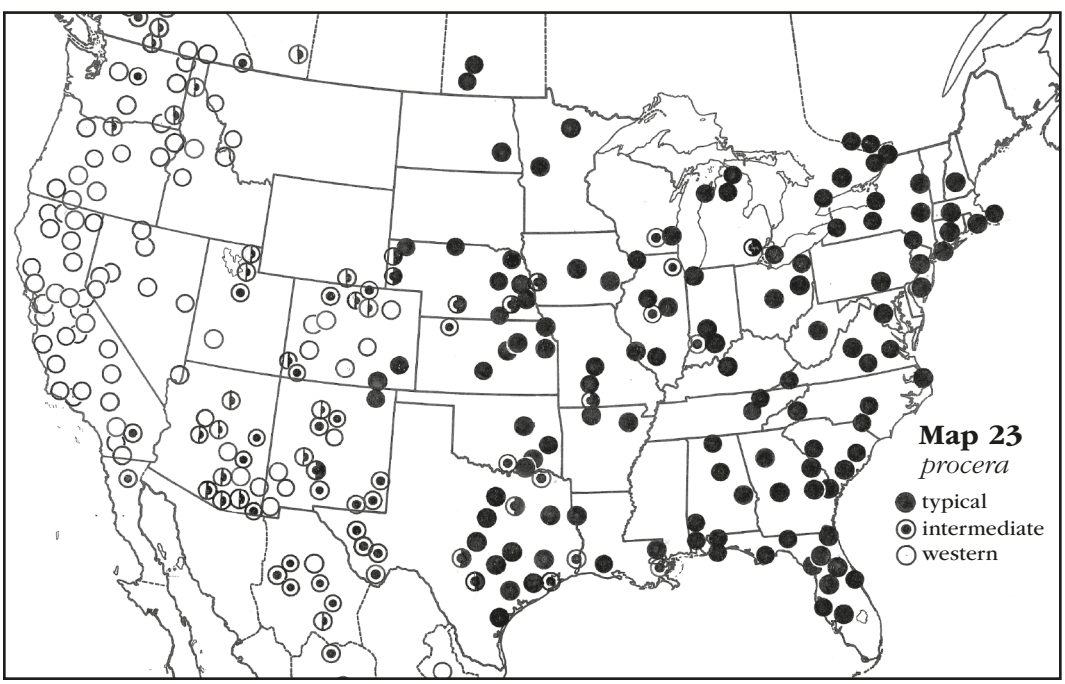
Ammophila barbata Smith, 1873. Annals and Magazine of Natural History (4)12:260. Syntypes: female, Mexico, apparently lost. Synonymy by Fernald, 1934:44. Menke, 1996:195 assumed that Fernald's synonymy was correct.

*Ammophila cere*s Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:8. Holotype male, San Geronimo, Guatemala (BMNH). Synonymy by Fernald, 1934:44. Type studied. Menke 1976:153, unnecessarily designated this specimen as lectotype.

Ammophila championi Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:9. Lectotype: female, San Geronimo, Guatemala (BMNH), designated by Menke, 1976:153. Synonymy by Fernald, 1934:44. Type studied.

Ammophila striolata Cameron, 1888. Biologia Centrali-Americana, Hymenoptera 2:10. Holotype: female, Ventanas (= Villa Corona), Durango, Mexico (BMNH). Synonymy by Fernald, 1934:44. Type studied.

Recognition: *Ammophila procera* and its sibling, *macra*, are the largest North American species. The two share the lamelliform metapleural flange whose outer edge is a curve (figs. 62, 157). *Ammophila procera* and *macra* are very similar, but *procera* has appressed silver setae in the scutal fossae (figs. 57, 160) best seen from the rear), while the fossae of *macra* are asetose (figs. 58, 161). The collar has a patch of silver setae posteromedially, and the pattern of appressed silver setae on the pleura is distinctive (fig. 159). *A. macra* usually does not have a patch of silver setae on the collar and the pleural bands of silver



are reducd. The acuminate female labrum is distinctive but *macra* is similar. *Ammophila murrayi* is the only other species in the *procera* group with an acuminate labrum.

Description:

Male: Average length 22.5 mm, range: 15-31 mm.

Color: Black; petiole black or petiole tergum with various degrees of reddening (eastern United States to Rocky Mountains), petiole tergum laterally red, black dorsally (Rocky Mountains to Pacific Coast, petiole sternum sometimes red in Arizona); gastral segments I mostly red, tergum black medially (eastern United States to Rocky Mountains), gastral segments I-II red, terga with median black spots, terga III-V laterally and sterna III-V frequently red (Rocky Mountains to Pacific Coast); wings clear or slightly infumate, veins black.

Vestiture: Gena with appressed silver setae along outer orbit (western United States); anterior vertical face of collar frequently with appressed silver setae, collar frequently with transverse patch of appressed silver setae posteromedially; pronotal side without appressed silver setae; scutal fossae and peritreme with appressed silver setae; mesopleuron with band of appressed silver setae along mesopleural suture from base of midcoxa to bottom of episcrobal area; lower metapleuron with narrower band of silver setae along metapleural sulcus from base of hindcoxa to about half the distance to upper metapleural pit; erect head setae black (eastern United States) or pale with occasional black setae.

Structure: Flagellomere I longer than II (59:41), length of flagllomere I less than least interocular distance (59:68); collar in dorsal view, fig. 160, collar with numerous strong ridges which are continuous over pronotal side, interspaces shiny, impunctate to moderately punctate; mesopleuron moderately to densely punctate, interspaces smooth to rugose, often punctatorugose or punctatostriate anteriorly; lower metapleuron moderately to densely punctate, interspaces usually rugose; propodeal side vertically rugosopunctate or punctatostriate; metapleural flange lamelliform, nearly as broad to broader than peritreme, outer margin arcuate (fig. 157); mesosternal area behind forecoxae frequently with pair of angular tubercles; penis valve head see fig. 66.

Female: Average length 29 mm, range: 20-35 mm.

Color: As in male except gastral segment I usually completely red, remainder black (eastern United States), or gaster red with black spots on terga II-IV (California), intermediate color forms in Great Basin region.

Vestiture: As in male except gena more broadly silvery (western United States); psammophore black (eastern United States) or pale (Rocky Mountains to Pacific Coast).

Structure: Labrum acuminate; clypeal disk moderately to strongly tumescent, densely micropunctate, moderately macropunctate, clypeal lobe produced, teeth small but well developed (fig. 221); flagellomere I nearly twice length of II (78:44); inner orbits parallel or slightly converging above; pronotum about as in male but not rising as sharply from streptaulus (fig. 159); mesosomal details as in male except scutal ridges sometimes obsolescent anteromedially and mesosternal region without angular tubercles.

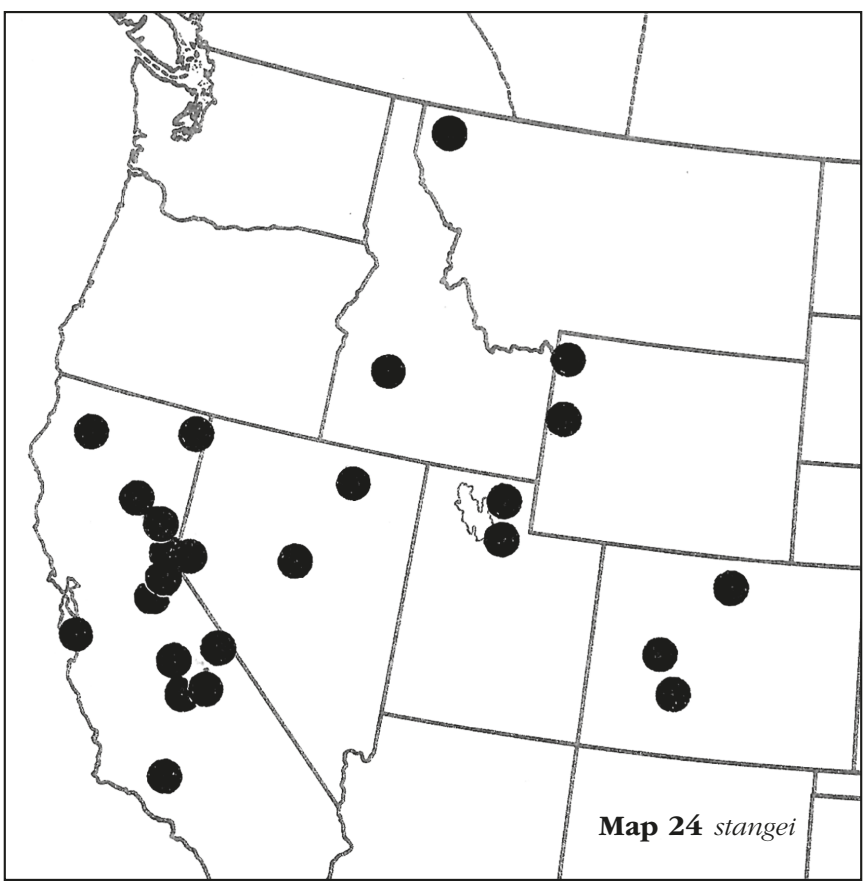
Variation: Variation in thoracic sculpture and particularly the shape and length of the pronotal collar, is frequent in *procera*. Quite often the collar, expecially in the male, is very elongate. Occasional examples of *procera* have very weak ridges on the collar and scutum. The mesopleuron varies from smooth and moderately punctate to densely punctate and rugose. If it were not for the constant form of the aedeagus throughout the wide variation in this species, one would be tempted to try dividing *procera* into several species.

Nomenclature: R. M. Bohart examined Dahlbom's type in 1960 and verified the identity of *procera*. The type of *barbata* could not be found in the British Museum in London

and may be located at Oxford. I have seen completely black female *procera* from Mexico that fit Smith's description of *barbata*.

Geographic variation (map 23): *Ammophila procera* is a highly variable species. As in many wasps that range across the entire width of the North American continent there are two distinct chromatic types in *procera*. East of the Rocky Mountains *procera* is predominantly black. The abdomen is usually all black in the male and the female has only gastral segment I red. In this form the erect head setae are black and there is usually no appressed silver setae on the gena. Westward, red becomes more extensive on the abdomen. Specimens from the Great Plains region often have both the petiole tergum and gastral tergum II red laterally in both sexes. These individuals are represented on the map by circles with black centers. This intermediate color form merges with the pale western type of *procera* in the Rocky Mountains. The western form, represented by open circles on the map, typically has white erect head setae and appressed silver setae on the gena. The gaster is often extensively red in the female so that there are only a few black spots on the last few terga. In Arizona and New Mexico the entire petiole is often red and the erect setae may be very short. Variation in setal length, color and also body color, becomes very complex in Mexico and this fact probably accounts in part for the many names proposed for this one species.

Geographic range (map 23): From coast to coast in the United States and southern Canada; as far south as Costa Rica. The black circles on the distribution map refer to



Map 24 *stangei*

records of the typical dark eastern form of *procera*. The open circles represent records of the paler western form of the species. Intermediate color forms are shown by circles with black centers.

***Ammophila stangei* Menke**

Figures 84, 178, 200, 222, 223, Map 24.

Ammophila stangei Menke, 1964. Acta Hymenopterologica 2:15. Holotype: male, Boca, California (UCD).

Recognition: The reflexed, non-emarginate male clypeus (fig. 84) and the free margin of the female clypeus which is a simple arc with no teeth or lobe (fig. 223) identify this small species. The pronotal collar is short in profile (fig. 178). The penis valve head is distinctive (fig. 195).

Description:

Male: Average length 11.5 mm, range: 9.5-14.5 mm.

Color: Black; petiole tergum red, sometimes with black stripe basodorsally; gastral segments I-II and sternum III red, terga I-II rarely with black spots; wings clear, veins black.

Vestiture: Face densely silvery setose; vertex, gena, pronotal side and collar, and scutum with sparse appressed silver or golden setae; mesopleuron and lower metapleuron with appressed silver setae which is densest on mesopleuron, especially along mesopleural suture.

Structure: Clypeal free margin entire, broadly spatulate, reflexed (fig. 84); flagellomere I longer than II (32:19), length less than least interocular distance (32:46); profile of collar similar to fig. 223, ridges fine; scutal ridges fine, often feeble anteriorly, interspaces minutely roughened, ridges stronger posteriorly; propodeal side rugose; metapleural flange not lamelliform; penis valve head as in fig. 200.

Female: Average length 14 mm, range: 12.5-15 mm.

Color: As in male except petiole tergum and gastral segments I-II always red.

Vestiture: As in male except clypeal disk largely asetose; vertex, gena and pronotal side usually with dense appressed silver or golden setae; collar anteriorly and scutum with rather dense appressed golden setae, scutal setae densest in fossae; mesopleuron, lower metapleuron and propodeal side rather evenly covered with appressed silver or golden setae; mesosoma without erect setae.

Structure: Clypeal disk strongly tumescent, shiny, free margin without defined lobe or teeth, free margin broadly lamelliform (fig. 222); flagellomere I nearly twice length of II (40:22); inner orbits parallel or slightly converging below; pronotal collar about as in male except less steeply inclined from streptaulus; scutal ridges weak, wrinkle-like, surface minutely roughened.

Variation: The appressed setae on the pronotal side are sometimes very sparse in males, but the reflexed, entire clypeus is diagnostic.

Geographic range (map 24): Most records of *stangei* are from California but specimens from localities throughout the western United States (western Wyoming, Colorado, Utah, Nevada) indicate a broad range. It is most frequently collected at elevations ranging from 4,000 to 11,000 feet.

Ammophila unita Menke

Figures 200, 224, 225, Map 19.

Ammophila unita Menke, 1966. Proceedings of the Biological Society of Washington 79:35.
Holotype: male, Castle Park, Dinosaur National Monument (USNM).

Recognition: Except for the presence of wrinkle-like ridges on the collar and slight abdominal color differences *Ammophila unita* is very similar to *novita*. The length of flagellomere I is slightly less than the least interocular distance in *unita* males whereas in *novita* the two measurements are equal. Anteroventrally males of *unita* have only a suggestion of the prominent tubercles seen in *novita* males. Gastral terga I and III-IV are partially black in females of *unita* whereas the female gaster of *novita* is usually completely red. The ranges of the two species do not overlap and distribution can be used in identification. *Ammophila mimica* is similar to *unita* also, but the penis valve is very different. Females of *mimica* are difficult to separate from *unita* except on the basis of distribution and association with males.

Description:

Male: Average length 15.5 mm, range 14-18 mm.

Color: Black; metapleural flange pale; petiole tergum red laterally, black above; gastral segments I-II red, terga I-II with median black spots, III-VI black; apex of front and middle femur below and front and middle tibia below, red; wings clear, veins black.

Vestiture: Face, gena, pronotal side, scutal fossae, mesopleuron and metapleuron covered with dense, appressed silver setae; collar and scutum sparsely covered with appressed silver setae; erect mesosomal setae sparse, shorter than on head.

Structure: Labrum truncate, sometimes broadly emarginate; clypeal free margin reflexed, emarginate; flagellomere I longer than II (43:25), length less than least interocular distance (17:20); pronotal collar rising abruptly from streptaulus, long in profile (fig. 224), surface with several feeble transverse ridges which do not reach pronotal side, surface otherwise smooth, sparsely, finely punctate; scutum with many strong cross ridges, interspaces shining, sparsely punctate; mesopleuron anteroventrally with slight elevation behind forecoxae, but no definite paired tubercles there; propodeal side diagonally rugosopunctate; metapleural flange lamelliform, outer margin strongly angulate; penis valve head as in fig. 200.

Female: Average length 18.5 mm, range: 18-19 mm.

Color: As in male except mandibles, clypeal free margin, scape frequently, tegula, subalar area frequently, metapleural flange, and propodeum adjacent to petiole socket, red; petiole sternum usually red; gaster red, tergum I sometimes with narrow black spot, terga III-IV largely black; legs more extensively red than in male.

Vestiture: As in male but no erect mesosomal setae except occasionally on pronotal collar.

Structure: Labrum truncate; clypeal disk slightly tumescent near free margin, surface shining, sparsely punctate, clypeal lobe slightly produced, teeth well formed (fig. 225); flagellomere I more than twice length of II (62:28), inner orbits parallel; pronotal collar similar to male except only slightly or not at all cutoff anteriorly, surface with few wrinkle-like ridges or smooth.

Variation: The ridges on the collar are often very weak or absent in females and occasional males. Male flagellomere I length is usually less than the LID, but in occasional

males the lengths are nearly equal. Because of this, such measurements have to be used with caution.

Nomenclature: Fernald (1934) confused this species with his *novita*. His paratype of *novita* from Beaver Co., Utah, is *unita*. I intended this species to be named uinta, after the Uinta Mountains., but during proof reading of the galley I missed the spelling error.

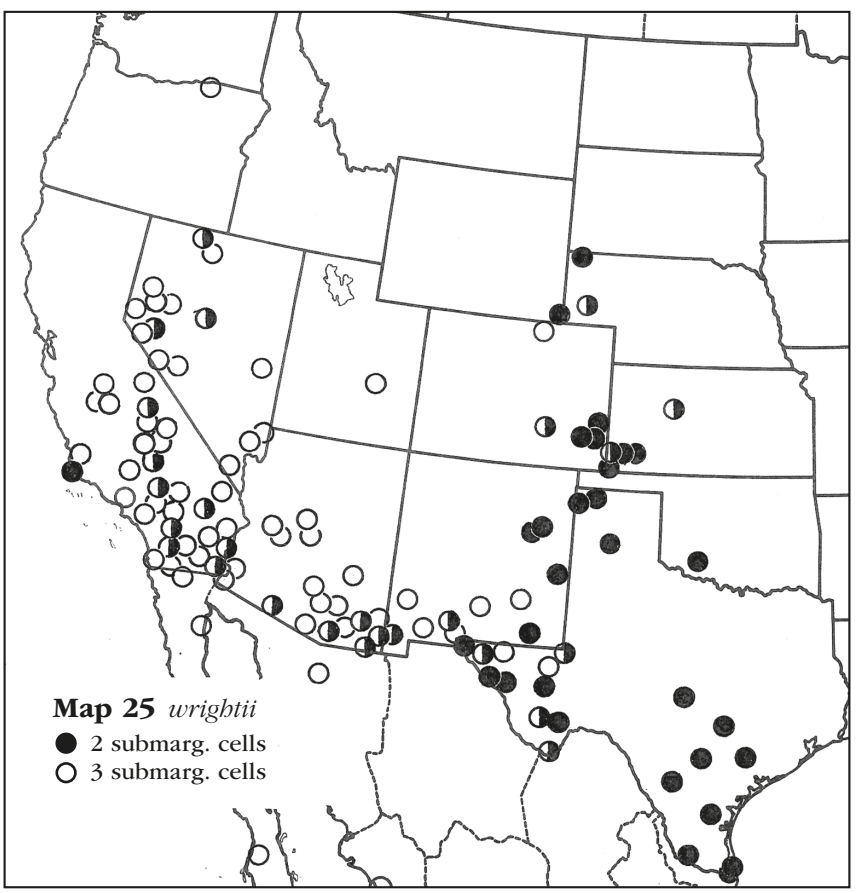
Geographic range (map 19: Restricted to the cold desert areas of the eastern Great Basin, the western Rocky Mountains and south to northern Arizona.

Ammophila wrightii **(Cresson)**

Figures 21, 22, 105, 226, Map 25.

Coloptera wrightii Cresson, 1868. Transactions of the American Entomological Society 1:378. Holotype: female, New Mexico (ANSP). Type studied.

Recognition: This is the smallest species of the genus in North America and its largely red body is distinctive. *Ammophila wrightii* is very similar to *formicoides* but the latter always has two submarginal cells and the wing tip is infumate. The wings are clear in *wrightii*, and there are two or three submarginal cells. *A. wrightii* is usually orange red while *formicoides* is dark red or reddish brown. The least interocular distance is nearly



equal to the greatest interocular distance in male *formicoides* and the clypeus usually has two vertical bulges. In comparison, *wrightii* males have more strongly converging eyes and the clypeus lacks the two parallel bulges (fig. 226). Females of *wrightii* have fine horizontal ridges on the episcrobal area (fig. 105). The episcrobal area is smooth in *formicoides*.

Description:

Male: Average length 11.5 mm, range: 7-14 mm.

Color: Red; following are black: terminal flagellomeres, ocellar triangle or occasionally entire vertex, scutum rarely posteriorly, propodeal enclosure rarely and propodeum above petiole socket occasionally, mesosternal region, dorsal surface of hindcoxa, trochanter and femur; gaster red, often terga with brownish or black transverse bands which sometimes obscure red color entirely; wings clear, veins brown or black.

Vestiture: Appressed facial setae dense, sparse or lacking; gena feebly covered with appressed silver setae or glabrous; pronotal lobe and meso- and metapleuron variably covered with appressed silver setae; erect setae restricted mainly to gena, often very sparse.

Structure: Clypeal margin entire or very slightly emarginate mesally (fig. 226), disk moderately swollen, often with anteromedian depression; labrum truncate or roundly truncate; flagellomere I longer than II (31:21), length less than least interocular distance (31:42); degree of eye convergence variable, average LID: GID (42:59), eyes more strongly converging in western material; collar elongate, flattened (fig. 105), often strongly so in Texas examples, surface with many fine ridges, ridges indistinct on pronotal side; scutum finely ridged; propodeal enclosure poorly defined, ridges continuous with those of propodeal side; episternal sulcus very short or absent; mesopleuron without ridges; episcrobal area sometimes horizontally ridged; metapleural flange not lamelliform; forewing with two or three submarginal cells, rarely only one (figs. 21, 22).

Female: Average length 13 mm, range: 8.0-15.5 mm.

Color: Red; ocellar triangle and mesosternal area black; gastral terga brown banded posteriorly, sometimes completely black.

Vestiture: Appressed silver setae when present restricted to pronotal lobe, mesopleuron anteriorly and ventrally, and spot adjacent to petiole socket; erect setae restricted to clypeus and gena.

Structure: Clypeal disk moderately tumescent, clypeal lobe slightly projecting, teeth small and obtuse; flagellomere I longer than II (43:24); inner orbits parallel or slightly converging below (Kansas to Texas), or parallel to slightly diverging below (New Mexico to California); pronotal collar as in male, ridges continuous over pronotal side; scutal and propodeal details as in male; episcrobal area finely, horizontally ridged (fig. 105); mesopleuron usually finely horizontally ridged near mesopleural suture; lower metapleuron finely ridged, ridges horizontal anteriorly, vertical or diagonal posteriorly.

Geographic variation: The most obvious variable in *wrightii* is the number of submarginal cells in the forewing. Most specimens from Texas, eastern New Mexico, Oklahoma, eastern Colorado, western Kansas, Wyoming, and Nebraska have only two submarginal cells. Material from California, Nevada, and Arizona typically has three submarginals. Occasional specimens of *wrightii* have two submarginals in one wing and three in the other as in Cresson's type. When three submarginals are present in *wrightii* the third cell is usually smaller than is normal in *Ammophila*; and often the third cell may be incompletely formed. Rare individuals of *wrightii* have only one large submarginal cell due to the lack of the crossvein between cells one and two.

A second type of variation is the degree of eye convergence in the males. In the west the eyes are more strongly converging below in comparison with males from the eastern

part of the range. This is most striking when California males are compared with males from eastern Texas. The difference is less striking, however, between material from Arizona and western Texas. Somewhat correlated with this male variation is a similar situation in the females. In Texas and areas to the north the inner orbits are often slightly converging below or merely parallel. Going westward the eyes tend to be divergent below. In California females the inner orbits are nearly always divergent below.

Another variable common to both sexes, and also coinciding with the east-west head variation, is the degree of flattening of the pronotal collar. Specimens from eastern and southern Texas have a very flat collar, but to the west there tends to be a slight convexity to the collar. All California examples seen have some degree of curvature.

Geographic range (map 25): *Ammophila wrightii* is found over most of the western part of the United States primarily in desert or semidesert areas. Its distribution extends well into Mexico with records as far south as Fresnillo, Zacatecas and the southern tip of the Baja California. The black circles on the map represent *wrightii* with two submarginal cells, and the open circles are records of three celled specimens. Halved circles are used for localities where both types occur and/or where the individual has one wing with two cells and the other with three.

Behavior: Females of this wasp are often found in association with the myrmicine ant genus *Pogonomyrmex*. They are often seen running across the ground among them. Their small size and reddish color makes *wrightii* difficult to distinguish from the ants.

NEFERTITI SPECIES GROUP

Diagnosis: The carinate clypeal tooth and hypostomal process in the male, combined with the short episternal sulcus are unique characteristics of the *nefertiti* group. However females lack distinctive group features, and agree with the *procera* group diagnosis. Thus the *nefertiti* group could be combined with that group as an abberant assemblage. The *nefertiti* group occurs only in western North America.

Included species: *Ammophila coachella* Menke and *nefertiti* Menke.

Description: Free margin of male clypeus semicircular with median carinate tooth, the carina extending onto disk of clypeus (figs. 15, 227, 230); hypostomal carina of male with incurved process at about two-thirds the distance to mandible base, hypostomal carina not evident between projection and mandible (figs. 12, 16); labrum truncate apically; pronotum and scutum transversely ridged; scutellum longitudinally ridged; propodeal enclosure laterally with diagonal ridges, interspaces shining, impunctate; episternal sulcus short, ending opposite pronotal lobe; metapleural flange broadly lamelliform, outer margin angulate (fig. 228); propodeal enclosure with appressed silver setae mesally, but no erect setae; base of gonoforceps not dorsoventrally elongate, penis valve head lacking teeth and basoventral spine, apex of head hook-like (figs. 18. 19).

***Ammophila coachella* Menke**

Figures 15, 16, 17, 18, 154, 229, Map 26.

Ammophila coachella Menke, 1966. Proceedings of the Biological Society of Washington 79:38. Holotype: male, Deep Canyon, 4 mi. S Palm Desert, Riverside Co., California (CAS).

Recognition: *Ammophila coachella* is very similar to *nefertiti*, and the only obvious external differences in the male of *coachella* are the narrower hypostomal process and the strongly elevated inner tooth of the mandible (fig. 17). Females of *coachella* can be separated from females of *nefertiti* only by the broader clypeal lobe (fig. 154). The scutal welts will separate *coachella* females from *boharti.* When *nefertiti* was described (Menke, 1964a), I included paratypic material from southern California. If I had checked the male genitalia of these southern specimens, I would have realized that they represented another undescribed species.

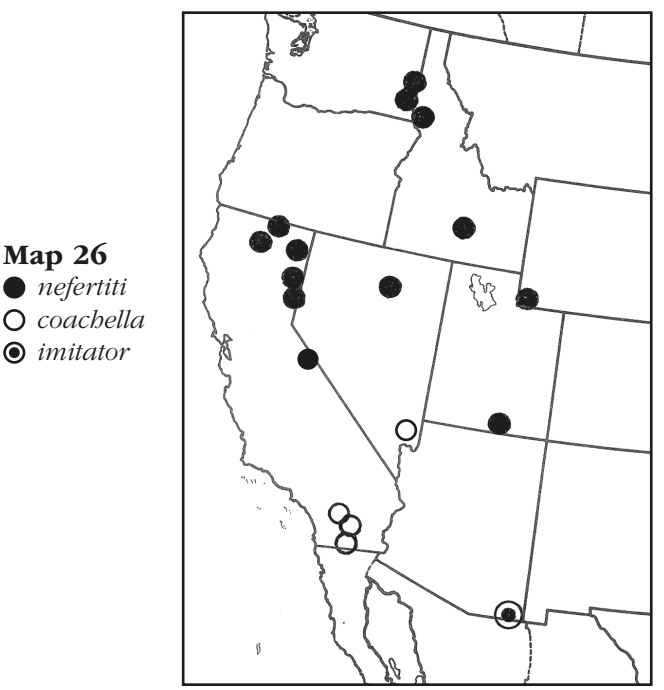
Description:

Male: Length 15 mm.

Color: Black; mandible, tegula and metapleural flange red; petiole red below, black above; gaster red, tergum I with elongate black spot, tergum IV with large black spot and V with small spot; legs largely red but coxa, trochanter and femur black dorsally; wings clear, veins black.

Vestiture: Clypeus, frons, gena, and mesosoma except propodeal enclosure laterally, with dense, appressed silver setae which obscures the underlying sculpture; head and mesosoma, except propodeal enclosure, with pale erect setae.

Structure: Inner tooth of mandible with raised lamelliform carina (figs. 16, 17); clypeal free margin reflexed, disk strongly tumescent dorsally (figs. 16, 17); hypostomal process about as broad as one half the antennal socket diameter, sides converging, tip broadly rounded (fig. 16); flagellomere I longer than II (40:25), length less than least interocular distance (40:48); pronotal collar in profile abruptly rising at streptaulus, then broadly



curving toward scutum, disk irregularly transversely ridged, ridges fading before reaching streptaulus; scutum transversely ridged, ridges strongest posteriorly and converging toward scuto-scutellar articulation; propodeal side diagonally rugose; penis valve head and gonoforceps as in fig 18.

Female: Average length 18.5 mm, range: 17.5-19.5 mm.

Color: As in male except clypeus largely red, scape red and petiole sternum often entirely black.

Vestiture: As in male except clypeus glabrous near free edge; scutal welts glabrous; psammophore pale.

Structure: Clypeus moderately tumescent near free margin, clypeal lobe with two weak teeth or angles, nearly twice width of lateral free margin (69:36) (fig. 154); flagellomere I nearly twice length of II (61:34); inner orbits slightly converging above; pronotal collar in profile gradually curving back from streptaulus (fig. 229); scutum anterolaterally and fossae rugosopunctate, area between fossae and median longitudinal sulcus welt-like, shining, sparsely to moderately punctate with few converging ridges posteriorly.

Geographic range (map 26): *Ammophila coachella* is known only from the Coachella and Imperial Valley regions of the Colorado Desert in southern California, and Clark Co., Nevada (Whitney Pocket area). It is a spring flyer and thus collected rarely. The species is one of the most poorly known in North America.

Material examined: CALIFORNIA, Riverside Co: Andreas Canyon near Palm Springs, IV-10-55 (CNC); Biskra Palms, March-29, 1957 (UCD); Boyd Desert Research Center, (Deep Canyon), 4 mi. S Palm Desert, April-6-12, 1963, on *Dalea schottii* (CIS); Thousand Palms, March-23, 1955 (CNC), April-9, 1955 (CNC), April 13, 1955 (CNC); Thousand Palms, 6 mi. E, March 20, 1960 (CIS); Willis Palms Oasis, Thousand Palms, March 25, 1955 (CNC); April 3, 1955 (CNC), April 10, 1955 (CNC). San Diego Co.: Anza State Park, April 23, 1951 (UCD); Borrego Valley, May 20, 1941 (CAS). NEVADA, Clark Co., 33 km SE jct. Hwy 170 on New Gold Butte Rd., June 2019, Irwin and Ballmer (ASM); 20 km SW Whitney Pocket, June/July 2019, Irwin and Ballmer (ASM).

Ammophila nefertiti Menke

Figures 12, 19, 153, 227, 228, Map 26.

Ammophila nefertiti Menke, 1964. Acta Hymenopterologica 2:16. Holotype: male, 10.6 mi. N. Litchfield, California (CAS).

Recognition: The clypeus of male *nefertiti* has a distinctive hypostomal process (fig. 12). The species is only confusable with *coachella.* which is similar. The broader, parallel-sided hypostomal process and normal mandible in *nefertiti* are distinctive (fig. 12). The penis valves are very different in the two species as well. Females of *nefertiti* can be separated from *coachella* females by examination of the clypeus. In *nefertiti* the teeth are large and prominent and the clypeal lobe is only slightly wider than the lateral free margin (figs. 153, 154). The presence of scutal welts will distinguish *nefertiti* females from those of *boharti* which are similar.

Description:

Male: Average length 18 mm, range: 17-19 mm.

Color: Black; mandible and metapleural flange red; tegula usually red but occasionally suffused with brown; following areas frequently red: pronotal side and lobe, subalar area, propodeal side from spiracle to socket; petiole sternum black or red ventrally, petiole

tergum red laterally, black above; gaster red, tergum I with elongate black spot and large spots on III-IV, II and VI occasionally with spots also; legs variable, largely red with narrow dorsal black streaks in lighter specimens or red restricted to venter of femur and tibia in darker legged examples; wings clear, veins brown or black.

Vestiture: Clypeus, frons, gena, pronotal side and lobe, propodeal enclosure mesally, peritreme, meso- and metapleuron, and coxae with dense appressed silver setae which obscure underlying sculpture; collar, scutum and propodeal side with sparse appressed silver setae, sculpture discernable; frons, vertex, gena, pronotal collar anteriorly and forecoxa with pale erect setae, rest of mesosoma with few scattered, short, erect setae.

Structure: Inner tooth of mandible with low carina dorsally; clypeal edge with median tooth, clypeus reflexed, disk strongly tumescent dorsally (fig. 228); hypostomal process parallel sided, about as broad as antennal socket diameter, apex truncate or rounded (fig. 12); flagellomere I nearly twice length of II (49:29), length less than least interocular distance (49:63); pronotal collar in profile abruptly rising at streptaulus, then broadly curving toward scutum, disk with six to ten strong irregular transverse ridges which do not reach streptaulus; scutum with irregular transverse ridges which are strongest posteriorly, ridges often obsolescent anteriorly and laterally, interspaces moderately punctate; propodeal side diagonally rugose; penis valve head and gonoforceps as in fig. 19

Female: Average length 22 mm, range 21-22 mm.

Color: As in male except clypeus largely red and mesosoma with more extensive reddening as follows: pronotal side, lobe and collar laterally and rarely dorsally, subalar area, propodeal side and often propodeal enclosure laterally.

Vestiture: As in male except clypeus glabrous near free edge; psammophore pale; scutal fossae with dense appressed silver setae, scutal welts glabrous.

Structure: Clypeus moderately to strongly bulging near lobe; clypeus with two large teeth, clypeal lobe slightly wider than lateral free margin (55:45) (fig. 153); flagellomere I nearly twice length of II (65:36); inner orbits slightly converging above; collar in profile gradually curving back from streptaulus, scutum anteriorly moderately punctate or transversely ridged and punctate area between fossae, median longitudinal sulcus welt-like, shining, moderately punctate with few converging ridges posteriorly.

Geographic range (map 26): *Ammophila nefertiti* is restricted to the Great Basin region and adjacent desert areas such as the east side of the White Mts of California (Dead Horse Meadow). I have seen one male from Mammoth, Mono Co., California (UCD). The southern California desert localities given by me for *nefertiti* (Menke, 1964a) were erroneous since they pertain to *coachella*.

Material examined (June and July): CALIFORNIA, Inyo Co.: Dead Horse Meadow, White Mts. (ASM). Lassen Co.: Hallelujah Junction (UCD), Litchenfield, 10.6 mi. N (CIS). Modoc Co.: Alturas, 6 mi. N (UCD), "Modoc Co." (OSU). Mono Co.: Leavitt Meadow (CAS), Mammoth (UCD). Plumas Co.: Vinton (ASM). Siskiyou Co.: Macdoel (UCD), Mt. Shasta City, on *Eriogonum nudum* (CIS). COLORADO, Montrose Co.: Star Spring (ASM). IDAHO, Blaine Co.: Carey (CUI). Nez Perce Co.: Lewiston (CAS). NEVADA, Elko Co.: Pequop Pass (UCD). UTAH, San Juan Co.: Navajo Mountain (CAS). WASHINGTON, Garfield Co.: Wawawai (CAS). Whitman Co.: Pullman (WSU). WYOMING, Uinta Co.: "Uinta Co.", 7000 feet (UCD).

NASALIS SPECIES GROUP

Diagnosis: Male clypeus acuminate, triangular in outline (fig. 14); hypostomal carina of male with triangular process near mandible (fig. 13); labrum rounded apically; collar and scutum without transverse ridges; propodeal enclosure irregularly rugose medially, diagonally ridged laterally, interspaces smooth; episternal sulcus long, ending ventrally; metapleural flange lamelliform; penis valve head without spine, irregular in form (fig. 231), base of gonoforceps not dorsoventrally elongate; clypeus and frons covered with dense appressed silver setae, clypeus glabrous anteromedially in female; pronotal lobe and propodeum adjacent to petiole socket covered with appressed silver setae; erect body setae pale; forewing with three submarginal cells; midtibia with only one apical spur.

Included species: *Ammophila nasalis* Provancher.

Discussion: The *nasalis* group is based primarily on features of the male. Except for the single midtibial spur the female agrees with the characteristics of the *azteca* group. The acuminate clypeus, hypostomal process and peculiar genitalia of the male (fig. 230) preclude the placement of *nasalis* in any of the other groups of North American *Ammophila*. The mandible of male *nasalis* is also distinctive. The inner tooth is large (figs. 14, 16) and at the base of the mandible there is an inner tooth-like projection.

Ammophila nasalis Provancher

Figures 13, 14, 16, 104, 122, 230.

Ammophila nasalis Provancher, 1895. Le Naturaliste Canadien 22:111. Holotype: male, Los Angeles, California (Laval University, Saint Foy, Quebec). Type studied. *Sphex craspedotus* Fernald, 1934. The North American and West Indian Digger Wasps of the Genus *Sphex* (*Ammophila* auct.), p. 96. Holotype: female, Los Angeles, California (USNM). Synonymy by Murray, 1951:976. Type studied.

Recognition: The triangular clypeus of male *nasalis* will readily identify this species (fig. 14). The underside of the male head has a pair of triangular projections on the hypostomal carina near the mandible base (fig. 13). The non-toothed, lamelliform free clypeal margin (fig. 122), and single midtibial spur are distinctive in the female.

Nomenclature: The type of *nasalis* is located at Laval University. See Comeau (1957). Provancher's collection was transferred there from the Museum in Quebec.

Geographic range: *Ammophila nasalis* is found only along the Pacific Coast from northern Baja California to the San Francisco Bay area. It is usually collected in sandy situations such as dune areas or beach bluffs. The species also occurs along the Sacramento River at Antioch, a famous sand dune area that many entomologists have visited.



Fig. 181, *centralis* female



Fig. 182, *mexica*



Fig. 183, *zanthoptera*



Fig. 184, *zapoteca* holotype



Fig. 185, *zapoteca* holotype



Fig. 186, *evansi* female



Fig. 187, *hallelujah* female



Fig. 188, *harti*



Fig. 189, *linda* female



Fig. 190, *linda*



Fig. 191, *mediata* female

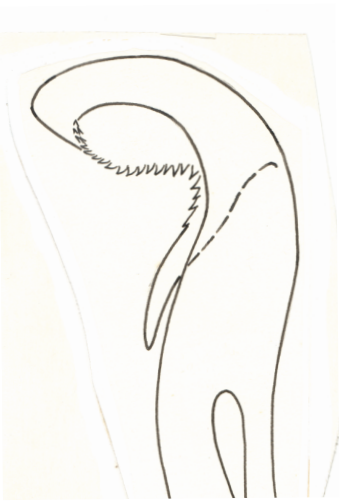


Fig 192, *aberti*



Fig. 193, *aellos*



Fig. 194, *bellula*

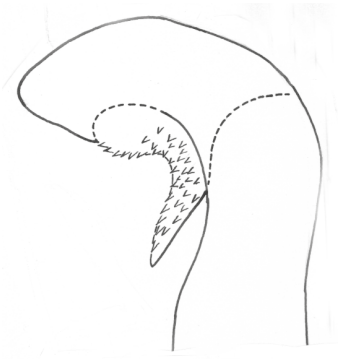


Fig 195, *cleopatra*

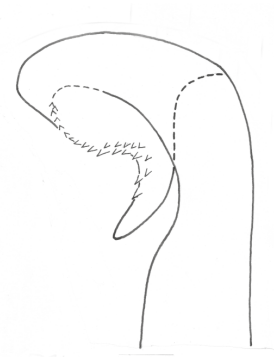


Fig. 196, *parkeri*



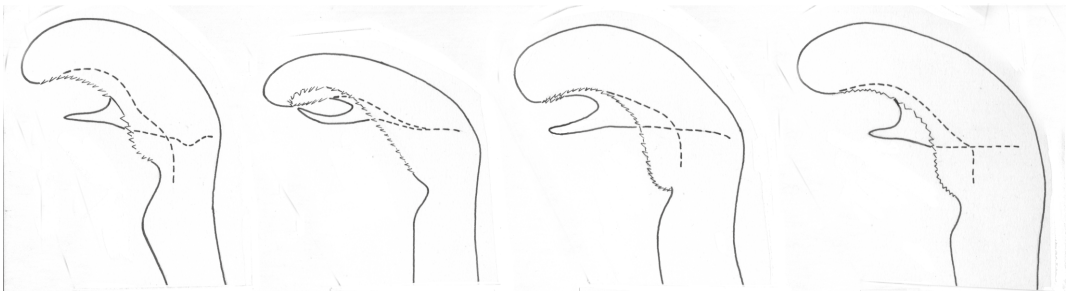
Fig. 197, *picipes* holotype



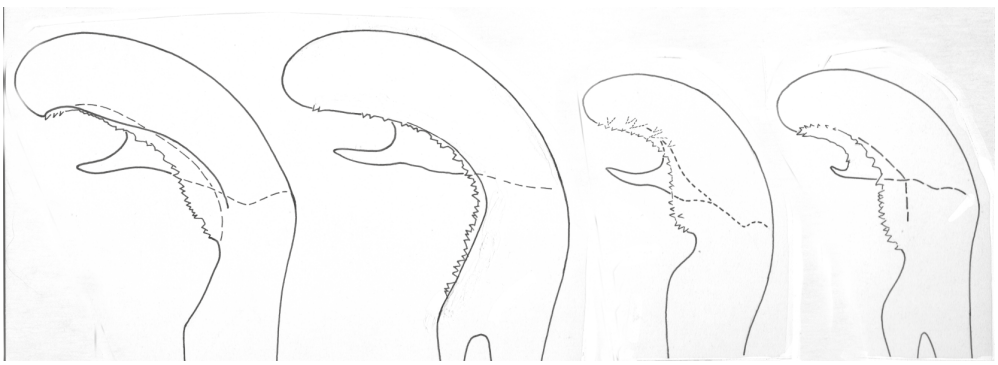
Fig. 198, *kennedyi* female



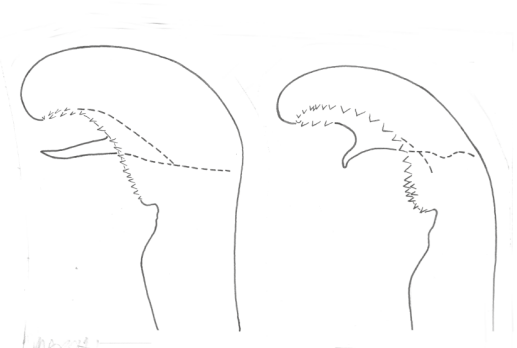
Fig. 199, *leoparda*



aphrodite *formicoides* *hurdi* *boharti*



macra *procera* *murrayi* *unita*



marshi *stangei*

Fig. 200, penis valves in the *procera* group



Fig. 201, *boharti*



Fig. 202, *ferruginosa*

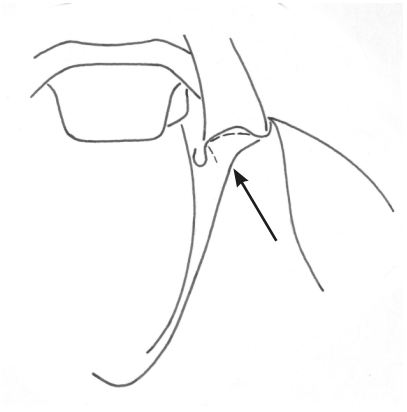


Fig. 204, *imitator*



Fig. 205, *imitator*



Fig. 206, *marshi* male



Fig. 207, *marshi* female



Fig. 208, *marshi* female



Fig. 209, *marshi* female



Fig. 210, *monachi* male



Fig. 211, *monachi*



Fig. 212, *monachi* female



Fig. 213, *murrayi* female



Fig. 214, *nearctica* female



Fig. 215, *nearctica* female



Fig. 216, *novita* male



Fig. 217, *novit*a female



Fig. 218, *parapolita* male



Fig. 219, *parapolita* female



Fig. 220, *polita* female



Fig. 221, *procera* female



Fig. 222, *stangei* female



Fig. 223, *stangei* female



Fig 224, *unita* male



Fig 225, *unita* female



Fig. 226, *wrightii* male



Fig. 227, *nefertiti* male



Fig. 228, *nefertiti* female



Fig. 229, *coachella* female

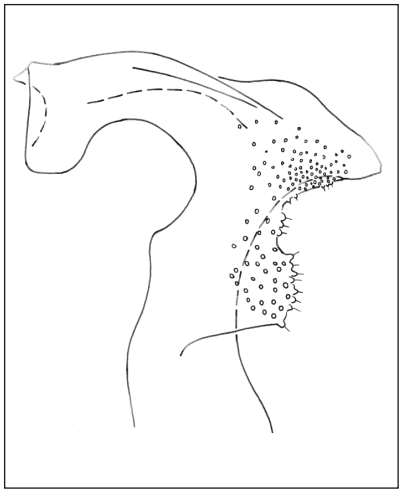


Fig. 230, *nasalis*

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APPENDIX

The *Ammophila* of the White Mountains, California and Nevada, and the Inyo Mountains.

For about 25 years I have been sampling the wasps of the White Mountains, particularly the genus *Ammophila*. I have managed to travel over most of the "roads" in the White Mountains in my Toyota 4Runner, even reaching the top of White Mountain itself. Some of the roads I have traveled are no longer accessible, being blocked by the Forest Service. The road to Dead Horse Meadow is now impassible due to flood damage which is unfortunate because that area is one of the most interesting and diverse for *Ammophila*. Cottonwood Basin is another rich area for collecting, but the upper access road is often blocked by a snow field. I have explored most of the accessible canyons on the Nevada side of the White Mountains (Chiatovich Creek, Middle Creek, Cottonwood Creek, and Leidy Creek), but I have not visited the west side canyons other than Silver Canyon. During my

yearly visits I stayed at Crooked Creek station operated by the University of California. People that have assisted me in survey for species of *Ammophila* are John Kirchner, Linda Rosenfield, Lynn and Bob Kimsey, Christine Menke, Kurt Menke, Frank Parker, the late Bob Denno, and my late wife Nancy.

Fourteen species of *Ammophila* are known in the Whites. *Ammophila azteca* Cameron, occurs as high as 13,200 feet (3.2 mi. N of Barcroft Station), but it is found all over the Whites above 5,000 feet, and is the most common species. *Ammophila stangei* Menke is another species that is fairly common at elevations above 6,000 feet. The other species in the Whites are: *acuta* (Fernald), *boharti* Menke, *breviceps* Smith, *ferruginosa* Cresson, *juncea* Cresson, *macra* Cresson, *mediata* Cresson, *nefertiti* Menke, *parapolita* (Fernald), *parkeri* Menke, *procera* Dahlbom, and *strenua* Cresson. A fifteenth species, *pruinosa* Cresson, has been taken in Deep Springs Valley at Antelope Spring, elevation 5,600' (UCD). This location is marginally in the White Mountains. The species will probably be found at lower elevations in the range.

Dead Horse Meadow and Cottonwood Basin have the most diversity of species, and unforuntely it is now impossible to drive to Dead Horse as noted above. Dead Horse is the only location where I have taken *Ammophila nefertiti,* a Great Basin species. Other species common at Dead Horse and the Cottonwood Basin are: *acuta*, *azteca*, *boharti, juncea, macra, mediata, parkeri, procera*, *stangei* and *strenua*. *Ammophila mediata* is really not common anywhere in the White Mountains, however. *Ammophila breviceps* has been collected only along highway 168 at Batchelder Spring, 6,000', near the turnoff to the White Mountains, 6,000-6,200', and Westgard Pass, 7300'. *Ammophila parapolita* is known from Cottonwood Basin, Schulman Grove and the top of Silver Canyon, but is uncommon. *Ammophila ferruginosa* has only been collected on the dirt road to the Westgard Mine off of highway 146. The elevation was 7,200 feet.

Above 10,000 feet *azteca* and *stangei* are the usual species encountered.

So far I have collected four species of the genus in the Inyo Mountains to the south: *azteca* Cameron, *karenae* Menke, *ferruginosa* Cresson and *pruinosa* Cresson. Curiously, *karenae* and *pruinosa* have never been taken in the White Mountains in 25 years. So far I have only made my survey for *Ammophila* in the Inyo Mountains at one place: Squaw Flat. So it is highly likely that more species will be found in the Inyos.

Species of *Ammophila* at 1429 Franklin St., Bisbee, Arizona

I have collected *Ammophila* on my 4 acres for 24 years. My late wife, Nancy, and our friend Juan Kirchner have also collected these wasps here. For the past 6 or 7 years I have also run a malaise trap. So far 20 species have been taken on my high desert property (5200 feet), and there is the possability of one or two more. *Ammophila breviceps* is one of the commonest species and I have collected it practically every month of the year. Other common species are *hermosa, cleopatra, procera*, *fernaldi*, and *bellula*. Rarely seen species are *aberti*, *mimica, juncea* and *strenua.* My malaise trap produced the first specimen of *mimica* in 2018 and the first specimens of *juncea* and *strenua* in 2020.

aberti Haldeman
bellula Menke
breviceps Smith
cleopatra Menke
dejecta Cameron
femurrubra Fox

fernaldi (Murray)
hermosa Menke
imitator Menke
juncea Cresson
karenae Menke
mcclayi Menke
mescalero Menke
mimica Menke
picipes Cameron
placida Smith
procera Dahlbom
pruinosa Cresson
strenua Cresson
wrightii (Cresson)

Ammophila rufipes **Guérin-Méneville**

Figures 231-236

In my paper on red-legged *Ammophila* in South America (Menke, 2004), I described this species in detail. I have seen much more material thanks to malaise traps operated in Peru by Mike Irwin. This material is all from northern Peru: Carhuaz, Carhuaz Province, Auquipampa, Ancash Region, 8600 feet and Lambayeque Zaña, Chiclayo Province, 311 feet. The latter location is the most northerly and is on the coast. As I noted in 2004 the thorax of females is extensively reddish (fig. 233). One female out of the 19 I have from Zaña has an entirely black thorax. The amount of red color in the remainder varies in extent but the pleura and propodeal side typically are red. About half of the females have an entirely red propodeum and the collar is largely red. The thorax in the 56 males from Zaña is black. The female gaster in the Zaña specimens varies from all red to having black areas on terga III-V or IV-V. The 10 females from Carhuaz have a black line running through gastral terga II-V (fig. 236). Sometimes there is a tiny black spot on tergum I. The thorax in the Carhuaz females is black dorsally including the propodeal enclosure. The penis valve head of *rufipes* is distinctive. The ventral spine diverges outwardly (fig. 234). All these specimens are in the Menke collection.



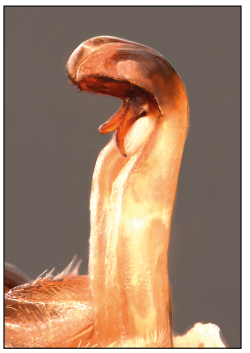
Fig. 231, female *rufipes*



Fig. 232, male *rufipes*



Fig. 233, *rufipes* female thorax





Figs. 234 & 235, *rufipes* penis valve



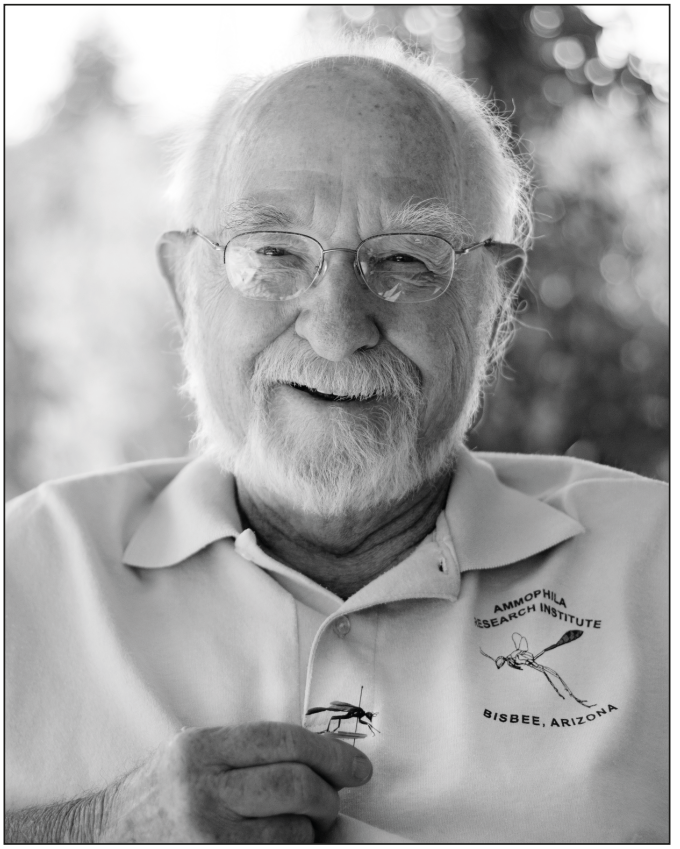
Fig. 236, *rufipes* female gaster


CONTRACTOR



Erin Prado took all of the color specimen photographs in this volume. Arnold took this photo at the California Academy of Sciences, where Erin did the photographic work.

About the Author



Arnold Menke was born in Glendale, California. His father was from Tallin, Estonia, and his mother was from New Bedford, Massachusetts. As a child he was fascinated by insects. His mother made him a collecting net out of a metal clothes hanger. While at Manual Arts High School in Los Angeles, Arnold met Fred Truxal at the nearby Los Angeles County Museum of Natural History. Fred instilled in Arnold an interest in aquatic bugs. Thus he began his several years study of the family Belostomatidae, about which he published numerous papers. At the museum Arnold also met his life-long friend Lionel Stange and the two of them took many memorable trips in the deserts of California and Arizona collecting insects.

When Arnold entered graduate school at the University of California, Davis, in 1957, his interests changed from bugs to wasps because his major professor, Richard M. Bohart, worked on those insects. He took up the study of the genus *Ammophila* in 1958. His PhD thesis was a revision of the North American species of the genus.

Arnold has published over 130 papers and books on various wasps, including the infamous "Big Blue Book", otherwise known as the Sphecid Wasps of the World he co-authored with Richard Bohart.

Arnold also has other interests, namely railroad history, especially the Southern Pacific Railroad and its steam locomotives. He has published many articles and book chapters on Southern Pacific locomotive tenders. Arnold has a professional photographic darkroom where he continues to make traditional gelatin silver, black and white photographs.

Arnold and his wife Linda, live in Bisbee, Arizona with their British Shorthair cat, Tom.