

The Ammophilini of Costa Rica; An Identification Guide (Hymenoptera: Sphecidae: Sphecinae)

ARNOLD S. MENKE

Systematic Entomology Laboratory, USDA, ARS, c/o National Museum of Natural History,
Washington D.C. 20560

Abstract.—Three genera (*Ammophila* Kirby, *Eremnophila* Menke and *Podalonia* Fernald) and nine species of Ammophilini are recorded from Costa Rica and a key and illustrations provided for their identification. *Ammophila* is represented by *centralis* Cameron, *gaumeri* Cameron, *picipes* Cameron, and *procera* Dahlbom; *Eremnophila* by *aureonotata* (Cameron), *melanaria* (Dahlbom) and *opulenta* (Lepeletier); and *Podalonia* by *atriceps* (Smith) and *montana* (Cameron). The following new synonyms are proposed: *Ammophila consors* Cameron, 1888, and *A. nigrocaerulea* Cameron, 1888 = *Ammophila centralis* Cameron, 1888; *Ammophila communis* Cresson, 1865, *A. alpestris* Cameron, 1888, and *Podalonia communis* ssp. *intermedia* Murray, 1940 = *Podalonia atriceps* (Smith), 1856. *A. piceiventris* Cameron, 1888 is treated as a tentative synonym of *P. atriceps* (Smith). *Ammophila gaumeri* Cameron is recorded from Venezuela. Records of *Podalonia robusta* (Cresson) in Costa Rica are shown to be erroneous.

INTRODUCTION

Publication of the book, *The Hymenoptera of Costa Rica* (Hanson and Gauld, 1995), will doubtless foster considerable interest in the wasps of the country, as will the keys to genera of Neotropical Sphecidae by Menke and Fernández (in press). The following is the first of a series of papers dealing with the identification of Costa Rican Sphecidae.

The ammophiline wasps are among the larger sphecids in Costa Rica, but because of their slender build, they are less conspicuous than their cousins in the genera *Sphex* and *Isodontia*. Nevertheless, they are fairly commonly collected. These wasps are predators of lepidopterous caterpillars, although nothing has been published on the biology of any Costa Rican ammophiline. Three genera are known in Costa Rica, *Ammophila* Kirby, *Eremnophila* Menke, and *Podalonia* Fernald, containing four, three, and two species, respectively (Hanson and Menke, 1995; Menke and Parker, 1996). Our knowledge of the distribution

of ammophiline species in Costa Rica is fragmentary, but the rapidly growing collection of the Instituto Nacional de Biodiversidad in Santo Domingo (INBio), Costa Rica should improve this situation dramatically in the coming years. Menke and Parker (1996) provided phenological data for some species of Ammophilini at one site in Guanacaste Province, Costa Rica. Populations of some species reach their zenith in the dry season, others in the wet season.

The Costa Rica/Panamá section of Central America is a zoogeographical crossroads between the North American and South American sphecid faunas (Hanson and Menke, 1995). Some northern elements extend south to the seasonably dry Guanacaste Province of northwestern Costa Rica, and apparently go no farther. Within the Ammophilini, *Ammophila procera* Dahlbom, *Eremnophila aureonotata* (Cameron), and *Podalonia montana* Cameron have this pattern. For some northern taxa, Panamá is the southern limit, and *Podalonia atriceps* (Smith) is the only example

in the Ammophilini. Some South American species occur as far north as Panamá or Costa Rica. The common South American wasp *Eremnophila binodis* (Fabricius) is the only ammophiline with this pattern, and so far, it is known only as far north as central Panamá. The remaining Costa Rican ammophilines are more widespread.

SOURCES OF MATERIAL

I would like to thank Terry Griswold, Bee Biology and Systematics Research Lab., Utah State University, Logan, Utah; Paul Hanson, Universidad de Costa Rica, San Jose, Costa Rica; and Jesús Armando Ugalde Gómez, INBio, Santo Domingo de Heredia, Costa Rica, for allowing me to study their Ammophilini. Frank Parker, also at Utah State University, sorted through his extensive Costa Rican material housed at the University, and sent interesting specimens to me for study. Colin Vardy, The Natural History Museum,

London, lent types for study. Depositories for types and other material listed in this paper are identified by city names in capital letters. These institutions are listed below.

The Natural History Museum, London, England (LONDON).

Zoologiska Institutionen, Lund, Sweden (LUND).

Università di Torino, Torino, Italy (TURIN).

Museo Civico di Storia Naturale, Genova, Italy (GENOA).

Museum für Naturkunde der Humboldt-Universität zu Berlin, Berlin, Germany (BERLIN).

Academy of Natural Sciences, Philadelphia, Pennsylvania (PHILADELPHIA).

National Museum of Natural History, Washington D.C. (WASHINGTON).

Bee Biology and Systematics Laboratory, Utah State University, Logan, Utah (LOGAN).

KEY TO GENERA AND SPECIES OF AMMOPHILINI IN COSTA RICA

1. Sternum I not tapering distad (ventral view), meeting and often overlapping base of II (Fig. 2); spiracle of tergum I located before apex of sternum I (lateral view, Fig. 1) 2
Podalonia Fernald
- Sternum I tapering distad, not reaching base of II, intervening space usually long and consisting of membrane and a ligament (Fig. 4); spiracle of tergum I (lateral view) usually located at or beyond level of sternum I apex (Fig. 3) 3
2. Female: gaster red, free margin of clypeus with four, large, irregular teeth; male terga I-II broadly black (red only laterally), III nearly all black; Guanacaste Province at elevations below 600 m *P. montana* (Cameron)
- Female: entirely black, free margin of clypeus without teeth; male terga I-III entirely red (III may be narrowly black distally); generally at elevations of 1000 m or more *P. atriceps* (Smith)
3. Episternal sulcus curving posterad from subalar fossa to scrobe, then extending obliquely ventrad to anteroventral area of mesopleuron (Figs. 5, 7); entirely black wasps with conspicuous spots of appressed silver setae on mesopleuron and propodeal side 4
Eremnophila Menke
- Episternal sulcus extending straight down from subalar fossa (Fig. 6), not curving toward scrobe (area in front of scrobe may be depressed, connecting with episternal sulcus), sulcus sometimes ending at level of pronotal lobe (Fig. 9); abdominal terga I-II often red; side of thorax with or without conspicuous spots of appressed silver setae 6
4. Scutum anteromedially with large area of appressed silver or golden setae, surface anterolaterally densely transversely carinate; male sternum VIII with prominent median tubercle; Guanacaste Prov *E. aureonotata* (Cameron)

- Scutum without appressed silver or golden setae, surface punctate anterolaterally; male sternum VIII without tubercle; widespread in Costa Rica 5
- 5. Setae forming appressed silver mesopleural spot arranged in a swirled, circular pattern (Figs. 7-8); mesopleuron with digiform or conical tubercle anteroventrally (Figs. 7-8); male gastral sternum I (not petiole) flat in lateral profile *E. opulenta* (Lepeletier)
- Setae forming silver mesopleural spot arranged in sinuate pattern; mesopleuron with angular bulge anteroventrally; male gastral sternum I with angular bulge at distal third in lateral profile *E. melanaria* (Dahlbom)
- 6. Pronotal collar and scutum coarsely, transversely ridged; Guanacaste Province *A. procera* Dahlbom
- Pronotal collar and scutum smooth, not cross-ridged; widespread in Costa Rica 7
- 7. Erect setae of head and thorax pale; mesopleuron with linear band of appressed silver setae (usually sharply defined) that extends along mesopleural suture from base of mid-coxa to just beneath tegula (Fig. 6); episternal sulcus ending at level of scrobe (Fig. 9) *A. picipes* Cameron
- Erect setae of head and thorax black; mesopleuron with broad, non-linear silver spot adjacent to mesopleural suture, or appressed mesopleural setae sparse, not forming a discrete silver band or spot; episternal sulcus extending past level of scrobe to ventral region of mesopleuron (Fig. 6) 8
- 8. Female, abdomen with six visible terga 9
- Male, abdomen with seven visible terga 10
- 9. Mesopleural silver spot larger than pronotal lobe, broadly triangular, extending from scrobe to near midcoxa; abdominal terga I-II usually partially to largely red (rarely all black); black part of abdomen without bluish-green tint *A. centralis* Cameron
- Mesopleural silver spot, if present, usually smaller than pronotal lobe, located next to midcoxa (spot rarely extending to level of scrobe as a narrow band); abdomen black; body, especially abdomen, with bluish-green tint *A. gaumeri* Cameron
- 10. Apex of gonoforceps drawn out into a long, narrow, parallel-sided and largely asetose process that is longer than outer spur of hindtibia, and truncate apically; edge of gonoforceps lateral to base of apical process fringed with one to three long, slender, pale setae (Fig. 10) *A. centralis* Cameron
- Apex of gonoforceps extended as a fingerlike, incurved lobe, acuminate apically, its outer edge densely fringed with short setae; edge of gonoforceps lateral to base of lobe fringed with many long, stout, black setae (Fig. 11) *A. gaumeri* Cameron

AMMOPHILA W. Kirby

Fernald's (1934) revision of the North American and Mexican members of this genus is of little use for various reasons. Murray (1938) clarified the status of a few species and provided a partial key. I (Menke, 1964a, b, 1965, 1966b, 1967, 1970) described many new species, established species groups, and new synonymy, but my revision of the New World fauna is still in progress. The four Costa Rican species are divided among three species groups: *picipes* Cameron is in the *urnaria* group (Menke, 1966b), *procera* is in the *procera* group (Menke, 1964a), and *centralis*

Cameron and *gaumeri* Cameron belong to the *nigricans* group (Menke, 1970).

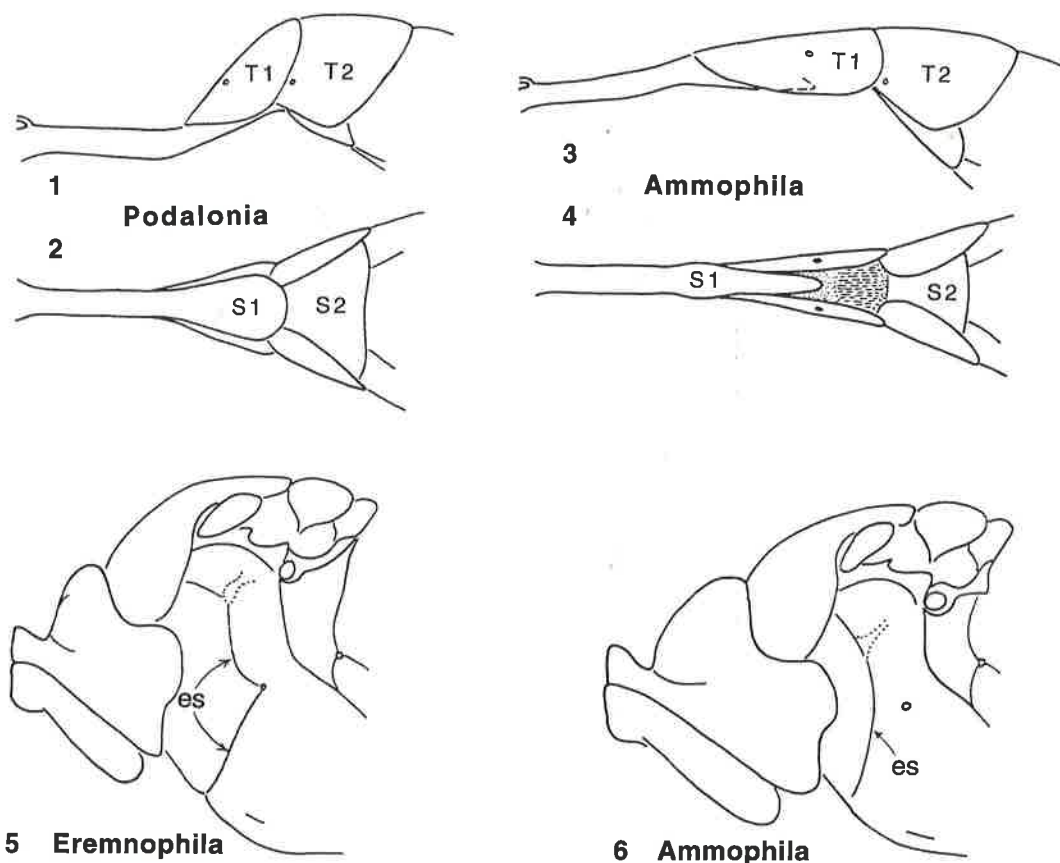
Ammophila centralis Cameron (Fig. 10)

Ammophila centralis Cameron, 1888:6. Lectotype: male, El Reposo, Guatemala (LONDON), designated by Menke, 1976:151.

Ammophila consors Cameron, 1888:12. Lectotype: male, N. Yucatán, México (LONDON), designated by Menke, 1976:151. **New synonym.**

Ammophila nigrocaerulea Cameron, 1888:12. Syn-types: females, San Gerónimo, Guatemala (LONDON). **New synonym.**

Ammophila centralis occurs from ex-



Figs. 1-6. Figs. 1-2. First two abdominal segments of *Podalonia*. 1, lateral profile; 2, ventral view. Figs. 3-4. First two abdominal segments of *Ammophila*. 3, lateral profile; 4, ventral view. Figs. 5-6. Lateral view of offthorax showing episternal sulcus (es). 5, *Eremnophila*; 6, *Ammophila*.

treme southern Texas (Hidalgo and Cameron Counties) through Central America. I have also collected the species in xeric areas of northwestern Venezuela (Zulia: 6 km W La Concepcion; Lara: 20 km E Carora; and Aragua: Ocumare de la Costa) and even in the Orinoco River basin of that country (Guarico: Hato Masaguaral, 44 km S Calabozo, see Menke & Carpenter, 1985). In Costa Rica *centralis* has been collected in Guanacaste and San José Provinces. In Guanacaste Province *centralis* reaches its highest population levels during the rainy season (Menke and Parker, 1996).

I studied the type material of Cameron's three names in 1964, and listed *consors* and

nigrocaerulea as synonyms of *centralis* (Menke, 1976), but I did not indicate that the synonymy was new. I do so now. Occasional females of *centralis* are entirely black and are thus similar to the all black *gaumeri*. Black females of *centralis* have a broad triangular patch of appressed silver setae on the mesopleuron, and the body lacks the bluish tint common in *gaumeri*. In *gaumeri* the mesopleural silver patch is located near the midcoxa and typically is smaller than the pronotal lobe. The first gastral segment of most females of *centralis* is largely red, as is tergum I (petiole). The male genitalia of *centralis* (Fig. 10) readily separate this species from males of *gaumeri* (Fig. 11).

***Ammophila gaumeri* Cameron**
(Fig. 11)

Ammophila gaumeri Cameron, 1888:4. Lectotype: female, N. Yucatán, México (LONDON), designated by Menke, 1976:152.

Ammophila micans Cameron, 1888:5. Syntypes: females, San Gerónimo, Guatemala (LONDON). Synonymy by Fernald, 1934:114.

Ammophila gaumeri ranges from tropical México to the xeric regions of northwestern Venezuela, but it is never as commonly collected as *centralis* with which it is easily confused. In Costa Rica the species is known only from Guanacaste Province (Menke, 1991, Menke and Parker, 1996). The Venezuelan records for *gaumeri* have never been published, but in 1976 and 1981 I collected it in the states of Aragua (Ocumare de la Costa) and Zulia (Los Angeles del Tucuco) (WASHINGTON).

This species is entirely black, and females in fresh condition have areas of microsetae with a bluish caste. This is particularly noticeable on the gaster, mesopleuron, and thoracic dorsum. In addition, females usually have only a small patch of appressed silver setae on the mesopleuron, and it is near the midcoxa. This patch is usually smaller than the pronotal lobe. In one female from Costa Rica the patch is expanded upward along the mesopleural suture and extends onto the hypopimeral area (Estación Experimental Enrique Jiménez Nuñez, 20 km SW of Cañas, Guanacaste Prov.; LOGAN). Males of *gaumeri* and *centralis* are very similar, but the genitalia readily separate them (see Figs. 10–11).

I examined Cameron's types of *micans* in 1964 and confirm Fernald's synonymy with *gaumeri*.

***Ammophila picipes* Cameron**
(Fig. 9)

Ammophila picipes Cameron, 1888:11. Holotype: male, Temax, Yucatán, México (LONDON).

Ammophila alticola Cameron, 1888:10. Holotype: male, Volcán de Chiriquí, Panamá (LONDON). Synonymy by Menke, 1965:2392.

Ammophila volcanica Cameron, 1888:17. Holo-

type: female, Volcán de Chiriquí, Panamá (LONDON). Synonymy by Menke, 1965:2392.

Ammophila chiriquensis Cameron, 1888:18. Holotype: female, Volcán de Chiriquí, Panamá (LONDON). Synonymy by Menke, 1965:2392.

Ammophila picipes occurs from northern Panamá to Texas and southern Arizona, and it is the most commonly collected species of *Ammophila* in Costa Rica. It is a dry season species, at least in Guanacaste Province (Menke and Parker, 1996).

The long band of appressed silver setae on the mesopleuron is distinctive (Fig. 9), but in some females of *picipes* from higher elevations the appressed silver pubescence of the mesopleuron (and propodeal side) is more extensive (San Isidro General, Puntarenas Prov., 600 m, LOGAN). In these specimens the setal patches of the mesopleuron and propodeal side lose their sharp margins because the integument is generally fairly densely covered with appressed silver setae. Even the scutum and propodeal dorsum are often silvery in such material. Most of the *picipes* that I have seen from Panamá have this expanded coverage of appressed silver setae on the thorax.

Ammophila picipes is similar to the widespread, common South American species *gracilis* Lepeletier, but until both can be thoroughly studied, I consider them distinct.

***Ammophila procera* Dahlbom**

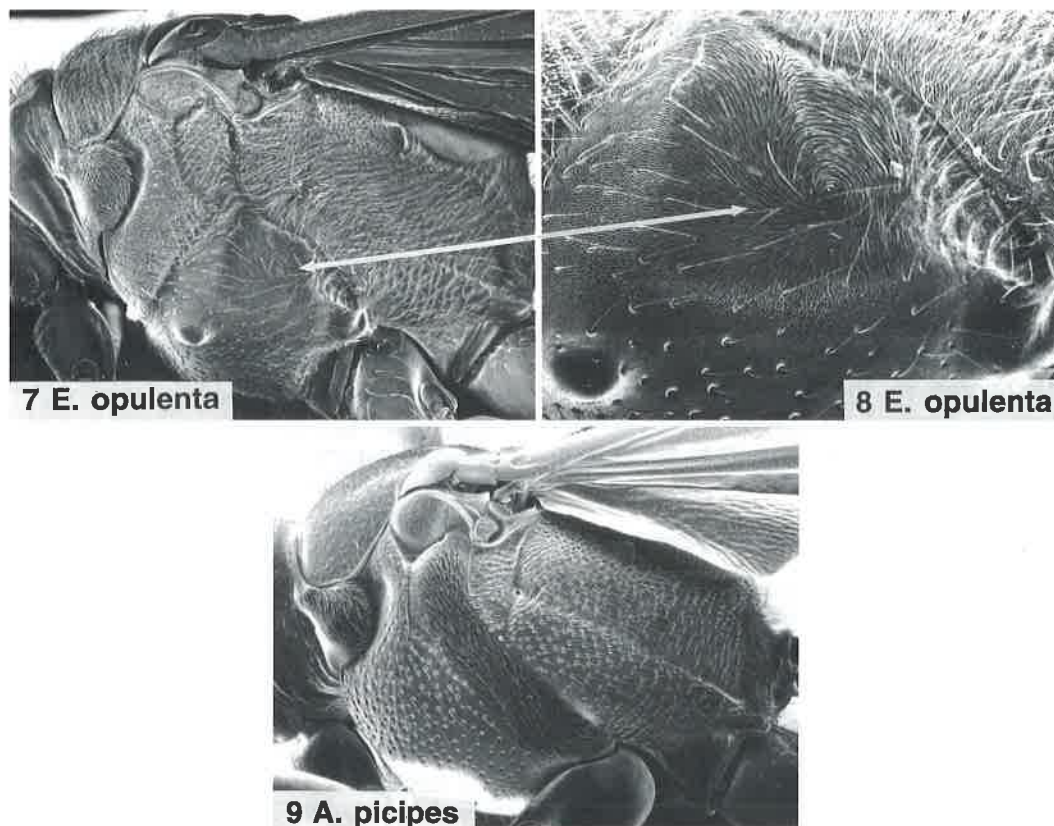
Ammophila procera Dahlbom, 1843:15. Holotype: female, "N. America" (LUND).

Ammophila procera Lepeletier, 1845:376. Holotype: female, "Am. Sept." (TURIN), nec Dahlbom, 1843. Synonymy by Menke, 1965:2392.

Ammophila saeva Smith, 1856:222. Lectotype: female, California (LONDON), designated by Menke, 1976:153. Synonymy by Fernald, 1934:44.

Ammophila gryphus Smith, 1856:222. Lectotype: female, Charlston, Florida (LONDON), designated by Menke, 1976:153. Synonymy by Fernald, 1934:44.

Ammophila barbata Smith, 1873:260. Syntypes:



Figs. 7-9. Fig. 7. Scanning electron photomicrographs of left side of thorax. 7-8, *Eremnophila opulenta*, 8 is closeup of whorled setae; 9, *Ammophila picipes*.

females, México (missing). Synonymy by Fernald, 1934:44.

Ammophila ceres Cameron, 1888:8. Holotype: male, San Gerónimo, Guatemala (LONDON). Synonymy by Fernald, 1934:44. Menke (1976:153) unnecessarily designated this specimen as lectotype.

Ammophila championi Cameron, 1888:9. Lectotype: female, San Gerónimo, Guatemala (LONDON), designated by Menke, 1976:153. Synonymy by Fernald, 1934:44.

Ammophila striolata Cameron, 1888:10. Holotype: female, Ventanas, Durango, México (LONDON). Synonymy by Fernald, 1934:44.

Ammophila procera is found throughout North America, and its range extends from southern Canada southward through México and into Central America. It occurs as far south as Costa Rica (Menke, 1991), where it is known only from Guan-

acaste Province (Estacion Experimental Enrique Jimenez Nuñez, 20 km SW Cañas; Finca Jenny, 30 km N Liberia. This is probably about the southern limit of its range.

The cross-ridged scutum and pronotal collar of *procera* are unique features among Costa Rican *Ammophila* and immediately identify it.

I examined the type material of all of the Smith (except *barbata*) and Cameron names in the above synonymy in 1964 and can confirm Fernald's synonymy. As to *barbata*, Smith's description strongly suggests that it is a synonym of *procera*. It is apparently an example of the entirely black *procera* occasionally found in México. Searches for type material of *barbata* at the Natural History Museum in London and the Museum at Oxford have been fruitless.

EREMNOPHILA Menke

This genus is endemic to the New World, but eight of its nine species are restricted to the Neotropical Region. I reviewed the genus (as a subgenus of *Ammophila*), segregated the species into groups, and keyed the species (Menke, 1964c). *Eremnophila* was subsequently elevated to genus (Menke, 1966a). Three species are currently known in Costa Rica, but a fourth, *binodis* (Fabricius), may be discovered in the southern end of the country because it is known from central Panamá. *Eremnophila binodis* is a common wasp in South America.

Eremnophila aureonotata (Cameron)

Ammophila aureonotata Cameron, 1888:7. Lectotype: male, Valladolid, Yucatán, México (LONDON), designated by Menke, 1964:881.

This wasp occurs commonly in eastern North America east of the 100th meridian from southern Canada to Florida and Texas. I (Menke 1964) recorded *aureonotata* from México to El Salvador in Central America, and subsequently noted its presence in Guanacaste Province, Costa Rica (Menke 1991). It is likely that this is the southern limit of the range of *aureonotata*. I have not seen it from other parts of Costa Rica. Population levels of *aureonotata* are highest during the dry season in Guanacaste Province (Menke and Parker, 1996).

The South American species, *binodis*, occurs as far north as central Panamá, and it is similar to *aureonotata*. The scutum of *binodis* is cross carinate like *aureonotata* but *binodis* usually lacks the appressed gold setae found on the scutum of *aureonotata*. The male genitalia also differ (see illustrations in Menke, 1964c).

Eremnophila opulenta

(Guérin-Méneville)

(Figs. 7-8)

Ammophila opulenta Guérin-Méneville, 1838:261.

Holotype: female, Pará, Brasil (GENOA).

Ammophila bimaculigera Strand, 1910:129. Lec-

totype: female, Villa Morra, Paraguay (BERLIN), designated by Menke, 1964:878. Synonymy by Menke, 1964:878.

This large wasp occurs from tropical México to Argentina. In Costa Rica it is the least commonly collected species of *Eremnophila*. The mesopleural tubercle and whorled nature of the mesopleural silver patch (Figs. 7-8) easily identify this wasp.

Eremnophila melanaria (Dahlbom)

Ammophila melanaria Dahlbom, 1843:15. Lectotype male: "Brasilia" (LUND), designated by Menke, 1964:878.

Ammophila miliaris Cameron, 1888:3. Lectotype: female, Bugaba, Panamá (LONDON), designated by Menke, 1964:878.

Ammophila iridipennis Cameron, 1888:5. Lectotype: female, Zapote [= El Zapote], Guatemala (LONDON), designated by Menke, 1964:878.

Ammophila velutina Schrottky, 1910:31. Holotype: female, San Ignacio, Argentina, (location unknown, possibly destroyed). Synonymy tentative.

Ammophila lobicollis Cameron, 1912:428. Holotype: female, Demerara, British Guyana (LONDON). Synonymy by Menke, 1964:878.

Eremnophila melanaria ranges from tropical México south to Argentina. The species is generally distributed in Costa Rica, and is most commonly collected in the wet season in Guanacaste Province (Menke and Parker, 1996).

It is still not clear whether the South American population of *melanaria* is distinct from the Central American one. As I mentioned and illustrated (Menke, 1964c), there appear to be slight differences between these populations in the male genitalia. I am still unable to resolve this problem, but if the Central American material proves to represent a separate species, the name *miliaris* (Cameron) would apply, with *iridipennis* as a synonym.

Unless Schrottky's material of *velutina* can be found, the status of the species will remain in doubt. However, the name is either a synonym of *melanaria* or *opulenta*.

Podalonia Fernald

Murray (1940) revised this genus for the New World. He recorded two species from Costa Rica, *communis* Cresson and *robusta* (Cresson). *Podalonia communis* is a commonly collected wasp in the western half of North America and it extends south to Costa Rica, but as I relate below, the proper name for the species is *atriceps* Smith. *Podalonia robusta* was recorded from Costa Rica by Murray based on one male specimen, but as I demonstrate below, his record is erroneous. The specimen is actually *atriceps*. Menke and Parker (1996) reported the first record of *Podalonia montana* Cameron in Costa Rica. Thus, there are still two species of the genus in the country, *atriceps* and *montana*.

***Podalonia atriceps* (Smith), new status**
(Figs. 12-19, 21-23)

Ammophila atriceps Smith, 1856:221. Female, male, México. Lectotype: male, designated by Menke, 1976:144. (LONDON).

Ammophila communis Cresson, 1865:462. 40 males, Colorado Territory. Lectotype: male designated by Cresson, 1916:94. (PHILADELPHIA). **New synonym.**

Ammophila alpestris Cameron, 1888:21. Syntypes: males, Volcán de Chiriquí, 4000-6000 feet, Panamá. (LONDON). **New synonym.**

Ammophila piceiventris Cameron, 1888:22. Holotype: female, Quezaltenango, Guatemala, 7800 feet (LONDON). Tentative synonymy.

Podalonia communis intermedia Murray, 1940:29. Holotype: male, Distrito Federal, México (WASHINGTON). **New synonym.**

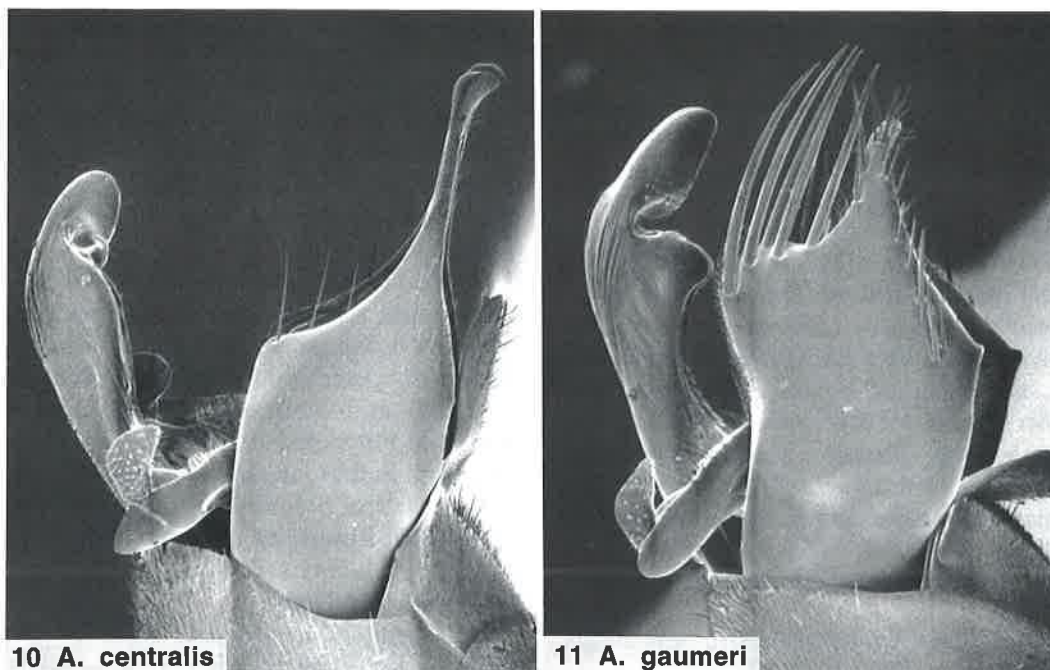
In *Sphecid Wasps of the World* (Bohart and Menke, 1976) I listed *atriceps* (Smith) as a subspecies of *communis* with *alpestris* as a synonym (I should have added "new synonym"). This presentation of facts was erroneous in two ways. First, Smith's *atriceps* is the oldest available name and must be used for the species. Second, the lectotype of *atriceps* is not identical with the syntypes of *alpestris* although they appear to be conspecific. I studied syntypes of both taxa in 1964 at The Natural His-

tory Museum, London and can confirm that the genitalia of *alpestris* agree with those of *atriceps* (Figs. 12, 16). However, specimens of *atriceps* from Costa Rica and Panamá have erect pale setae on the male clypeus (all black in typical *atriceps*), and the name *alpestris* was based on this population.

Smith (1856) described *atriceps* from a female and a male. Since he did not designate a holotype in the original description, both specimens are syntypes. Fernald (1927:35) and Murray (1940:30) studied the male but noted the female was missing. Both authors mistakenly regarded the female as the holotype, and Murray declared that it must be an *Ammophila*. Consequently Murray did not apply the name *atriceps* in *Podalonia*.

My designation (Menke 1976) of the male as lectotype resulted in the assignment of *atriceps* to *Podalonia*. The genitalia of the lectotype agree with the traditional interpretation of *communis* (Murray 1940). In fact, Murray noted that the genitalia of Smith's male of *atriceps* were identical to *communis*, and furthermore, that the male of *atriceps* was conspecific with Cameron's *alpestris*.

Murray treated *alpestris* as a Costa Rican/Panamanian subspecies of *communis* (i.e., *atriceps*) because of slight external morphological differences. The female clypeus was "... slightly more bulging in the middle than in typical *communis*" and the arolium was "... large, being considerably larger than in typical *communis* and almost as large as in *violaceipennis*." These female differences do not withstand scrutiny. The size of the arolium depends on the degree of its inflation, and the convexity of the clypeus varies. Murray differentiated the male of *alpestris* from *communis* by the presence in the former of erect white setae on the clypeus (all black in *communis*). The pale clypeal setae of the male differentiates the Costa Rican/Panamanian *alpestris* from typical *atriceps*. In addition, the erect setae on the gena are also pale in *al-*



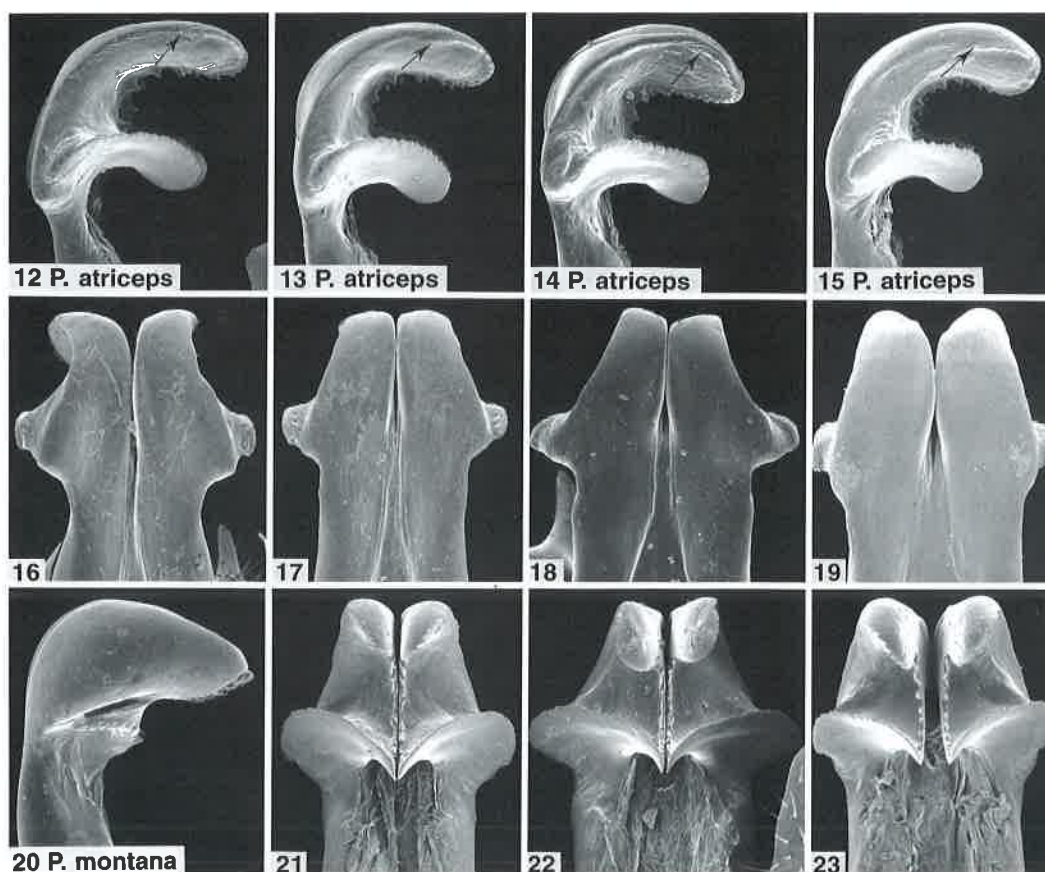
Figs. 10–11. Scanning electron photomicrographs of male genitalia of *Ammophila* in lateral profile. 10, *A. centralis* (30 km n Liberia, Guanacaste Prov. Costa Rica), 11, *A. gaumeri*. (Quezaltepeque, El Salvador).

pestris (unlike *atriceps*). The erect setae of the male thoracic pleura are extensively pale in *alpestris*, and even the coxae and lateral areas of the pronotal collar and scutum sometimes have pale erect setae. In typical *atriceps* pale setae are restricted to the pleura and are often intermixed with black setae. Murray (1940:31) also noted that the shape of the male clypeus varied in *alpestris*, some specimens looking like typical *atriceps*, others being more broadly truncate. I have examined the large series of males from La Carpentera [1200–1800m], Costa Rica, collected by W. Mann in April 1924 (WASHINGTON) studied by Murray, and can confirm the clypeal variation, but most specimens are more or less typical of *atriceps*. Perhaps this variation is to be expected at the extreme southern end of the species' range.

One male from La Carpentera was misidentified by Murray (1940:64) as *robusta* (Cresson). Apparently Murray misassociated the genitalia of this specimen with

those from a male of *robusta*, and on that basis erroneously recorded Cresson's species from Costa Rica.

I have studied the holotype of Cameron's *piceiventris*, as well as three females from Totonicapam, Guatemala, mentioned in the original description as "probably referable to the same species." There is also another female from the type locality, and it, and the Totonicapam specimens, are smaller (13–15 mm long) than the type (19 mm), and entirely black. These four are undoubtedly examples of *atriceps*, but the identity of the holotype of *piceiventris* is puzzling. Murray (1940), who did not study the type, treated it as a questionable synonym of *communis* (i.e., *atriceps*). The problem with this specimen is that abdominal terga II–V are amber rather than black as noted by Cameron and shown by his figure 7 on plate II. Small areas of the thorax, especially the pronotum and legs, have similar coloration. The holotype may simply have been collected in some type of flu-



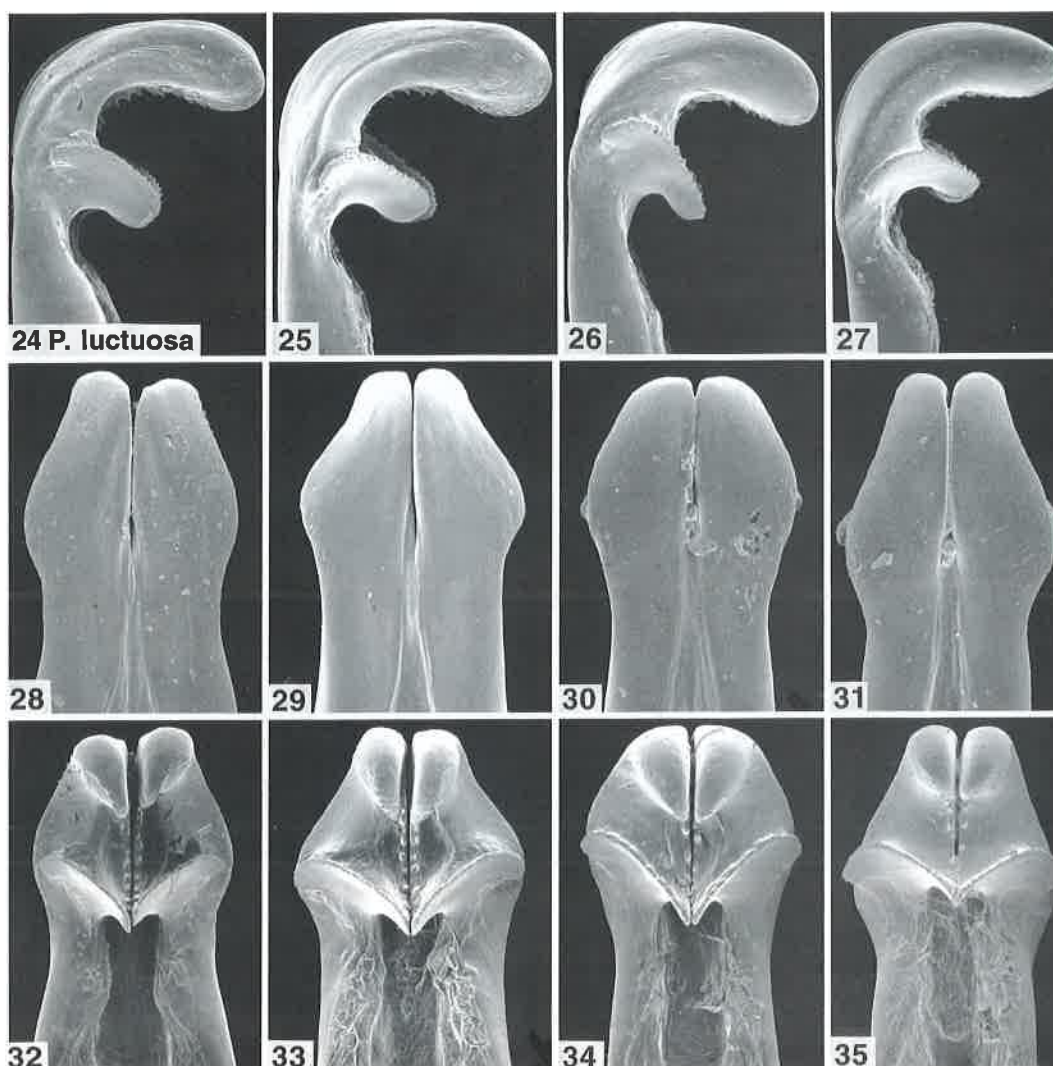
Figs. 12–23. Scanning electron photomicrographs of male genitalia of *Podalonia*, all but 20 are *atriceps*. 12–15, penis valve head in lateral profile (arrow marks end of row of teeth); 12, specimen from Volcan de Chiriquí, Panamá; 13, specimen from La Carpintera, Costa Rica; 14, specimen from Paria Canyon, Arizona; 15, specimen from Boulder, Colorado. 16–19, dorsal view of penis valve head shown in 12–15, respectively. 20, penis valve head of *P. montana* in lateral profile, specimen from Ahuacatlan, México. 21–23, ventral view of penis valve head shown in 13–15, respectively.

id that brought on discoloration, because the specimen otherwise looks like *atriceps*.

Murray's (1940:29) description of the subspecies *Podalonia communis intermedia* was based on a single male from the Federal District of México. It differs from North American material of the species, and from the Costa Rican/Panamanian population, in having an entirely black abdomen. I have examined the holotype (WASHINGTON) and agree with Murray that the genitalia are identical with those of *communis* (i.e., *atriceps*, see Figs. 12–13, 16–17). I have also found five additional males

of this taxon from San Marcos, Guatemala, elevation 3052 m (WASHINGTON), and one male from Cerro Verde, El Salvador (WASHINGTON). Apparently it is a melanistic, high altitude form of *atriceps*. The erect body setae are black except on the mesopleura where pale and black setae are mixed just as in males of typical *atriceps*. It is likely that Murray's *intermedia* is a junior synonym of *piceiventris* Cameron, described from 7800' in Guatemala, but males of the latter will have to be collected at the type locality to settle the matter.

The range of *atriceps* includes the west-



Figs. 24-35. Scanning electron photomicrographs of male genitalia of *Podalonia luctuosa*. 24-27, penis valve head in lateral profile (arrow marks end of row of teeth); 24, specimen from Hallelujah Junction, California; 25, specimen from Shoshone, Idaho; 26, specimen from "Cochetopa Natl. Forest", (probably Saguache Co.), Colorado; 27, specimen from Powell, Wyoming. 28-31, dorsal view of penis valve head shown in 24-27, respectively. 32-35, ventral view of penis valve head shown in 24-27, respectively.

ern half of North America, the central plateau of México, and Central America as far south as northern Panamá. Apparently it occurs only at high elevations in Mesoamerica, and differences between such isolated populations are to be expected. *Podalonia* has been poorly sampled in Central America; thus, I feel it would be premature to recognize the Costa Rican/Panamanian

alpestris and Mexican/Guatemalan/El Salvadoran *intermedia* (= *piceiventris*?) as subspecies of *atriceps*.

Podalonia atriceps is similar to *P. luctuosa* (Smith), another common North American species that is sympatric in the west, but which occurs across the continent in the north. In fact, Murray (1940) had difficulty separating females of *luctuosa* and *com-*

munis (i.e., *atriceps*). Of the separating features in couplet 29 of his key, only the deeply impressed frontal line of female *luctuosa* seems to separate it reliably from females of *communis* (i.e., *atriceps*) in which the frontal line is not impressed. But this difference may be artificial and needs careful scrutiny. The only differences between males of the two species are clypeal shape and structure of the penis valve (compare Figs. 12–14, 16–18, and 24–31). I have examined the material of both taxa in the collection of the National Museum of Natural History, Washington D.C., much of it identified by Murray, and there seems to be variation in the form of the male clypeus and penis valves of both species. The clypeal margin in *luctuosa* was said by Murray to be "more or less broadly transverse". By that he meant the straight or slightly concave portion of the free margin was broader than in *atriceps*. Generally this is true, but when many specimens are examined, the distinction is not always clear. The male genitalia appear more reliably diagnostic. The essential difference is the shape of the penis valve in dorsal outline. In *atriceps* the outer edge is abruptly angled at the point where the ventral toothed flange ends dorsad (Figs. 16–18). In *luctuosa* the outer edge of the penis valve is an uninterrupted arc at this point (Figs. 28–31). Another apparent difference is seen in the fringe of teeth along the inner, ventral margin of the penis valve head. In *atriceps* this row of teeth passes around the lower end of the penis valve head and extends dorsad for some distance (Figs. 12–15). In *luctuosa*, this row of teeth does not extend as far dorsad (Figs. 24–27). Examination of the penis valves of many males of *luctuosa* and *atriceps* from North America has demonstrated to me that in occasional specimens the dorsal outlines described above are not always clearly diagnostic (for example, see Fig. 19). However, in such doubtful cases, the fringe of teeth along the inner, ventral margin of the penis

valve head seems to be reliable for discrimination. Nonetheless, the separation of *atriceps* and *luctuosa* should be studied further.

***Podalonia montana* (Cameron) (Fig. 20)**

Ammophila montana Cameron, 1888:20. Holotype: male, Ventanas, Durango, México, 4000' (LONDON).

Ammophila jason Cameron, 1888:20. Holotype: female, San Gerónimo, Guatemala (LONDON). Synonymy by Murray, 1940:46.

Ammophila quadridentata Cameron, 1888:23. Holotype: female, Ventanas, Durango, México (LONDON). Tentative synonymy by Murray, 1940:46, confirmed here.

Bohart and Menke (1976) list this large wasp from México and Guatemala, and I have seen material from Nicaragua (WASHINGTON). Menke and Parker (1996) recorded *montana* from Costa Rica based on a single male and three females from Finca Montezuma, Guanacaste Province (LOGAN). Guanacaste Province may prove to be the southernmost range of *montana*. Collecting times were February and March suggesting that *montana* may be a dry season species.

The irregularly toothed female clypeus immediately identifies this sex of *montana*. The male abdominal terga of *montana* are black except I and II are red laterally. In males of *atriceps* terga I and II are entirely red. The penis valve heads of the male genitalia of these two species differ markedly (compare Figs. 12, 20).

I examined the type material of Cameron's three names in 1964 and confirm Murray's (1940) synonymy.

ACKNOWLEDGMENTS

Woj Pulawski, California Academy of Sciences, San Francisco, California; Frank Parker, Fernley, Nevada; Paul Hanson, Universidad de Costa Rica, San José, Costa Rica; and Douglas Ferguson and Ronald Hodges, Systematic Entomology Laboratory, USDA, Washington D.C., critically read the manuscript. Their help is much appreciated.

LITERATURE CITED

- Bohart, R. M. and A. S. Menke. 1976. *Sphecid wasps of the world, a generic revision*. University of California Press, Berkeley. ix + 695 p.
- Cameron, P. 1888. Insecta, Hymenoptera, vol. 2 (Fossorial), p. 1-32 in: Godman and Salvin, *Biologia Centrali-Americana*, Taylor and Francis, London.
- Cameron, P. 1912. The Hymenoptera of the Georgetown Museum. Part IV. The Fossorial Hymenoptera. *Timehri: The Journal of the Royal Agricultural and Commercial Society of British Guiana* (3) 2(2): 413-440.
- Cresson, E. T. 1865. Catalogue of Hymenoptera in the collection of the Entomological Society of Philadelphia, from the Colorado Territory. *Proceedings of the Entomological Society of Philadelphia* 4:426-488.
- Cresson, E. T. 1916. The Cresson types of Hymenoptera. *Memoirs of the American Entomological Society* (1):1-141.
- Dahlbom, A. G. 1843. Fascicle I, pp. 1-172 in: *Hymenoptera Europaea praecipue borealia*. Lundbergiana, Lund.
- Fernald, H. T. 1927. The digger wasps of North America of the genus *Podalonia* (*Psammodromia*). *Proceedings of the U. S. National Museum* 71(9):1-42.
- Guérin-Ménéville, F. E. 1838. Crustacés, arachnides et insectes, p. 57-319 in: Duperrey, *Voyage autour du monde, exécuté par ordre du Roi, sur la Corvette de sa Majesté, la Coquille, pendant 1822-1825*. Vol. 2 (Zoologie). A. Bertrand, Paris. (dating from Cowan, 1970, *Journal for the Society for the Bibliography of Natural History* 5:358-360).
- Hanson, Paul and Ian Gauld. 1995. *The Hymenoptera of Costa Rica*. Oxford University Press, Oxford. 893 p.
- Hanson, Paul, and A. S. Menke. 1995. Chapter 17, The Sphecid Wasps (Sphecidae), p. 621-649 in: *The Hymenoptera of Costa Rica*, Hanson and Gauld, editors. Oxford University Press, Oxford. 893 p.
- Lepeletier de Saint-Fargeau, A. 1845. *Histoire naturelle des insectes. Hyménoptères*. Vol. 3, 644 p. Roret, Paris.
- Menke, A. S. 1964a. New species of North American *Ammophila* (Hymenoptera, Sphecidae). *Acta Hymenopterologica* 2(1):5-27 (dated Dec. 1, 1963 in error, proof was read Dec. 31, 1963 and copies mailed in March 1964).
- Menke, A. S. 1964b. Miscellaneous notes on *Ammophila* (Hymenoptera, Sphecidae). *Entomological News* 75:149-155.
- Menke, A. S. 1964c. A new subgenus of *Ammophila* from the Neotropical Region (Hymenoptera: Sphecidae). *Canadian Entomologist* 96:874-883.
- Menke, A. S. 1965. A revision of the North American *Ammophila* (Hymenoptera, Sphecidae) (abstract). *Dissertation Abstracts* 26(4):2392.
- Menke, A. S. 1966a. The genera of the Ammophilini (Hymenoptera: Sphecidae). *Canadian Entomologist* 98:147-152.
- Menke, A. S. 1966b. New species of North American *Ammophila*, part II (Hymenoptera, Sphecidae). *Proceedings of the Biological Society of Washington* 79:25-39.
- Menke, A. S. 1967. New species of North American *Ammophila*, part III (Hymenoptera, Sphecidae). *Los Angeles County Museum, Contributions in Science* (123):1-8.
- Menke, A. S. 1970. The genus *Ammophila* in the West Indies (Hymenoptera: Sphecidae). *Proceedings of the Entomological Society of Washington* 72:236-239.
- Menke, A. S. 1976. Tribe Ammophilini, p. 134-154 in: Bohart and Menke, *Sphecid wasps of the world, a generic revision*. University of California Press, Berkeley. ix + 695 p.
- Menke, A. S. 1991. Waspings in Costa Rica—1991. *Sphecos* 22:10-12.
- Menke, A. S. and J. Carpenter. 1985. Hato Masaguaral, Venezuela (or the adventures of the Mud D'aub and Duncan YoYo). *Sphecos* 10:31-33.
- Menke, A. S. and F. Fernández. 1996. Claves ilustradas para las subfamilias, tribus y géneros de esfécidos neotropicales (Apoidea: Sphecidae). *Revista de Biología Tropical*.
- Menke, A. S. and F. D. Parker. 1996. Phenology of ammophiline wasps in a premontane wet forest in Costa Rica (Hymenoptera, Sphecidae, Ammophilini). *Journal of Hymenoptera Research* 5: 184-189.
- Murray, W. D. 1938. Some revisions in the genus *Spheg*, with one new species, a new subspecies, and a new name (Hymenoptera: Sphecidae). *Annals of the Entomological Society of America* 31:17-43.
- Murray, W. D. 1940. *Podalonia* (Hymenoptera: Sphecidae) of North and Central America. *Entomologica Americana* 20(1-2):1-82.
- Schrottky, C. 1910. Neue Arten der Hymenopteren-gattung *Ammophila* aus Argentinien. *Societas Entomologica* 25:30-32.
- Smith, F. 1856. *Catalogue of hymenopterous insects in the collection of the British Museum, part IV, Sphecidae, Larridae, and Crabronidae*, p. 207-497. London.
- Smith, F. 1873. Descriptions of new species of Hymenoptera in the collection of the British Museum, and of a species of the rare genus *Iswara* belonging to the family Dorylidae. *Annals and Magazine of Natural History* (4)12:253-260.
- Strand, E. 1910. Beiträge zur Kenntnis der Hymenopterenfauna von Paraguay auf Grund der Sammlungen und Beobachtungen von Prof. J. D. Anisits. I. Crabronidae. *Zoologischen Jahrbüchern, Abteilung für Systematik, Geographie und Biologie der Tiere* 29(2):125-178.