

BULLETIN OF THE CALIFORNIA INSECT SURVEY
Volume 26

California Spider Wasps of the Subfamily Pompilinae

(Hymenoptera: Pompilidae)

by M. S. Wasbauer and L. S. Kimsey

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OF THE SUBFAMILY POMPILINAE

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CALIFORNIA SPIDER WASPS OF THE SUBFAMILY POMPILINAE (Hymenoptera: Pompilidae)

by

M.S. Wasbauer and L.S. Kimsey

INTRODUCTION

THE POMPILINAE are worldwide in distribution and comprise the largest subfamily of Pompilidae in America north of Mexico. In North America, the subfamily contains 141 species in 18 genera as compared with a total of 124 species in 13 genera for the Pepsinae and 25 species in 3 genera for the Cero-palinae. California has a large and diverse fauna of Pompilinae, with 15 genera and 79 species. Thus 56% of the pompiline species of the United States and Canada occur within the boundaries of this state.

There has been little concurrence throughout the world on a tribal classification of the subfamily. Even workers dealing strictly with the Nearctic fauna have produced somewhat differing tribal arrangements. Bradley (1944), for example, divided the Pompilinae into seven tribes. Banks (1947) abandoned the use of tribes entirely and Evans (1950, 1966) recognized two tribes, the Aporini and Pompilini based on fundamental morphological and biological differences. We use the latter system to treat the California Pompilinae, but have some doubt as to the position of *Psorthaspis* in the Aporini.

The basic color of the pompiline wasps is black, although in California *Tachypompilus* species, the majority of the body is red and in *Poecilopompilus*, yellow dominates. There are species scattered throughout the subfamily with combinations of black, red and/or yellow integumental markings. Most pompilines are clothed with a minute appressed pubescence which may be dull or, in some cases, may impart a brilliant blue or green caste to the entire insect. The wings are normally transparent, usually with a darker apex, or often entirely dark. A faint banding pattern is found in one California species.

Morphologically, the Pompilinae form a more or less discrete assemblage, characterized by splayed, unevenly spaced spines which are of unequal length at the apex of the posterior tibia; small spine pits dorsally near the apex of the posterior femur; and a small invagination at the posterior proximal corner of the third discoidal cell. The posterior tibia may bear spines dorsally but is never serrate and the second metasomal sternum is lacking a transverse groove.

BIOLOGY

With a few exceptions the Pompilinae are inhabitants of relatively open situations and are encountered in a variety of habitats such as sand dunes, dry washes, margins of streams and ponds, forest clearings and trails. Since they are fast flyers and move rapidly with long legs over low vegetation and along the ground, often they are inconspicuous and difficult to capture. Many appear reluctant to fly from the ground when a net is placed over them, preferring to seek refuge in a crevice or under vegetation, and darting away when the net is removed. Collecting even a small series of some of these more fugitive species can be a study in exasperation.

Since many species spend a large proportion of their time running along the ground or flying low over it, flight traps have proven a very successful means for capturing them. Interestingly, flight trap catches usually show a large preponderance of males. This is probably due to the fact that the females are often engaged in activities such as nest construction and provisioning.

All Pompilidae are restricted in prey selection to spiders. The majority of Pompilinae nest in the ground and provision each burrow with a single

	Filistata	FILISTATIDAE	Loxosceles	LOXOSCELIDAE	Aptostichus Bothriocryptum	CTENIZIDAE	Amaurobius	AMAUROBIIDAE	Gnaphosa Orodassus Herpyllus Callilepis	GNAPHOSIDAE	Clubiona	CLUBIONIDAE	Anaphaena	ANAPHAENIDAE	Xysticus Thanatus Misumenops	THOMISIDAE
<i>Aporus (Aporus) luxus</i> (Bks.) <i>Aporus (Plectraporus) hirsutus</i> (Bks.) <i>Psorthaspis planata</i> (Fox)					1 1 1											
<i>Tastiotenia festiva</i> Evans <i>Agenioideus (Gymnochaeres) birkmanni</i> (Bks.) <i>Agenioideus (Agenioideus) humilis</i> (Cress.)									1							
<i>Agenioideus (Ridestus) biedermani</i> (Bks.) <i>Episyron quinquenotatus hurdi</i> Evans <i>Episyron biguttatus californicus</i> (Bks.)			1													
<i>Episyron conterminus posterus</i> (Fox) <i>Episyron oregon</i> Evans <i>Episyron snowi</i> (Vier.)																
<i>Sericopompilus neotropicalis</i> (Cam.) <i>Poecilopompilus interruptus interruptus</i> (Say) <i>Anoplius (Lophopompilus) aethiops</i> (Cress.)																1
<i>Anoplius (Lophopompilus) cleora</i> (Bks.) <i>Anoplius (Arachnophroctonus) americanus ambiguus</i> (Dahlb.) <i>Anoplius (Arachnophroctonus) nigrinus</i> (Dahlb.)																
<i>Anoplius (Pompilinus) insolens</i> (Bks.) <i>Anoplius (Pompilinus) tenebrosus</i> (Cress.) <i>Anoplius (Pompilinus) cylindricus</i> (Cress.)															2	1
<i>Anoplius (Pompilinus) clystera</i> (Bks.) <i>Anoplius (Anoplius) ithaca</i> (Bks.) <i>Anoplius (Anoplius) imbellis</i> Bks.																
<i>Anoplius (Anoplius) toluca</i> (Cam.) <i>Anoplius (Anoplius) dreisbachi</i> Evans <i>Anoplius (Anoplius) fulgidus</i> (Cress.)																
<i>Pompilus (Perissopompilus) phoenix</i> Evans <i>Pompilus (Ammosphex) angularis angularis</i> (Bks.) <i>Pompilus (Ammosphex) anomalus anomalus</i> (Dreisb.)	1								2						1 1	
<i>Pompilus (Ammosphex) solonus solonus</i> (Bks.) <i>Pompilus (Ammosphex) luctuosus luctuosus</i> Cress. <i>Pompilus (Ammosphex) occidentalis</i> (Dreisb.)													1			
<i>Pompilus (Arachnospila) arctus</i> Cress. <i>Pompilus (Arachnospila) scelestus</i> Cress. <i>Pompilus (Arachnospila) fumipennis eureka</i> (Bks.)							2	1	1		1					
<i>Aporinellus taeniatus</i> (Kohl) <i>Aporinellus medianus</i> Bks. <i>Aporinellus basalis</i> Bks.																1
<i>Aporinellus completus</i> Bks. <i>Aporinellus yucatanensis</i> (Cam.)																1

Table 1. Summary of prey records for California Pompilinae

spider. The egg is glued to the abdomen of the prey. Most members of the tribe Pompilini construct a burrow in the ground with a single enlarged terminal cell, and females of many species are equipped with a comb of spines on the anterior tarsus to facilitate digging. Prey capture and part of transport activities characteristically take place before nest construction begins, but there are a number of exceptions to this. The Aporini attack subterranean spiders and utilize the burrow of their prey as a nest. In this tribe, a tarsal comb is lacking.

Although there have not been thorough studies of the biology of many species of Pompilinae, the indications are that these wasps vary greatly in prey specificity. Some, such as *Anoplius marginatus* (Say) of the eastern United States, prey on a wide range of mostly errant spiders in several families. *A. marginatus* has been reported transporting a harvestman. Others seem to be restricted to certain families of spiders. For example, females of the genera *Poecilopompilus* and *Episyron* are known to provision only with orb weavers, while those of *Tachypompilus* nearly always provision only with wolf spiders. Certain species, such as *Anoplius ithaca* (Banks) are adapted for relatively specific niches so the variety of prey available to them is necessarily limited. Table 1 summarizes current knowledge of prey selection in California Pompilinae by species of wasp and genus of spider arranged according to Kaston and Kaston (1953). All available records are included, some of which originate from parts of the ranges outside California.

Adults of some species feed at the exuding blood of spider prey, and some apparently capture prey specifically for feeding purposes. Adults of perhaps the majority of species feed, at least to some extent, on secretions from flowers and extrafloral nectaries of plants. Many are also attracted to honeydew secretions of various insects.

The only paper summarizing the scattered literature on the biology of Nearctic Pompilinae is that of Evans and Yoshimoto (1962). In addition, a number of original observations are included in this paper. Evans (1953a) has published an interesting article on ethological patterns in various groups of Pompilidae and the relationship of these patterns to systematics. For other works dealing with pompiline biology, see the excellent studies of Olberg (1959) and Iwata (1976).

TAXONOMIC METHODS

The Pompilidae are a difficult group, taxonomically, and the morphological homogeneity in the pompilines is such that generic separation is often based on slight differences. Biological criteria have

been of value in emphasizing the discreteness of some of the genera, but unfortunately, not enough biological information has accumulated to help with decision making at the specific level. In many Pompilinae, characteristics of the male terminalia are invaluable in separating species, and both the subgenital plate and the genital capsule (fig. 3) are sources of excellent characters.

In the females of many species, however, the only available characters are subtle differences in the shape of the head or relative lengths of various structures. Measurements of the head (fig. 2) are made in full frontal view, with the crest of the vertex in the same plane of focus as the apex of the clypeus. In designating parts of the body, we use the terms *mesosoma* and *metasoma* after Michener (1944). The veins and cells of the wing are labeled in accordance with the Jurine-Cresson system, in general use for aculeate Hymenoptera. A tarsal comb is present in females of many species of Pompilini. This is a rake-like arrangement of spines on the anterior tarsus and is considered present when there is a single spine on the outer side of the second tarsal segment which is as long as the spine at the apex of that segment (fig. 95). A moderate degree of sexual dimorphism in structural features is evident in the Pompilinae. For this reason, separate keys are provided, in most cases, for males and females. Females (fig. 1) have 12 segmented, usually convolute antennae, the metasoma with six visible sterna and a sting, which usually is visible. Males have 13 segmented, non-convolute antennae, the metasoma with seven visible sterna, and possess no sting.

The plant names taken from specimen data labels have been changed in the text, where necessary, to conform with current botanical concepts.

Discussions of seasonal occurrence for each species are based on all available specimens but the accompanying graphs are drawn from California records only. The numbers on the left side of the graphs represent the number of specimens seen.

Abbreviations used in keys throughout this paper are as follows:

- A - anal vein (fig. 1).
- Ba - basal vein (fig. 1).
- Cu - cubital vein (fig. 1).
- D - discoidal cell (fig. 1).
- FD - facial distance. The length of the head in full frontal view, from the crest of the vertex to the apex of the clypeus (fig. 2).
- LID - lower interocular distance. The minimum distance between the lower margins of the compound eyes (fig. 2).
- M - medial vein (fig. 1).
- MC - marginal cell (fig. 1).

- MID – middle interocular distance. The maximum distance between the inner margins of the compound eyes (fig. 2).
 OOL – ocellular length. The minimum distance between the outer margin of the lateral ocellus and the inner margin of the compound eye (fig. 2).
 POL – postocellar length. The minimum distance between the inner margins of the lateral ocelli (fig. 2).
 r – recurrent vein (fig. 1).
 R – radial vein (fig. 1).
 S – sternum (fig. 1).
 SD – subdiscoidal vein (fig. 1).
 SGP – subgenital plate.
 SM – submarginal cell (fig. 1).
 SMe – submedial cell (fig. 1).
 T – tergum (fig. 1).
 tCu – transverse cubital vein (fig. 1).
 TFD – transfacial distance. The maximum distance across the head from the outer margin of one compound eye to the outer margin of the other (fig. 2).
 tM – transverse medial vein (fig. 1).
 UID – upper interocular distance. The minimum distance between the upper margins of the compound eyes (fig. 2).

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Following are abbreviations cited in the text for institutional and private collections upon which this study is based. We wish to thank the persons cited for cooperation in making specimens available.

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 CAS – California Academy of Sciences, San Francisco – P.H. Arnaud, Jr.
 CDFA – California Department of Food and Agriculture, Sacramento – M.S. Wasbauer
 CIS – California Insect Survey, University of California, Berkeley – J.A. Powell, J.A. Chemsak
 CNC – Canadian National Collection, Ottawa – L. Masner
 CU – Cornell University, Ithaca – L.L. Pechuman
 HSU – Humboldt State University, Arcata – D.M. Gordon
 LACM – Los Angeles County Museum – R.R. Snelling, C.L. Hogue
 MSW – personal collection – M.S. Wasbauer, Sacramento, California

- MCZ – Museum of Comparative Zoology, Harvard University, Cambridge – R. McGinley, N.D. Stone
 NDA – Nevada Department of Agriculture, Reno – R.C. Bechtel
 ODA – Oregon Department of Agriculture, Salem – R.L. Westcott
 OSU – Oregon State University, Corvallis – G. Ferguson
 PM – Peabody Museum, Yale University, New Haven – C. Remington
 SBM – Santa Barbara Natural History Museum, Santa Barbara – S. Miller
 SDM – San Diego Natural History Museum, San Diego – D.K. Faulkner
 SJS – San Jose State University, San Jose – W.E. Ferguson
 TG – personal collection – T. Griswold, Logan, Utah
 UCD – University of California, Davis – R.M. Bohart, R.O. Schuster
 UCR – University of California, Riverside – S. Frommer
 USNM – United States National Museum, Washington, D.C. – A.S. Menke

Institutions abbreviated in the text but not cited in the acknowledgments are ANSP – Academy of Natural Sciences at Philadelphia; BMNH – British Museum (Natural History), London; CM – Carnegie Museum, Pittsburgh; MNHH – Museum of Natural History, Geneva; NCDA – North Carolina Department of Agriculture, Raleigh; NR – Naturhistoriske Riksmuseum, Stockholm; RNH – Rijksmuseum Natural History, Leiden; UK – University of Kansas, Lawrence; UL – University of Laval, Quebec; UN – University of Nebraska, Lincoln; VM – Vienna Museum, Vienna; ZI – Zoological Institute, Lund; ZMH – Zoological Museum, Hamburg; ZML – Zoological Museum, Leningrad.

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The junior author prepared the illustrations, but the following figures of the male genital capsule and subgenital plate have been reproduced from Evans (1950, 1951, 1951a, 1966) with the author's permission: 39-44; 47; 48; 56-69; 72-74; 100-110; 141-143; 146; 148; 151-154; 156; 160-167; 170-179.

SYSTEMATICS

KEY TO SUBFAMILIES OF POMPILIDAE

1. Apex of posterior tibia with spines of unequal length, irregularly spaced and somewhat radiating or splayed out; hind femur with spine pits dorsally near the apex (fig. 1); S2 without a well defined transverse groove; labrum at least partially hidden beneath clypeus (fig. 2); D3 usually produced into a pocket at its basiposterior corner (fig. 1) **Pompilinae**
- Apex of posterior tibia with spines of rather uniform length and spacing, more or less parallel and not splayed out; hind femur usually without spine pits dorsally near apex; S2 with a well defined transverse groove (fig. 19) or labrum fully exposed (fig. 5); D3 not produced into a pocket at its basiposterior corner (fig. 25) 2
2. S2 with a well defined, transverse groove (fig. 19) (absent in some males); labrum at least partially hidden beneath clypeus; hypopygium of female without a ventral keel or sharp fold; dorsal surface of posterior tibia often with a series of teeth or serrations (fig. 23) **Pepsinae**
- S2 without a transverse groove; labrum fully exposed; hypopygium of female with a ventral keel or sharp fold at least apically (figs. 29, 30); dorsal edge of posterior tibia smooth (fig. 24) **Ceropalinae**

KEY TO GENERA OF CALIFORNIA POMPILINAE

1. Females 2
- Males 16
2. Pronotum along midline longer than mesoscutum, without steep anterior slope (fig. 18), posterior margin transverse or nearly so, collar situated close to vertex (Aporini) . 3
- Pronotum subequal to or shorter than mesoscutum, with steep anterior slope to level of collar (fig. 1), posterior margin arcuate or angulate, collar considerably below vertex (Pompilini) 5
3. Anterior wing with three SM cells; clypeus medially forming a narrow bridge with frons (fig. 6) **Psorthaspis** Banks
- Anterior wing with two SM cells; clypeus medially below level of frons 4
4. SM2 little, if any, wider than high, receiving two recurrent veins (fig. 28); very small black and red (occasionally all black) species, pubescence not imparting bluish reflections **Allaporus** Banks
- SM2 considerably wider than high, receiving one recurrent vein, r2 meeting cubitus beyond or interstitial with tCu2 (figs. 20, 21); larger, all-black species, pubescence imparting strong bluish or greenish reflections **Aporus** Spinola
5. Propodeum with a sharp, conical tooth on posterolateral margin (fig. 185); either legs nearly without spines or postnotum absent dorsally (fig. 12) 6
- Propodeum without tooth on posterolateral margin; legs more or less spinose and postnotum present dorsally (occasionally interrupted medially) (figs. 10, 11) 7
6. Anterior tarsus with comb (figs. 181, 182); postnotum absent dorsally (fig. 12); head not strongly concave posteriorly **Aporinellus** Banks
- Anterior tarsus without comb (fig. 22); postnotum complete dorsally; head lenticular, strongly concave posteriorly and convex anteriorly **Allochaes** Banks
7. Posterior wing with tM straight, meeting A at a distinct angle (fig. 27); propodeum with posterior rim nearly absent **Tastiotenia** Evans
- Posterior wing with tM and A meeting in a smooth arc (figs. 51, 52); propodeum with posterior rim well developed 8
8. Posterior wing with jugal lobe very large, about 0.75 length of SMe (fig. 26); apical tarsal segment with spines in an irregular double row (fig. 17) **Chalcochaes** Banks
- Posterior wing with jugal lobe smaller, not much over 0.50 length of SMe (figs. 1, 51, 52); apical tarsal segment with spines, if present, in a single, median row (fig. 16) (one or two lateral spines occasionally present also) 9
9. Postnotum broadened between median line and spiracles (fig. 10); posterior wing with A meeting M beyond origin of Cu or T1 invested with scale-like pubescence 10
- Postnotum with nearly parallel margins (fig. 11); posterior wing with A usually meeting M at or before origin of Cu (fig. 1); T1 without scale-like pubescence 12
10. Apical tarsal segment without spines ventrally (fig. 15) **Sericopompilus** Howard
- Apical tarsal segment with a row of spines ventrally (fig. 16) 11
11. T1 with appressed, scale-like pubescence; middle and hind tarsal claws cleft **Episyron** Schiodte
- T1 without appressed, scale-like pubescence; middle and hind tarsal claws dentate **Poecilopompilus** Howard
12. Frons with distinct, blunt median tubercle just above antennal sockets (fig. 9); integument mostly reddish **Tachypompilus** Ashmead
- Frons without tubercle above antennal sockets; integument mostly black 13
13. Pygidium with at least a few stout, inflexible bristles, sometimes also with slender setae (fig. 14) **Anoplius** Dufour
- Pygidium never with stout, inflexible bristles, with or without slender setae (fig. 13) 14

14. Antenna short, thickened, length of third segment 2.8 or less its maximum width, 0.6 or less the UID **Evagetes** Lepeletier
Antenna longer, length of third segment at least 3.0 its maximum width, more than 0.6 the UID 15
15. Anterior wing with SD reaching wing margin, or nearly so, r2 meeting SD more than half the distance from origin of SD to wing margin (fig. 71) **Agenioideus** Ashmead
Anterior wing with SD not reaching wing margin, r2 meeting SD half or less the distance from origin of SD to wing margin (fig. 1) **Pompilus** Fabricius
16. Anterior wing with two SM cells, the second receiving one r (fig. 20) **Aporus** Spinola
Anterior wing with 3 SM cells, or 2, the second receiving both r (figs. 183, 184) 17
17. Posterior wing with tM short and straight, forming strong angle with A and intersecting M well basad of origin of Cu (figs. 27, 28) 18
Posterior wing with tM and A forming continuous arc (figs. 1, 26, 37) 19
18. Anterior wing with 3 SM cells; posterior rim of propodeum weak **Tastiotenia** Evans
Anterior wing with 2 SM cells; posterior rim of propodeum well developed **Allaporus** Banks
19. Posterior wing with jugal lobe large, about 0.75 length of SMe; metasomal dorsum densely hairy .. **Chalcochares** Banks
Posterior wing with jugal lobe smaller, at most slightly over 0.5 length of SMe; metasomal dorsum not densely hairy .. 20
20. Propodeum occasionally broadly produced posterolaterally but without acute, conical tooth (fig. 11) 21
Propodeum with acute, conical tooth on posterolateral margin (figs. 12, 185) 29
21. Postnotum expanded on each side of median line and constricted opposite propodeal spiracles (fig. 10); either posterior wing with A meeting M beyond origin of Cu or T1 with appressed, scale-like pubescence 22
Postnotum either with nearly parallel margins (fig. 11), slightly expanded at midline or absent (fig. 12); posterior wing with A meeting M usually at or before origin of Cu (fig. 1) ... 24
22. Tarsal claws dentate; most tarsal segments banded basally with white or yellow; wings not folded longitudinally **Sericopompilus** Howard
Tarsal claws bifid; tarsal segments not banded; wings often somewhat folded longitudinally 23
23. Propodeum and T1 with appressed, scale-like pubescence; metasoma black with yellow markings, if any, limited to apical tergum and rarely, paired spots on T3 **Episyrion** Schiodte
Propodeum and T1 without scale-like pubescence; metasoma extensively marked with yellow and/or red **Poecilopompilus** Howard
24. Head with a blunt median tubercle just above antennal sockets (fig. 9); integument mostly reddish **Tachypompilus** Ashmead
Head without a tubercle above antennal sockets; integument mostly black 25
Claws of all tarsi bifid 26
Claws of at least mid and posterior tarsi dentate 27
26. Antenna with third segment less than 1.6X as long as wide; propodeum with a distinctly concave posterior declivity **Psorthaspis** Banks
Antenna with third segment more than twice as long as wide; propodeum at most flattened posteriorly, never with a concave declivity **Anoplius** Dufour
27. Anterior wing with SD reaching wing margin, or nearly so, r2 meeting SD more than half the distance from origin of SD to wing margin **Agenioideus** Ashmead
Anterior wing with SD not reaching wing margin, r2 meeting SD half or less the distance from origin of SD to wing margin 28
28. Antenna short, third segment less than twice as long as wide, shorter than fourth segment; apical margin of clypeus truncate; propodeum convex with a distinct posterior declivity; apices of metasomal terga without transverse bands of coarse silvery pubescence **Evagetes** Lepeletier
Either a) antenna longer, third segment more than twice as long as wide; or b) apical margin of clypeus distinctly convex; or c) propodeum long and low, without a distinct posterior declivity and apices of metasomal terga with transverse bands of coarse silvery pubescence **Pompilus** Fabricius
29. Postnotum absent dorsally, metanotum and propodeum in broad contact (fig. 12); legs spinose (fig. 180); often only 2 SM cells **Aporinellus** Banks
Postnotum complete dorsally, separating metanotum and propodeum; legs smooth with reduced spines (fig. 22); three SM cells **Allochares** Banks

Tribe Aporini Genus *Aporus* Spinola

The genus *Aporus* has been recorded from the Palearctic, Nearctic and Neotropical Regions. In the United States there are two subgenera containing six recognized species. Three of these, representing both the nominate subgenus and the monotypic *Plectraporus*, occur in California.

From the other five aporine genera in the New World fauna, *Aporus* may be distinguished readily by venational characters: the anterior wing has only two submarginal cells and the second submarginal receives a single recurrent vein. Sometimes the second recurrent is interstitial on the cubitus with the second transverse cubital. Three other genera (*Allaporus*, *Chelaporus* and

Euplaniceps) are characterized by having two submarginal cells, but in these, the second submarginal receives both recurrent veins.

The American species have been treated by Bradley (1944) and Evans (1966, 1973).

Our current knowledge of the biology of New World *Aporus* is based on observations of only one species which preys on trapdoor spiders of the genus *Aptostichus* [see biology under *Aporus* (*P.*) *hirsutus* (Banks)]. Because of similar structural modifications throughout the genus in the head, prothorax and anterior femora, it is assumed that all species of *Aporus* attack some sort of trapdoor or folding door spider.

KEY TO CALIFORNIA SPECIES OF *APORUS*

1. Females 2
Males 4
2. Head in frontal view with antennal sockets mostly below line drawn between ventral margins of eyes; posterior wing with tM differentiated, forming an angle with A and meeting M far basad of origin of Cu (fig. 36); anterior tarsus with first three segments somewhat produced at outer apex, each bearing a stout, flattened spine (fig. 35) (Subgenus *Plectraporus*) *hirsutus* (Banks)
Head in frontal view with antennal sockets above line drawn between ventral margins of eyes; posterior wing with tM and A nearly confluent, forming a smooth arc, meeting M near origin of Cu (fig. 37); anterior tarsus with first three segments not produced, bearing only small spines (fig. 34) (Subgenus *Aporus*) 3
3. Mandible with small tooth on ventral margin (fig. 38); anterior wing with tCu2 somewhat oblique to main axis of wing (fig. 20) *concolor* (Smith)
Mandible without tooth on ventral margin; anterior wing with tCu2 nearly perpendicular to main axis of wing (fig. 21) *luxus* (Banks)
4. SGP, in lateral view, strongly tectate, with high arched ridge; in ventral view, tapering evenly to acute or subacute apex (fig. 44) *hirsutus* (Banks)
SGP, in lateral view, not strongly tectate, ridge not or only slightly arched; in ventral view, not tapering evenly, apex broadly rounded or subtruncate (figs. 42, 43) 5
5. Antenna short, segment 4 usually less than 1.5 times as long as wide; genitalia with ventral margin of gonostylus evenly curved (fig. 39); SGP, in ventral view, with lateral margins entire (fig. 41) *concolor* (Smith)
Antenna more elongate, segment 4 usually more than 1.5 times as long as wide; genitalia with ventral margin of gonostylus somewhat angled (fig. 40); SGP, in ventral view, with lateral margins toothed (fig. 42) *luxus* (Banks)

Aporus (Aporus) concolor (Smith) (Figs. 20, 31, 34, 38, 39, 41; map 1)

Planiceps concolor Smith, 1860:80. Holotype female, Mexico, Oaxaca: Oaxaca (BMNH).

Pompilus monticola Cameron, 1893:190. Holotype male, Mexico, Guerrero: Xucumanatlan (BMNH).

Geographic range. — Southern California to eastern Texas and south to Costa Rica. This primarily Central American species occurs in the United States only along its southwestern border.

California distribution. — Los Angeles Co.: (no further data), 2 ♂♂ (D.W. Coquillett, USMN). Monterey Co.: Seaside, 6 ♂♂, V-23-1959 (J.R. Powers, CIS, MSW). San Diego Co.: San Diego, 1 ♂, X-14-1950 (H.A. Hill, SDM); Canyon Road, 1 ♀, X-10-1950 (H.A. Hill, SDM); Pt. Loma, 2 ♂♂, X-29-1952 (H.A. Hill, SDM, MSW).

A. concolor and *A. luxus* are very similar in appearance. The features that separate *concolor* in the male are the shorter antennae, evenly curved gonostyli and lack of teeth on the lateral margins of the subgenital plate. It is necessary to extrude the genitalia to see the latter traits. In the female, the



Map 1. Overall distribution of *Aporus (Aporus) concolor* (Smith).

ventral (inferior) margin of the mandible bears a small tooth and the second transverse cubital vein of the anterior wing is more oblique to the main axis of the wing.

The biology of *A. concolor* is unreported.

Aporus (Aporus) luxus (Banks) (Figs. 21, 33, 37, 40, 42, 43; map 2; graph 1)

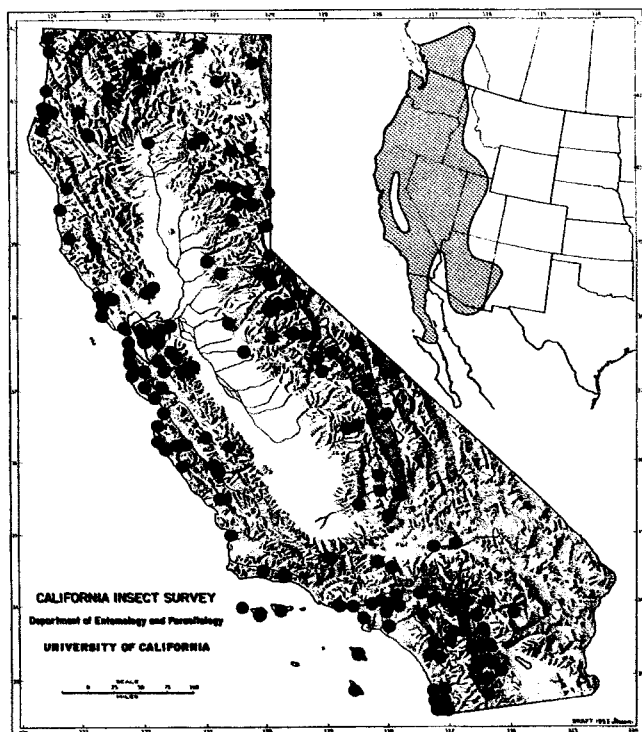
Planiceps luxus Banks, 1914:304. Holotype male, California: National City (MCZ).

Planiceps assimilis Banks, 1917:100. Holotype female, Canada, British Columbia: Penticton (MCZ).

Geographic range (map 2). — British Columbia south to Baja California Sur, east to Idaho, Utah and New Mexico. There are no records from the state of Sonora, Mexico but the species undoubtedly occurs there.

California distribution (map 2). — Occurring at elevations from sea level to 3,000 m, *A. luxus* is widespread and abundant over most of the state including the following Channel Islands: San Clemente (Canyon below Stone, China Pt., Eel Pt.; Horse Cyn., Middle Cyn., Pyramid Cove; Rock Wall Cyn., West Cove, Whale Pt., Wilson Cove); San Miguel (Willow Cyn.); Santa Cruz (Albert's Ridge, Canada del Medio, 2.5 mi. E mount Canada Saucos Oeste, Christi Beach, E. base Portoguelo Grande); Santa Rosa (China Camp, Torrey Pines area). It is absent from the floor of the Central Valley and the southeastern deserts. We have seen a total of 614 females and 524 males.

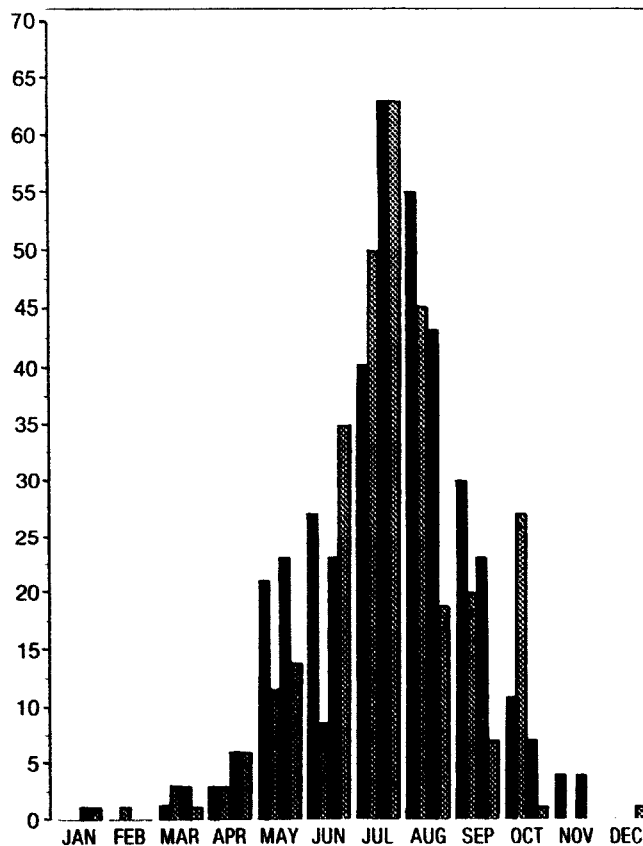
Seasonal occurrence (graph 1). — *A. luxus* has been taken during every month, most frequently in July and August. The seasonal data seem to indicate an overlapping of generations.



Map 2. California distribution of *Aporus (Aporus) luxus* (Banks). Inset: overall distribution.

This species is very similar to *A. concolor*, the other representative of the nominate subgenus in California. The males of *luxus* have longer antennae with segment 4 usually more than 1.5 times as long as wide, but there is some variation in this feature. The most reliable means of identifying the males is found in characters of the genitalia and subgenital plate. The gonostyli are somewhat elbowed and the lateral margins of the subgenital plate are toothed. The females lack a tooth on the outer margin of the mandible, and in the anterior wing, the second transverse cubital vein is more nearly perpendicular to the long axis of the wing.

Bradley (1944:91) proposed subspecies status for *assimilis* (Banks) based on the presence or absence of erect hairs on the anterior femora of the females. Wasbauer (1960:175) retained its subspecies status and provided a number of distributional records. Evans (1966:48) placed *assimilis* in synonymy. There is little doubt that two separate populations of this species exist. One (*luxus*) inhabits the transition and Upper Sonoran Life Zones of southern California north to Marin County and the other (*assimilis*) is more widely distributed in the western states, occurring in the Upper Sonoran to Canadian Life Zones. Differentiation of these populations is weak and they are separable on the basis of characters in only one sex. We therefore concur with Evans that they should not be accorded subspecific rank.



Graph 1. Seasonal occurrence of *Aporus (Aporus) luxus* (Banks). Black columns represent females; gray columns are males.

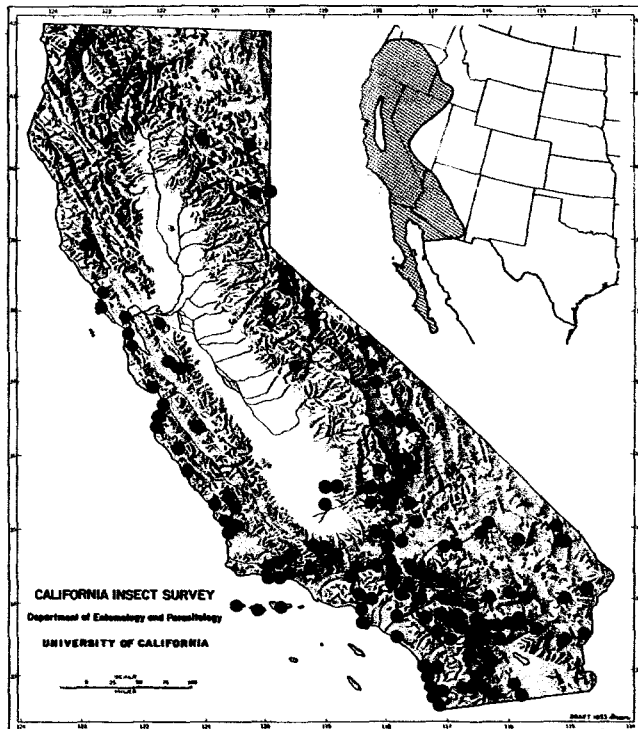
Biology. — H.B. Leech has taken females at aphid honeydew on *Cirsium lanceolatum* at Vernon, B.C. We have taken both males and females feeding on honeydew exuding from the galls of the cynipid, *Disholcaspis eldoradensis* on *Quercus lobata* in Riverside County. Members of this species sometimes visit flowers and have been taken on *Bebbia*, *Chilopsis*, *Chrysothamnus*, *Daucus*, *Eriogonum*, *Euphorbia*, *Grindelia*, *Prosopis*, *Sambucus*, *Sphenosciadium*, *Tamarix* and *Wislizenia*. In addition, we have found them visiting the extra-floral nectaries of *Helianthus annuus*.

The only clue to the nesting biology or prey of *A. luxus* is a male specimen reared from *Aptostichus* sp. (Ctenizidae) (Wasbauer, 1983).

Aporus (Plectraporus) hirsutus (Banks)
(Figs. 32, 35, 36, 44; map 3; graph 2)

Planiceps hirsutus Banks, 1917:99. Holotype male, California: Pasadena (MCZ).

Geographic range (map 3). — California and Oregon east to Idaho, Nevada, and western Arizona, south to Baja California Sur and northern Sonora, Mexico. We have examined 439 females and 259 males.



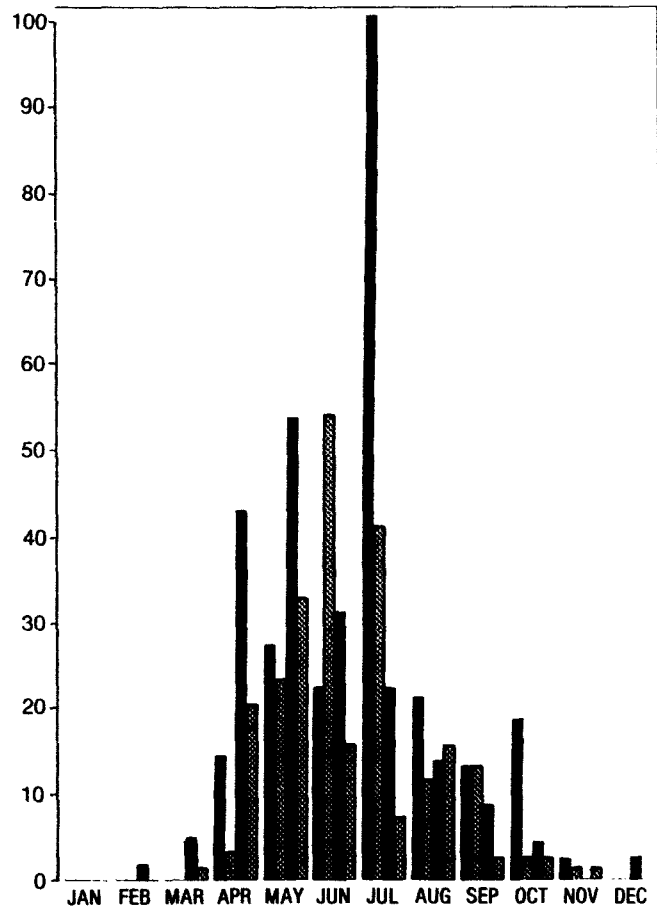
Map 3. California distribution of *Aporus (Plectraporus) hirsutus* (Banks). Inset: overall distribution.

California distribution (map 3). — Abundant in the southern California montane, transverse ranges and deserts; also at elevations to 2,100 m in the Coast Ranges and Sierra Nevada, north to Lassen County. It has also been taken on the Channel Islands. San Miguel: Simonton Cove, 1 ♀, 6 ♂♂, VII-11-1970 (A.A. Grigarick, R.O. Schuster, UCD); Bay Point Slope, 1 ♀, VII-11-1970 (A.A. Grigarick, R.O. Schuster, UCD). Santa Cruz: Canada del Medio, 1 ♂, VI-20-1967 (D.S. Horning, UCD); S. Ridge, IX-28-1968 (R.O. Schuster, UCD). It is absent from the Central Valley except in the extreme southern portion.

Seasonal occurrence (graph 2). — There are records from February through December although the majority of collections have been made between April and August with a significant peak in July.

In contrast to females of *Aporus luxus* and *concolor*, those of *hirsutus* are quite hairy. In females of all three species, the integument is uniformly black with bluish reflections imparted by the pubescence. The color is frequently more intense in those of *hirsutus* and often is more greenish than blue. The antennal sockets are usually below the level of the eyes. The malar space is long. In the posterior wing, the transverse median vein forms an angle with the anal vein, meeting the median far basad of the origin of the cubitus. The anterior tarsi bear characteristic flattened spines at the outer apices of the first three segments.

Scattered through the range of *A. hirsutus* are individuals which have the antennal sockets above the ventral margins of the compound eyes and the spatulate spines of the anterior tarsus reduced.



Graph 2. Seasonal occurrence of *Aporus (Plectraporus) hirsutus* (Banks). Black columns represent females; gray columns are males.

These individuals appear most frequently in populations from San Diego County.

The males are most readily distinguished from those of *luxus* and *concolor* by the narrow, compressed subgenital plate which in ventral view tapers to an acute apex.

Biology. — Adults have been taken at the honeydew of aphids on *Chrysothamnus*, honeydew exuding from galls of *Disholcaspis eldoradensis* on *Quercus lobata*, extra-floral nectaries of *Helianthus* and at flowers of *Adenostoma fasciculatum*, *Haplopappus Bloomeri* and *sonorensis*, *Asclepias erosa*, *Chrysopsis villosa*, *Chrysothamnus nauseosus* and *viscidiflorus*, *Croton californicus*, *Dalea polyadenia*, *Eriogonum inflatum*, *latifolium* and *parvifolium*, *Euphorbia albomarginata* and *serpyllifolia*, *Foeniculum vulgare*, *Helianthus niveus*, *Malacothrix* sp., *Oenothera* sp., *Prosopis juliflora* and *Tamarix gallica*.

Williams (1928) provided observations on this species at the San Francisco sand dunes. The prey is the ctenizid spider, *Aptostichus stanfordianus* Smith. The female wasp hunts over the surface of

the sand until she encounters the limp door flap to the silk-lined burrow of the spider. She pries the flap open sufficiently to enter part way in an inverted position and then backs out. She enters and backs out several times until the spider is driven from its burrow. She then pursues it over the open sand,

paralyzes it and drags it back to be interred in its own burrow. The flap door is used by the wasp as a closure. Oviposition apparently is subsequent to closure and the egg is laid dorsolaterally on the abdomen of the spider. The adult wasp exits from the sand a short distance from the closed burrow.

Genus *Allaporus* Banks

The eight currently recognized species of the genus *Allaporus* are restricted to the New World and are found from the southern half of the United States through Central America. Evans (1966:67) gives southern Mexico as the southern terminus of the range of the genus, but Wasbauer has recently taken *A. smithianus* (Cameron) at Turrialba, Costa Rica (unpublished record). As Evans has pointed out, specimens of these small to minute wasps are rare in collections so range extensions can be expected and new species probably will be found.

On the basis of rather scanty material, two species are known in California.

KEY TO CALIFORNIA SPECIES OF *ALLAPORUS*

1. Females 2
Males 3
2. Mandible broad, obliquely angled near base, the apical portion flattened and polished (fig. 169); crest of vertex rather sharply angled *smithianus* (Cameron)
Mandible slender, not angled near base, apical portion not flattened (fig. 168); crest of vertex not as sharply angled *pulchellus* (Banks)
3. Wings nearly hyaline; posterior wing with tCu forming a distinct angle with the strongly arcuate Cu (fig. 70); antennae short, 6th segment about as wide as long *smithianus* (Cameron)
Wings somewhat infuscate; posterior wing with tCu strongly inclined, forming nearly a straight line with Cu (fig. 28); antennae more elongate, 6th segment at least 1.2 x as long as wide *pulchellus* (Banks)

Allaporus pulchellus (Banks) (Figs. 8, 28, 168; map 4)

Planiceps pulchella Banks, 1910:123. Holotype female, Virginia: Falls Church (MCZ).

Planiceps hesperus Banks, 1929:327. Holotype female, California: San Francisco (Lone Mountain) (MCZ).

Allaporus rufiventris Bradley, 1944:121-122 (in part). Misidentification.

Euplaniceps aquilonaris Dreisbach, 1952:94. Holotype male, California: Santa Clara County, Stanford University (MCZ).

Geographic range (map 4). — Widespread in the United States and Mexico to Campeche.

Allaporus may be separated in both sexes from *Aporus*, its companion genus in the tribe, by features of the wing venation. The second submarginal cell is not much, if any, wider than long and receives two recurrent veins. In the California species coloration is also distinctive. The pubescence in neither sex is bluish and in addition, the females are usually bicolored, with the mesosoma black and the metasoma red. Males are uniformly black.

The genus has been reviewed recently by Evans (1950a, 1966).

The nesting biology of members of this genus is unknown.



Map 4. California distribution of *Allaporus pulchellus* (Banks). Inset: overall distribution.

California distribution (map 4). — Sea level to 1,800 m in the southern California montane, Sierra foothills, Great Basin and Coast Ranges. There are two records from the Channel Islands. San Miguel: Simonton Cove, 1 ♀, VII-11-1970 (A.A. Grigarick, R.O. Schuster, UCD). Santa Rosa: Windmill Cyn., n. fork,

50-250 feet, 2 ♂♂, VI-7-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM). It is absent from the floor of the Central Valley and the southeastern deserts. The absence of this species from a large area in the north Coast Ranges may be more apparent than real. Both sexes of *A. pulchellus* are quite small and easily overlooked by the general collector. We have seen a total of 16 females and 48 males from California and 49 specimens of both sexes from out of state.

Seasonal occurrence. — Although there are Mexican records for December and January, almost all the California specimens have been collected from April to September. The majority of both sexes are from June and July.

The two California species of *Allaporus* are very similar in size and color. Females of *pulchellus* from San Francisco and Marin counties sometimes have the metasoma suffused with black. Black females from San Francisco were the basis for Banks' *hesperus*. There appear to be no differences other than color between females from San Francisco and other localities and the males differ in no discernable way from other males throughout the range of the species so recognition of subspecies does not appear warranted.

Biology. — There are few adult feeding records for this species. Females have been taken at flowers of *Condalia mexicana* and males at flowers of *Atriplex semibaccata* and *Euphorbia* sp. Nesting habits and prey are unknown.

Allaporus smithianus (Cameron)
(Figs. 70, 169)

Pompilus (*Aporus*) *smithianus* Cameron, 1893:191-192.
Holotype female, Mexico. Veracruz: Atoyac (BMNH).

Allaporus amabilis Evans, 1950a:2. Holotype female, California: Tulare County, Potwisha (CAS).

Geographic range (map 5). — Southern California and southern Texas south to Costa Rica. This is an uncommon species over its entire range. We have seen 11 females and 16 males, the majority from outside California.

California distribution. — Alameda Co.: Corral Hollow, 1 ♂, V-26-1966 (A.S. Menke, UCD). Inyo Co.: Darwin Falls, 1 ♂, VI-5-1939 (AMNH); 6 mi. NNE Darwin, 1 ♂, V-12-1969 (P.A. Rude, CIS). Riverside Co.: 2 mi. W. Gilman Hot Springs,

2 ♀♀, in antifreeze pit trap, IX-13-1978 to I-7-1979 (F.G. Andrews, CDFA). San Diego Co.: San Diego (Wards Road), 1 ♀, IX-27-1953 (H.A. Hill, SDM); North of Pala, 1 ♂, McPhail trap in plum, VII-27-1960 (C. Johnson, CDFA). Tulare Co.: Potwisha, 2 ♀♀ (type and paratype of *amabilis* Evans), VI and VII (E.C. Van Dyke, CAS, USNM).

The broad, obliquely angled, flattened mandibles and transversely angled, flattened clypeus of the female indicate that this species may have habits somewhat different than those of *pulchellus*. The legs may be red or black, and the crest of the vertex is more sharply angled than in the latter species. The males are very similar to those of *pulchellus*, but the wings are hyaline and the



Map 5. Overall distribution of *Allaporus smithianus* (Cameron).

antennae somewhat shorter. There are slight differences in the venation of the posterior wing as detailed in the key.

Genus *Psorthaspis* Banks

Exclusively a new world genus, *Psorthaspis* occurs from northern South America to the southern half of the United States. The genus contains 28 species, 9 of which are found in the United States. Only one species has been recorded from California.

The genus is comprised of mostly medium-sized wasps. Some species have strikingly banded wings and are ornamented with highly contrasting integumental colors. Sometimes they also possess areas of brightly colored, appressed tomentum.

The North American species have been treated by Bradley (1944) and Evans (1954), the Central American species by Evans (1966).

Knowledge of the biology of *Psorthaspis* is based on observations of only one species (*planata*) which preys on Ctenizidae. Because structural modifications such as the long pronotum and specialized clypeus occur throughout the genus, it is assumed that all of the species utilize either Ctenizidae or similar subterranean spiders.

Psorthaspis planata (Fox)
(Figs. 6, 18; map 6; graph 3)

Planiceps planatus Fox, 1892:171. Holotype female, California: San Diego (ANSP).

Planiceps aequus Fox, 1894:99. Holotype female, Mexico, Baja California: El Taste (CAS).

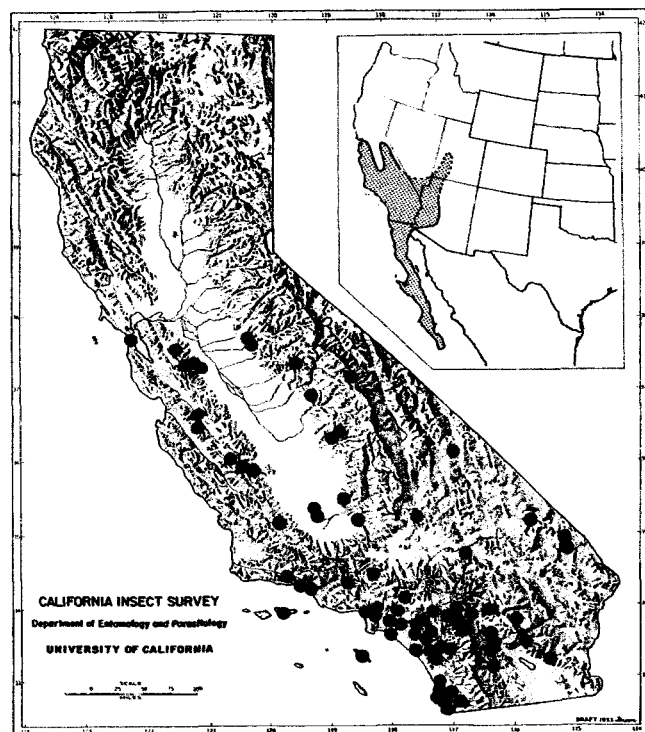
Sophropompilus tumifrons Banks, 1917:103. Holotype male, California: San Diego Co. (MCZ).

Pedinaspis bucephala Malloch, 1929:101. Holotype male, California: Palm Springs (USNM).

Pedinaspis albocaudata Malloch, 1929:101. Holotype male, Arizona: Higley (USNM).

Psorthaspis morosa Bradley, 1944:42. Holotype female, Utah (USNM).

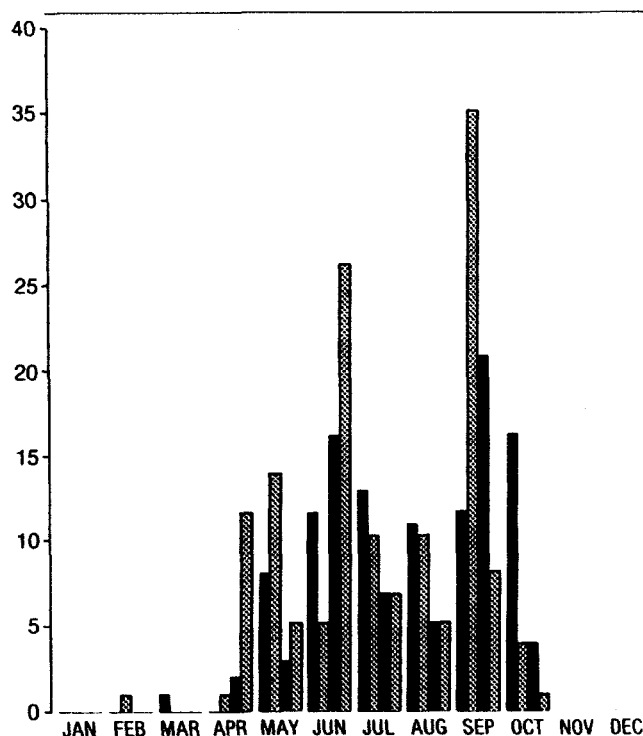
Geographic range (map 6). — California, southern Nevada, Utah, Arizona, Baja California.



Map 6. California distribution of *Psorthaspis planata* (Fox). Inset: overall distribution.

California distribution (map 6). — Foothill areas and deserts of southern California, southern San Joaquin Valley, northward along the inner Coast Ranges and foothills of the Sierra Nevada to Alameda and Stanislaus counties. Channel Islands records are Santa Catalina: Cape Canyon, 850', 1 ♂, VII-13-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); Cherry Valley, 2 ♀♀, VII-1-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM). Santa Cruz: Canada del Medio, 1 ♀, 4 ♂♂, VI-16/23-1967 (A.S. Menke, CDFA); Canada del Puerto, 1 ♂, VI-20-1967 (R.O. Schuster, UCD); Upper Central Valley, 1 ♀, VI-8-1966 (R.L. Langston, CIS); Coches Prietos, 1 ♀, VI-17-1967 (CDFA); Prisoner's Harbor, 1 ♀, 2 ♂♂, IX-25-1978 (J.A. Powell, R. Coville, CIS). This is a fairly common and conspicuous species in the southern portion of the state. We have examined 235 females and 224 males.

Seasonal occurrence (graph 3). — Most of the California collections have been made from April to October. There are peaks in June and September which indicate that in California the



Graph 3. Seasonal occurrence of *Psorthaspis planata* (Fox). Black columns represent females; gray columns are males.

species may be bivoltine. There are Baja California records for most of the winter months.

This species forms a closely knit species group with *portiae* (Rohwer) (southern Arizona to central Mexico) and *formosa* (Smith) (southern Mexico to Costa Rica). Color is a convenient means of separating females of *planata* (entirely black) from those of the former two species which are conspicuously marked with orange. Males of *planata* are all dark or have only a small amount of pale pubescence. The wings are uniformly infuscate. Males of *portiae* and *formosa* have the majority of the body clothed with pale pubescence. The wings are hyaline or somewhat infuscate toward the apices.

In California coastal populations of *planata*, the males are entirely dark. Those from southern California east of the coast ranges often have pale pubescence on the apical metasomal terga. Evans (1966) has suggested that this geographic segregation of secondary sexual characters may be due to introgression with Arizona populations of *portiae*.

Biology. — Adults of both sexes have been collected at honeydew exuding from galls of *Disholcaspis eldoradensis* on *Quercus lobata* and from extra-floral nectaries on the stems of *Helianthus*. They have been taken on flowers of *Haplopappus sonorensis*, *Haplopappus* sp., *Asclepias* sp., *Baccharis glutinosa*, *Calochortus catalinae*, *Chrysothamnus* sp., *Eriogonum fasciculatum*, *Heliotropium curassavicum*,

Karwinskia Humboldtiana, *Lepidospartum squamatum* and *Viguiera deltoidea* var. *Parishii*.

Davidson (1905:233) reported rearing this species from burrows of the trap door spider, *Bothriocyrtum californicum* (O.P. Cambridge) (Ctenizidae). Jenks (1938), in a well illustrated popular article, discussed the biology.

The female wasp locates the trap door closing the spider's burrow and gains entry by prying it open or chewing through it. The spider is attacked and paralyzed inside the burrow and the egg placed dorsally on the abdomen. Larval development and pupation occur within the burrow and the newly emerged adult exits through the trap door.

Tribe Pompilini

Genus *Chalcochaes* Banks

Containing only two species and confined to the southwestern United States and Mexico, the genus *Chalcochaes* presents an array of characters unique in the Pompilinae. The large anal lobe of the posterior wing at once sets it apart from other genera in the subfamily and to our knowledge is a trait not found elsewhere in the New World Pompilidae. The legs are short and relatively stout and the tarsal segments each have a double row of ventral spines, characters shared with certain genera in the Pepsinae. The males are covered with dense, long hair even on the metasomal terga and have a slight tendency to constriction between the metasomal segments. They thus bear a strong

superficial resemblance to males of some species of the pepsine genus *Chirodamus*. In the structure of the head and prothorax, however, the similarities to aporine genera, notably *Psorthaspis*, on the one hand and to certain pompilines such as *Evagetes*, on the other are indicative of a possibly close phylogenetic affinity.

Although relatively large and conspicuous, specimens of *Chalcochaes* are not common in collections. In his study of the North American Pompilinae, Evans (1950) saw less than 50 specimens of both species.

No information on nesting biology is available for the genus.

Chalcochaes hirsutifemur (Banks)

(Figs. 17, 26; map 7)

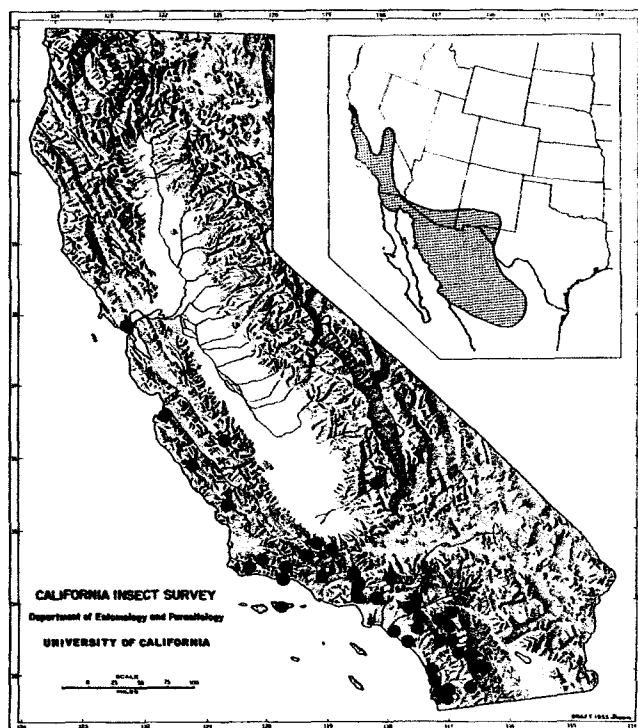
Psammochaes hirsutifemur Banks, 1914:304. Holotype female, California: Lemon Grove (MCZ).

Geographic range (map 7). — Sonoran fauna, central California to western Texas south to Zacatecas, Mexico.

California distribution (map 7). — Mountains of southern California and coastal hills north to Marin County with sierran records from Kern and Inyo counties. There is also a record from the Channel Islands. Santa Cruz: Griffith Canyon, 1500', 1 ♂, VI-22-1967 (D.R. Miller, UCD).

Seasonal occurrence. — Of the 104 females and 47 males we have examined, the majority of records are for June, July and August. Two specimens from San Diego County were collected in May. The comparatively short flight period for this species indicates that there is a single annual brood.

The two species of *Chalcochaes* are fairly large, robust wasps. Although the ranges overlap to some extent in Mexico and narrowly in western Texas, *C. engleharti* (Banks) in the United States is limited to Texas. It is a larger species than *hirsutifemur* and females are distinguishable by the strongly elevated vertex which is above the level of the posterior ocelli by 1.4 to 2.0 times the POL. In females of *hirsutifemur* the vertex is elevated but



Map 7. California distribution of *Chalcochaes hirsutifemur* (Banks). Inset: overall distribution.

not as strongly so. It is above the level of the posterior ocelli by 1.0 to 1.3 the POL. Males are separable on the same basis; the vertex of *engleharti* is sharp and is situated considerably above and behind the tops of the eyes; that of *hirsutifemur* is rounded a short distance above and behind the tops of the eyes. It is not always possible to distinguish males on this basis and in doubtful cases, the genitalia must be examined. These structures are illustrated by Evans (1950: figs. 16-17).

Biology. — In California, *C. hirsutifemur* seems

to be an inhabitant primarily of chaparral situations. Both sexes have been taken in several different areas visiting the flowers of *Eriogonum fasciculatum*. There are also California floral visitation records for *Asclepias erosa* and *Foeniculum vulgare*. In southern Arizona we have taken both sexes at extra-floral nectaries of *Helianthus annuus*. Arizona and New Mexico floral visitation records include: *Haplopappus Hartwegi*, *Asclepias* sp., *Baccharis glutinosa*, *Flourensia cernua* and *Koeberlinia spinosa*.

Genus *Evagetes* Lepeletier

This is a moderate-sized genus, best developed in the Palearctic and Nearctic Regions. There are 10 species inhabiting the United States, two of which are ditypic. Five of these species also occur in Mexico, with two extending further into Central America. Banks (1947:429-432) records three species from South America (as *Sophropompilus* Ashmead). According to Evans (1966:132), material assigned by Banks to one of the three, *E. coeruleus* Taschenberg, may be conspecific with *E. mohave* (Banks), a species widespread in the southern United States. We have recently seen what appear to be two additional species from Chile.

The California fauna is rather rich, 9 of the 10 United States species having been taken here.

The genus may be recognized by the short antennae, those of the female somewhat thickened and flattened on one side, the third segment in the male not more than twice as long as wide. The clypeus, although often broad, is never wider than the lower interocular distance. The pulvillar comb is weak in both sexes, consisting of not over seven slender setae. The tarsal claws are toothed in both sexes and the female pygidium is provided with a few flexible hairs.

Because the majority of North American species are represented in California and because existing

keys do not treat some of the more recently recognized species, the key presented below includes all species and subspecies known in North America. In many respects, this key is unsatisfactory, especially for the females. We have been unable to provide criteria for separating females of *asignus* and *hyacinthinus*, but the former is extralimital to California.

Evagetes is a difficult genus taxonomically since most species vary tremendously in nearly all traits that can be used for separating them. Evans (1950:161) has suggested that the variation may be due to the unusual host-parasite relationship exhibited by species of this genus.

There is considerable evidence that all *Evagetes* are cleptoparasites of other genera of Pompilinae. Evans and Yoshimoto (1962) have summarized knowledge on the nesting activities of these wasps.

Females may locate the provisioned burrow of another pompilid by use of the specialized antennae or happen across the female of a provisioning species in the process of nest construction. By one means or another, she enters the burrow and locates the provisioned cell. She then destroys the egg of the original wasp, lays one of her own on the spider and fills the burrow before leaving.

KEY TO NORTH AMERICAN SPECIES OF *EVAGETES*

1. Females 2
- Males 12
2. Pronotum with posterior margin broadly arcuate, occasionally with a small notch at midline (fig. 54); body with brilliantly refulgent pubescence 3
- Pronotum with posterior margin angulate or subangulate (fig. 55); body only obscurely refulgent 9
3. Both pairs of wings uniformly deeply infusate; head and body without silvery pubescence; posterior wing with SMe broadly rounded apically, occasionally appendiculate (fig. 51) *ingenuus* (Cresson)

- Wings not uniformly deeply infusate, at least the posterior pair lighter near the base (in doubtful cases, lower frons usually with silvery pubescence); posterior wing with SMe pointed or narrowly rounded apically, not appendiculate (fig. 52) 4
4. Anterior basitarsus with 3 short comb spines, apical comb spine not over 0.8 length of second tarsal segment, pubescence dark blue or violaceous, usually not silvery on the frons *parvus* (Cresson)
- Anterior basitarsus with 3 to 5 longer comb spines, apical one more than 0.8 length of second tarsal segment ... 5

5. Anterior basitarsus with comb spines broad and flat, apical one subequal to slightly longer than second tarsal segment; SM3 as wide as or wider on cubitus than SM2 (fig. 49)..... 6
Anterior basitarsus with comb spines long and slender, apical one considerably longer than second tarsal segment; SM3 small, narrower on the cubitus than SM2, often triangular (fig. 50)..... 7
6. Head with vertex produced at level of posterior ocelli, giving a slightly humped appearance; pubescence strongly bluish or greenish refulgent, silvery on lower front and often on clypeus..... *mohave* (Banks)
Head with vertex not produced; pubescence not as strongly bluish or greenish refulgent, more often dull violaceous, often not silvery on lower front or clypeus.....
asignus Dreisbach
hyacinthinus (Cresson)
7. Anterior basitarsus with 4 comb spines; length 9-11 mm; propodeum in profile strongly convex, posterior declivity well defined with a few erect hairs laterally.....
calefactus Evans
Anterior basitarsus with 3 comb spines; length 4-9 mm; propodeum in profile not strongly convex, posterior declivity less well defined, usually lacking erect hairs laterally..... 8
8. Body with silvery pubescence limited to head and mesosoma, absent on metasomal terga.....
padrinus padrinus (Viereck)
Body with extensive silvery pubescence, involving most of head, mesosoma and at least metasomal terga.....
padrinus minusculus (Banks)
9. Propodeum noticeably hairy; pubescence with deep blue reflections; anterior basitarsus with 3 or 4 long comb spines, apical one usually longer than second tarsal segment.....
subangulatus (Banks)
Propodeum not hairy or at most with a few scarcely noticeable erect hairs; pubescence without blue reflections; anterior basitarsus with 3 (rarely 4) comb spines, apical one not or scarcely longer than second tarsal segment..... 10
10. Pubescence entirely dark; propodeum with a few short erect hairs on sides.....
macswaini Evans
Pubescence silvery at least on posterior surface of posterior coxa, often on middle coxa and lower face; propodeum without erect hairs..... 11
11. Metasoma with at least some reddish integumental color at base.....
crassicornis crassicornis (Shuckard)
Metasoma entirely black...*crassicornis consimilis* (Banks)
12. SGP with a pair of basal carinae (fig. 57); genitalia with digitus abruptly constricted and produced into a slender apical lobe (fig. 63); integument black or black and red, pubescence without bluish reflections..... 13
SGP without carinae or with a single median carina; genitalia with digitus not constricted or produced into an apical lobe (figs. 62, 66); integument black, pubescence variable..... 14
13. Metasoma marked with red basally.....
crassicornis crassicornis (Shuckard)
Metasoma entirely black...*crassicornis consimilis* (Banks)
14. SGP with median carina strongly elevated, in profile forming an arcuate ridge (figs. 58, 60); SM3 usually narrower on both R and Cu than SM2, sometimes triangular or petiolate (fig. 50)..... 15
SGP with median carina absent or feebly elevated (fig. 56); SM3 usually as wide on Cu as SM2 (fig. 49)..... 17
15. Third antennal segment not or only slightly longer than greatest width; pubescence brown, silvery on clypeus and lower front; genitalia with gonostylus short, not exceeding digitus (fig. 66).....
macswaini Evans
Third antennal segment at least 1.5 times as long as width; pubescence brilliant blue, green or violet refulgent, silvery at least on clypeus and lower front, often more extensively so; genitalia with gonostylus considerably exceeding digitus (fig. 67)..... 16
16. Body with blue refulgence on dorsum of mesosoma and part of metasoma; west of the 100th meridian.....
padrinus padrinus (Viereck)
Body almost entirely silvery, pubescence only in small part brown or brown violaceous, never blue; eastern United States.....
padrinus minusculus (Banks)
17. Both pairs of wings uniformly deeply infusate; antenna with third segment about twice length of second.....
ingenuus (Cresson)
Wings not uniformly deeply infusate; antenna with third segment less than twice length of second..... 18
18. Anterior tarsus with apical segment symmetrical, no more than faint indication of lobe on inner margin; SGP with basal, sclerotized points absent or weakly developed (fig. 56)..... 19
Anterior tarsus with apical segment asymmetrical, a distinct lobe on inner margin (fig. 53); SGP with well developed basal pair of sclerotized points (as in fig. 58)..... 20
19. Antenna with third segment 1.2-1.4 as long as wide; genitalia with digitus slender, apex directed mesally; gonostylus extending nearly to apex of aedeagus (fig. 61).....
asignus Dreisbach
Antenna with third segment 1.6-1.8 as long as wide; genitalia with digitus shorter, more strongly inflated; gonostylus much shorter than aedeagus (fig. 62).....
calefactus Evans
20. Pronotum with posterior margin subangulate (fig. 55); pubescence deep blue-black; genitalia with digitus barely produced mesally (fig. 69).....
subangulatus (Banks)
Pronotum with posterior margin arcuate, sometimes with a slight median notch (fig. 54); pubescence silvery, at least on lower frons and propodeum; genitalia with digitus more strongly produced mesally (fig. 68)..... 21
21. Head with vertex produced at level of posterior ocelli, giving a humped appearance in frontal view; pubescence brilliant blue and silvery.....
mohave (Banks)
Head with vertex not produced at level of posterior ocelli, not appearing humped in frontal view; pubescence darker..... 22
22. Propodeum with at most a few inconspicuous erect hairs on sides, frons scarcely to moderately hairy; genitalia with digitus slightly less strongly produced mesally, uniformly sparsely setose (fig. 68).....
parvus (Cresson)
Propodeum with conspicuous dark, erect hairs; frons more strongly hairy; genitalia with digitus slightly more produced mesally, more densely setose with a number of short erect setae at upper, outer angles (fig. 64).....
hyacinthinus (Cresson)

Evagetes ingenuus (Cresson)
(Figs. 51, 54, 59, 65; map 8)

Pompilus ingenuus Cresson, 1867:89. Lectotype female, Dakota Territory (no further data) (ANSP).

Geographic range (map 8). — Transcontinental in southern Canada and the United States. The species probably occurs widely in Mexico but has been recorded only from the states of Mexico and Chihuahua. There is a single record from Costa Rica.



Map 8. California distribution of *Evagetus ingenuus* (Cresson). Inset: overall distribution.

California distribution (map 8). — This widespread but apparently uncommon species occurs from Orange and Riverside counties northward along the Sierra Nevada to Lassen County and along the Coast Ranges to Contra Costa County. It has been taken in the Central Valley at Sacramento and Dos Palos and on Santa Cruz Island: Fraser Point, 1 ♀, V-11-1968 (D.S. Horning, UCD); Christi Beach, 1 ♀, X-2-1968 (D.S. Horning, UCD). It appears to be absent from the North Coast Range and Cascades and from the southeastern deserts. Forty-five females and 17 males have been available to us for study.

Seasonal occurrence. — Capture records for this primarily midsummer species are from May 11 on Santa Cruz Island to October 7 at Sacramento. The majority of records are in August.

E. ingenuus is the largest of the North American species of *Evagetus*. Both pairs of wings are entirely dark and the pubescence is dark over the entire body. Several other species have dark wings but the posterior wing is hyaline or subhyaline toward the base.

Biology. — Adults are typically found in open, sandy situations, mainly in the Upper Sonoran Life Zone. They occasionally visit honeydew and have been taken on flowers of *Daucus*, *Eriogonum* and *Solidago*.

Evagetus parvus (Cresson)
(Figs. 52, 53, 68; map 9; graph 4)

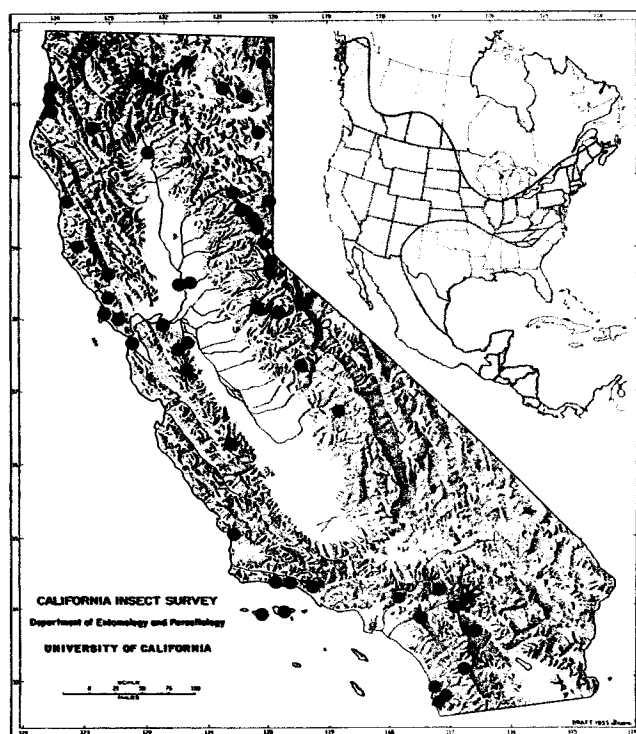
Pompilus parvus Cresson, 1865a:453. Holotype female, Colorado (no further data) (ANSP).

Pompilus subviolaceus Cresson, 1867:91. Lectotype female, Delaware (no further data) (ANSP).

Pompilus argenteus Cresson, 1867:93. Lectotype male, Virginia (no further data) (ANSP).

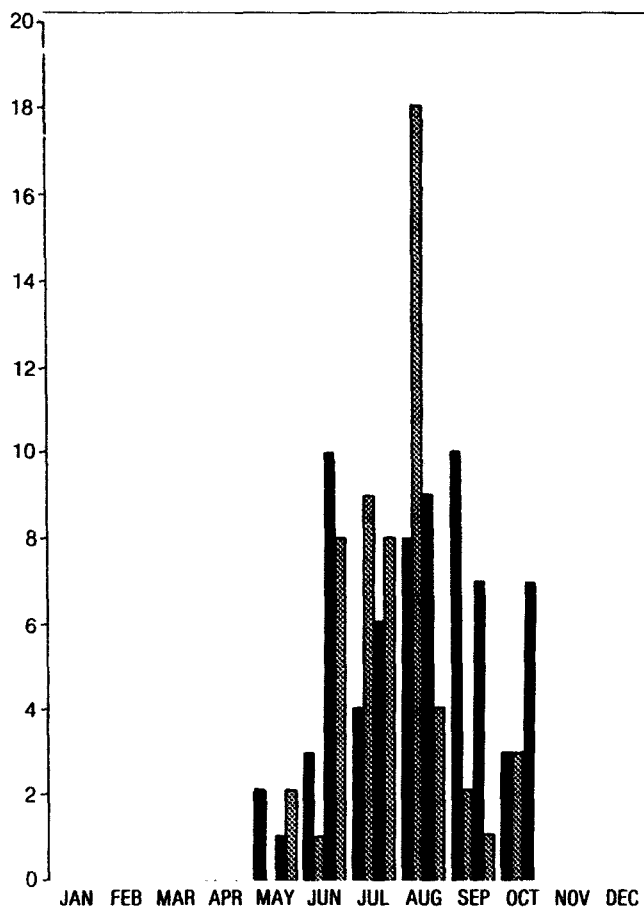
Pompiloides minora Banks, 1911:227. Holotype female, Virginia: Falls Church (MCZ).

Geographic range (map 9). — Widespread in western Canada and the United States, south through the central plateau of Mexico to Costa Rica at higher elevations. Evans (1950) states that this species "is one of the commonest Pompilini in the northeastern and north central United States and eastern Canada; there are but few records from west of the Rocky Mountains." Examination of considerable new material has shown that the species is common in California, although not as abundant as certain others such as *padrinus padrinus* and *hyacinthinus*. We have seen a total of 85 females and 58 males from the state.



Map 9. California distribution of *Evagetus parvus* (Cresson). Inset: overall distribution.

California distribution (map 9). — Southern California mountains, Coast Ranges, Sierra Nevada and Cascade ranges from San Diego County to Humboldt, Siskiyou and Modoc counties. This species is essentially absent from the Central Valley and the desert regions. Specimens from the two Central Valley localities shown on the map (Sacramento Co.: Sacramento and Yolo Co.: Davis) are from riparian situations.



Graph 4. Seasonal occurrence of *Evagetes parvus* (Cresson). Black columns represent females; gray columns are males.

Seasonal occurrence (graph 4). — Except for a few April, May and June dates from southerly areas outside of California, the vast majority of collection records are June through September, with a peak in August. This would indicate, for most California localities, a single summer generation.

Evagetes parvus is a smaller wasp than *E. ingenuus* but superficially resembles it, often being entirely dark, without any silvery pubescence. In more fundamental morphological traits, *parvus* is closer to *hyacinthinus* and the females of these two species are sometimes difficult to distinguish because of variation and the effects of wear on form and length of the comb spines on the anterior tarsus. Females of *parvus* average a little smaller, are generally less hairy, and more frequently lack silvery pubescence. The body color imparted by microscopic pubescence tends to be a bit more dull. These latter traits are all subject to variation but may help to assign specimens in doubtful cases.

The male genitalia of *ingenuus*, *parvus* and *hyacinthinus* are all quite similar but males of *parvus* can usually be distinguished from those of the other two by the digitus, which is sparsely hairy

and not as strongly directed toward the midline. The propodeum of male *parvus* is usually without erect hair or with at most a few very short, fine hairs, while in *hyacinthinus* the propodeal hairs are generally long and numerous.

Biology. — Adults have been taken at honeydew on *Liriodendron tulipifera*, at extra-floral nectaries of *Helianthus annuus* and at flowers of *Angelica* sp., *Asclepias* sp., *Baccharis* sp., *Chrysothamnus nauseosus*, *Cleome serrulata*, *Daucus carota*, *Eriogonum latifolium nudum*, *Pastinaca sativa* and *Solidago* sp. There have been no detailed observations published on the oviposition habits of *E. parvus*, but the Peckhams (1905) observed a female of this species (cited as *Pompilus subviolaceus*) digging into the filled burrow of *Pompilus scelestus* Cresson. Evans (1950) saw females entering the burrows of *Anoplius marginatus* (Say) on two different occasions. There is thus circumstantial evidence that *E. parvus* is cleptoparasitic.

Evagetes mohave (Banks)

(Fig. 49; map 10)

Sophropompilus quadrispinosus Banks, 1919a:82. Holotype female, New York: Long Beach, Long Island (MCZ). Preocc. in *Evagetes*.

Sophropompilus mohave Banks, 1933:6. Holotype female, Arizona: Tempe (MCZ).

Geographic range (map 10). — Southern portion of the United States from Oregon to New York, south through western Mexico to the Isthmus of Tehuantepec.



Map 10. California distribution of *Evagetes mohave* (Banks) (open circles) and *E. macswaini* Evans (closed circles). Inset: overall distribution of *E. mohave*.

California distribution (map 10). — We have seen 57 females and 37 males of this species which occurs sparingly over most of the state, from San Diego north to Humboldt and Siskiyou counties. It has been taken on the fringes of the desert at Victorville, Indio and Borrego and once on the floor of the Central Valley at Nicolaus, Sutter Co. There is one record of 4 males from Canada del Medio, Santa Cruz Island, taken May 7, 1968 (Schuster and Horning, UCD).

Seasonal occurrence. — This species has been collected during nearly every month of the year, although records for midwinter are from Mexico (1 ♂, Baja California Sur: Punta Lobos, 1 mi. S.E. Todos Santos, XII-25-1958, H.B. Leech, CAS; Sonora: Alamos, II-25-1963, P.H. Arnaud, CAS). In California, it is most common during the warmer months, May through September.

Undoubtedly sharing a fairly recent common ancestry with *Evagetes hyacinthinus* (Cresson), this species is separable from the latter primarily by the somewhat humped appearance of the ocellar region of the vertex in both sexes.

Biology. — Adult feeding of *Evagetes mohave* is not commonly witnessed. Honeydew secretions are sometimes visited. There is a single record of a male taken at honeydew on *Chrysothamnus*. Floral visitation records include *Asclepias* sp., *Croton californicus* and *Eriogonum trichopes*.

Evans (1950) made brief observations on this species at Manhattan, Kansas and found it entering the provisioned burrow of *Anoplius americanus ambiguus* (Dahlbom), while the female *ambiguus* was still inside filling the tunnel. When the cell was exposed, the *mohave* female was resting on the spider and presumably had eaten the egg of the original provisioner.

Evans et al. (1953) made more detailed observations of this species, again near Manhattan, Kansas. They found the host wasp to be *Anoplius apiculatus autumnalis* (Banks) which was nesting in a broad, flat area of sand, relatively devoid of vegetation and provisioning with the lycosid spider *Arctosa littoralis*. Females of *mohave* were found to enter the provisioned burrows of *autumnalis* while the females of the latter were inside. This did not seem to interrupt the provisioning cycle and the *autumnalis* oviposited and initiated the burrow-filling sequence with the *Evagetes* female inside. In several experiments with host and parasite wasps at this locality, they found that the *Evagetes* female eats the egg of the host wasp, then lays one of its own, placing it transversely on the dorsum of the anterior portion of the spider's abdomen. If the spider begins to recover from the effects of the *autumnalis* sting before the *mohave* female is able to oviposit, she stings it beneath the cephalothorax until it is once again in a paralyzed state. *Evagetes mohave* females avoid healthy spiders or those recently recovered from paralysis. They do not attempt to oviposit on suitably paralyzed but non-egg bearing

spiders. They react to a spider carrying the egg of another *mohave* as they do to one carrying an *autumnalis* egg.

Evagetes hyacinthinus (Cresson)

(Fig. 64; map 11)

Pompilus hyacinthinus Cresson, 1867:90. Holotype female, Connecticut (no further data). Lost.

Pompilus brevicornis Cresson, 1867:90. Lectotype male, Pennsylvania (no further data) (ANSP).

Pompilus castaneus Provancher, 1882:35. Lectotype male, Quebec: St. Hyacinthe (UL).

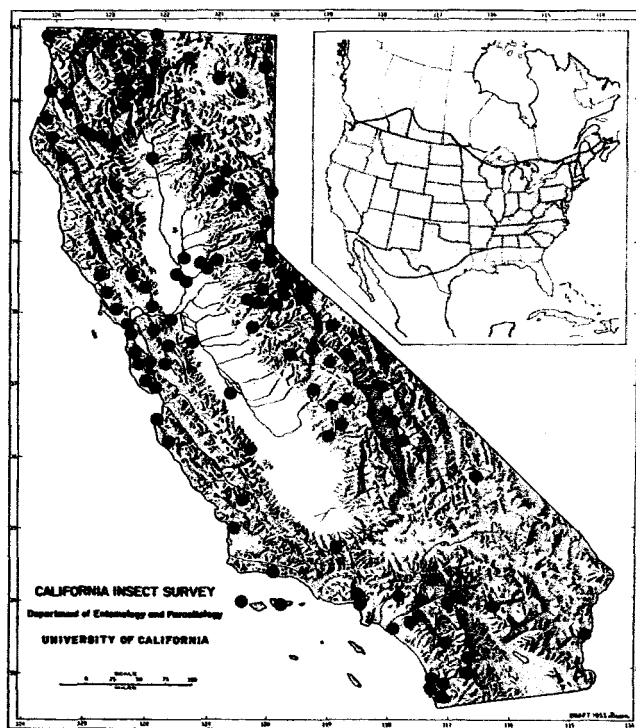
Pompilus (Arachnophila) scudleri Banks, 1917:104. Holotype female, Canada, Manitoba: Winnipeg (MCZ).

Sophropompilus bradleyi Banks, 1919:237. Holotype female, California: Sequoia National Park, Grant Forest (CU).

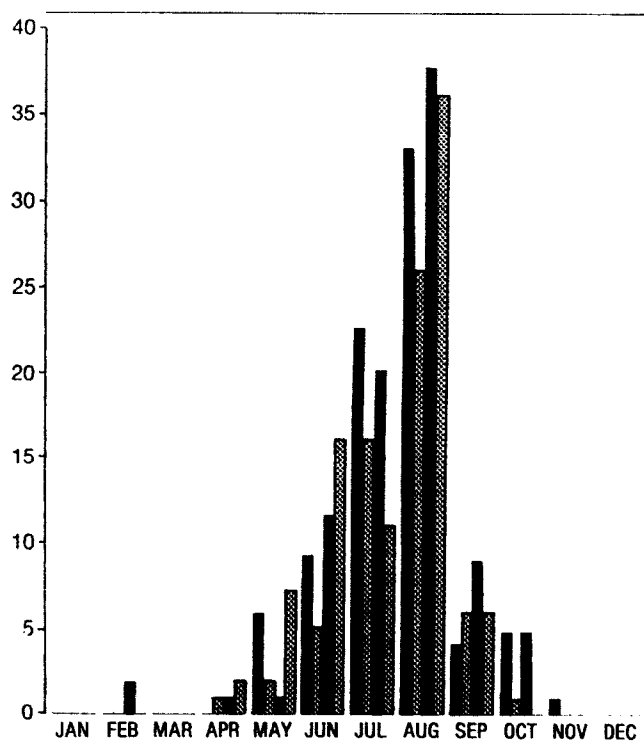
Nannopompilus texanus Banks, 1944:170. Holotype female, Texas: Richmond (MCZ).

Geographic range (map 11). — Across the continent from southern Canada to the tip of Baja California. The species has not been reported from the Mexican mainland but probably occurs in the northern portions.

California distribution (map 11). — This is a widespread and relatively abundant species in California with a broad habitat range, occurring from near sea level at various coastal localities to 3,050 m at Blanco's Corral in the White Mountains of Mono Co. It has been taken on two of the Channel Islands. Santa Cruz: Canada del Puerto, 1 ♀, V-9-1968 (R.O. Schuster, UCD); Christi Beach, 2 ♀♀, IX-22-1968 (R.L. Brumley, D.S. Horning, UCD). San Miguel: Willow Creek, 3 ♀♀, IV-25-1979 (S. Miller, SBM). Although there are a few desert records for *E. hyacinthinus*, it does not appear to be a common inhabitant of the Lower Sonoran Zone in California.



Map 11. California distribution of *Evagetes hyacinthinus* (Cresson). Inset: overall distribution.



Graph 5. Seasonal occurrence of *Evagetes hyacinthinus* (Cresson). Black columns represent females; gray columns are males.

Seasonal occurrence (graph 5). — There are records from February 20 (Playa de Rey, Los Angeles Co., California) to November 13 (Ehrenberg, Yuma Co., Arizona). The majority of collections have been made from May to October and the species seems to be most abundant during July and August.

The similarities between *Evagetes hyacinthinus* and *E. parvus* and the problems of separating them have been treated in the discussion of the latter.

Biology. — This species, like other *Evagetes*, is partial to open areas of light, sandy soil. It is frequently found near watercourses. Adults have been taken feeding on secretions from the extrafloral nectaries of *Helianthus annuus* and at flowers of *Atriplex semibaccata*, *Chrysothamnus* sp., *Daucus carota*, *Eriogonum Wrightii*, *Koeberlinia spinosa* and *Lomatium triternatum*. Evans (1950:181) gives a few additional floral visitation records but some of these may apply to *E. mohave*.

Evagetes calefactus Evans (Fig. 62)

Evagetes calefactus Evans, 1966:136. Holotype female, California: Warner Springs (San Diego Co.) (MCZ).

Geographic range. — California, Arizona, Montana and Texas.

California distribution. — We have seen no specimens of this species other than part of the type series, as follows: San Diego

County: Agua Caliente Creek, Warner Springs, 1 ♀, (holotype), 1 ♂ (allotype), VIII-25-1962 (H.E. Evans, MCZ).

Evagetes calefactus shares with *E. padrinus* the much narrowed SM3 in the anterior wing. The females of both species have long, slender comb spines on the anterior tarsus. The number of spines on the anterior basitarsus separates the two species. Females of *calefactus* have four; those of *padrinus* have three. In addition, the marginal cell of the anterior wing is uniformly larger in both sexes of *calefactus*.

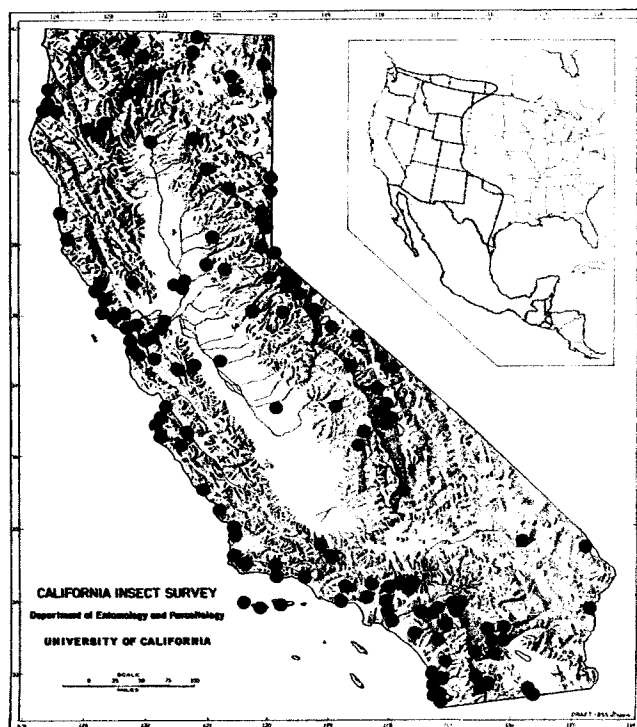
Biology. — Unknown.

Evagetes padrinus padrinus (Viereck) (Figs. 50, 60, 67; map 12)

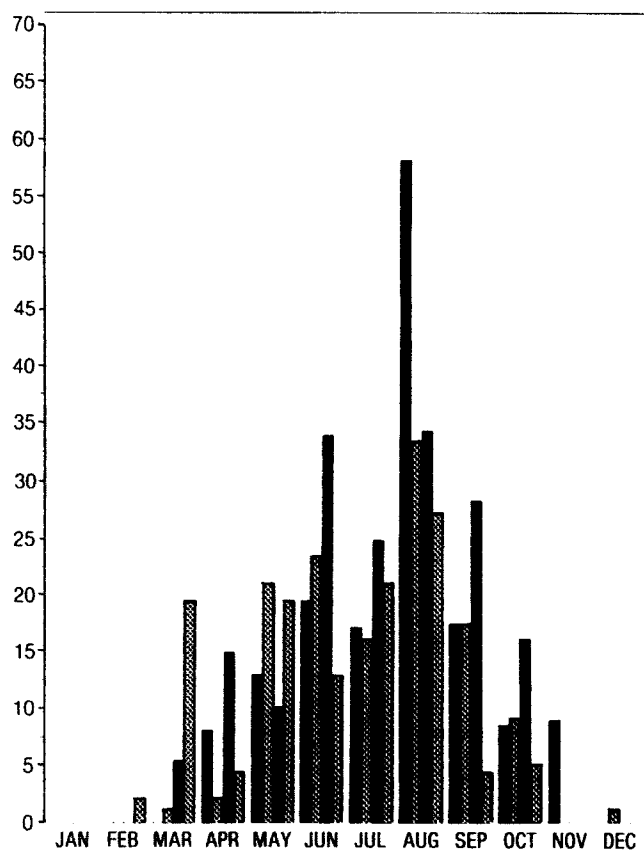
Anoplius (Pompilinus) padrinus Viereck, 1902:734. Holotype male, California: San Pedro (ANSP).

Geographic range (map 12). — Southern British Columbia south to El Salvador and east to Manitoba and Texas. In the eastern United States and northeastern Mexico, it is replaced by the subspecies *minusculus* (Banks).

California distribution (map 12). — *Evagetes padrinus padrinus* is widespread and abundant over the entire state at elevations from sea level to over 1,100 m, although infrequently encountered in the Central Valley and the Sonoran deserts. It occurs on the Channel Islands. San Miguel, Santa Cruz (Canada del Medio, La Cascada, Central Valley, Christi Beach, Fraser Point and Upper Valley). Santa Rosa (Canada Lobos, Cuyler Harbor, Windmill Canyon to Black Mountain). We examined 395 females and 235 males of this species.



Map 12. California distribution of *Evagetes padrinus padrinus* (Viereck). Inset: overall distribution.



Graph 6. Seasonal occurrence of *Evagetes padrinus padrinus* (Viereck). Black columns represent females; gray columns are males.

Seasonal occurrence (graph 6). — In California, *E. p. padrinus* has been collected during every month except January, although early and late season records are mostly from warmer, southern areas. The majority of collections have been May through September.

This small, bright bluish or greenish refulgent wasp is characterized in both sexes by the small third submarginal cell which is usually narrower on both the radius and cubitus than the second. In some specimens it is petiolate and occasionally is lacking entirely. The comb spines on the anterior tarsus of the female are long and slender. The apical comb spine of the basitarsus is usually at least 1.5 times as long as the second tarsal segment. In the male, the subgenital plate has the median carina elevated to form an arcuate ridge when viewed in profile. In addition to the characters given in the key, the ratio of the length of the marginal cell to its distance from the apex of the wing will separate both sexes of *Evagetes padrinus* from all other North American species of *Evagetes*. For *E. padrinus* this ratio is 0.42-0.63. In the other species it is 0.70-1.20.

Biology. — We have observed both sexes of this subspecies visiting extra-floral nectaries of *Helianthus annuus*, and have collected it at the

honeydew exuding from galls of *Disholcaspis eldoradensis* on *Quercus lobata*. It has also been taken at honeydew on *Chrysothamnus* sp. There are few floral visitation records but it has been collected at flowers of *Eriogonum Wrightii subscaposum*, *Euphorbia serpyllifolia* and *Phacelia* sp.

Nothing has been reported on the nesting habits or life cycle of this species.

Evagetes subangulatus (Banks) (Figs. 55, 69; map 13)

Sophropompilus subangulatus Banks, 1919:237-239. Holotype female, California: Ingleside, San Francisco (CU).

Psammochares (Sophropompilus) tebemi Brimley, 1936:127. Holotype female, North Carolina: Smokemont (NCDA).

Geographic range (map 13). — Transcontinental in the United States and Canada extending as far north as Labrador and the Yukon and as far south as the mountains of southern California, Arizona and New Mexico. There is one record from the gulf coast of southern Texas.

California distribution (map 13). — Great Basin montane, Siskiyou Mountains, Coast Ranges and Sierra Nevada with a few records from southern California montane. We have seen specimens from Santa Rosa Island: Water Canyon, 100'-750', 1 ♂, VI-10-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM) and Windmill Canyon, 50'-250', 1 ♂, VI-7-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).



Map 13. California distribution of *Evagetes subangulatus* (Banks). Inset: overall distribution.

Seasonal occurrence. — This is primarily a midsummer species. Of the 121 females and 98 males we have examined, the majority have been taken in July and August, although there are records as early as February and as late as October.

Allied with *Evagetes macswaini* and *E. crassicornis* by the broadly angulate posterior pronotal margin, this species is distinguishable in both sexes from the latter two species by the dark bluish cast usually imparted to the body by the pubescence, the more robust form and the long, erect hair on the propodeum. In addition, the comb spines on the anterior tarsus of the females are longer than in *macswaini* and *crassicornis*. The antennae are longer than in other species of *Evagetes*.

Biology. — In California, we have taken both sexes of *E. subangulatus* at honeydew from the aphid *Chaitophorus populicola* on *Populus trichocarpa*. In Oregon, males have been taken at extrafloral nectaries of *Helianthus annuus*. Floral visitation records include *Euphorbia serpyllifolia* and *Foeniculum vulgare*. Evans (1950) records the species from flowers of *Solidago* and *Spiraea*. No information has been published on the nesting habits.

Evagetes crassicornis consimilis (Banks)
(Figs. 57, 63; map 14)

Pompilus consimilis Banks, 1912:228. Holotype female, Colorado: Florissant (USNM).

Geographic range (map 14). — Canadian and Transition zones of the western United States and Canada. To the east and north, it is replaced by the nominate subspecies.

California distribution (map 14). — Siskiyou, Sierra Nevada and San Bernardino Mountains at elevations usually above 2,100 m.

Seasonal occurrence. — We have seen 34 females and 32 males of this species, nearly all of which were taken during June, July and August. There is one record for May 8 at Reno, Nevada (I. La Rivers, CIS) and one for September 9 at Dock Well, Siskiyou Co., California (T. Haig, CDFA). Both these areas are at lower elevations than the species is usually found.

Of the three *Evagetes* species with an angulate posterior pronotal margin, *crassicornis consimilis* is very similar to *macswaini* Evans in the female. It may be separated from the latter by silvery pubescence at least on the posterior surface of the posterior coxa and very short, scattered erect hairs on the propodeum. *Evagetes macswaini* is entirely dark and the propodeum is without erect hairs. The males are easily separated by details of the subgenital plate and genitalia as given in the key.

Biology. — We have seen only one record of this species visiting flowers, a male taken on July 5,



Map 14. California distribution of *Evagetes crassicornis consimilis* (Banks). Inset: overall distribution.

1967, at Craters of the Moon National Monument, Idaho on flowers of *Heracleum lanatum* (D.S. Horning, MSW). Evans (1950) records it from flowers of *Cleome serrulata*.

The provisioning biology of *E. crassicornis consimilis* has not been reported, but the nominate subspecies has been studied in Europe by Ferton (1901) and Adlerz (1910). Their observations indicate a cleptoparasitic habit similar to that of *Evagetes mohave* (Banks), the females preying on *Pompilus unguicularis* Thoms. and *Episyron rufipes* (Linn.).

Evagetes macswaini Evans
(Figs. 58, 66; map 10)

Evagetes macswaini Evans, 1957:181-182. Holotype male, California, Mono County: Blanco's Corral, White Mts. (CAS).

Geographic range. — California and Wyoming.

California distribution (map 10). — This entirely black species of the Central Sierra Nevada and White Mountains is an inhabitant of high elevation meadows and is not commonly found below 2,700 m. California records are as follows: Fresno Co.: Humphrey's Basin, 14 mi. S.W. Bishop, 1 ♀, IX-23-1965 (M. Wasbauer, MSW). Inyo Co.: Mono Pass, 2 ♂♂, 2 ♀♀, VIII-13-1957 (D.D. Linsdale, J.A. Powell, CIS); near Mono Pass, 12,000', 4 ♀♀, VIII-8-1956, VIII-12-1957 (C.D. MacNeill, CAS, MSW); Mt. Starr, 10,500', 1 ♂, 1 ♀, VI-30-1974 (T. Griswold, MSW).

TG); Northwest Upper Rock Creek, 10,000', 1 ♀, VIII-14-1963 (M. Tauber, C. Toschi, CIS). Mono Co.: Sheep Mountain, White Mtn, 11,200', 1 ♂, 1 ♀, VII-5-1961 (J.A. Powell, CIS); Blanco's Corral, White Mts., 10,000', 1 ♂, VI-30-1953 (J.W. MacSwain, CAS) (Holotype); 2 ♂♂, same data, VI-14 to 15-1954 (D. Burdick, C.D. MacNeill, CIS) (paratypes); Arrowhead Lake, 2 mi. S.E. Lk. Mary, 9700', 1 ♀, VIII-22-1977 (J.A. Powell, CIS); Big McGee Lake, 10,500', 1 ♀, VII-2-1974 (T. Griswold, TG). Tuolumne Co.: Sonora Pass, 9-10,000', 2 ♂♂, VII-11-1957 (J.W. MacSwain, CIS);

same data, 1 ♀, VIII-19-1955 (J.W. MacSwain, CIS); same data, 1 ♀, VIII-10-1957 (D.D. Linsdale, CIS); Tuolumne Meadows, 1 ♀, VIII-19-1955 (J.W. MacSwain, CIS).

Seasonal occurrence. — The 8 males and 15 females we examined were taken from mid June to the latter part of September. Probably there is a single annual generation.

The biology of the species is unreported.

Genus *Tastiotenia* Evans

The monotypic genus *Tastiotenia* is confined to the warmer, more arid regions of the southwestern United States and northern Mexico. In California, the distribution is limited to the Colorado and Mojave deserts.

Tastiotenia presents a puzzling array of characteristics, some, such as the lack of a posterior rim on the propodeum and the compressed hypopygium of the female, appearing quite specialized. Others, such as the broad head and narrow compound eyes, are pepsine-like and seem rather primitive with respect to other genera of Pompilini.

Tastiotenia festiva Evans (Fig. 27; map 15)

Tastiotenia festiva Evans, 1950:152. Holotype female, Mexico. Sonora: Guaymas (USNM).

Geographic range (map 15). — Desert areas from southern California to western Texas, south into northern Mexico (Sonora and Baja California).

California distribution (map 15). — Mojave (1 record) and Colorado deserts of southern California.

Seasonal occurrence. — Throughout the summer months. There are records from the last week in March to the third week in October. We have examined 31 females and 51 males of this species.

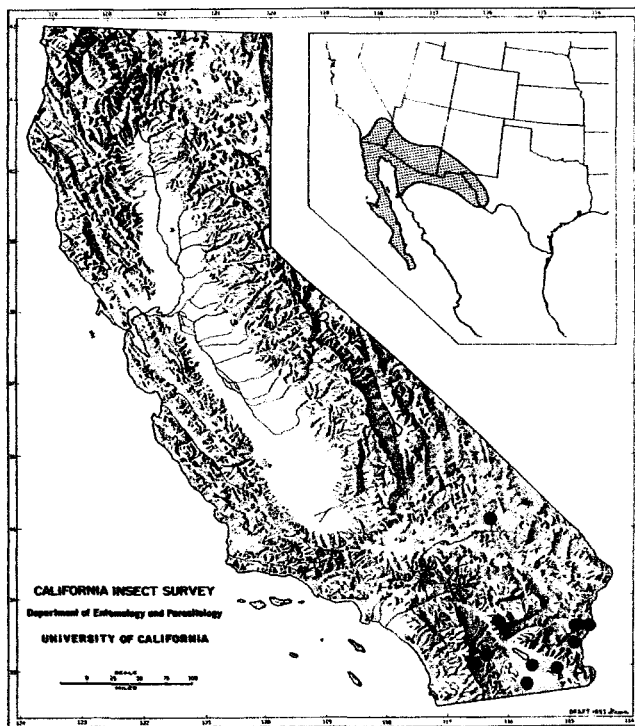
Biology. — Males have been taken at the extrafloral nectaries of *Helianthus annuus* and at flowers of *Wislizenia refracta*. Females have been recorded at flowers of *Haplopappus gracilis*, *Eriogonum* sp. and *Prosopis* sp. Both sexes have been found on flowers of *Croton californicus*, *Euphorbia polycarpa* and *Stillingia* sp.

Evans (1961) made the only biological observations on this species. He found a female at Rodeo, New Mexico entering the burrow of *Tachytes distinctus distinctus* Smith (Sphecidae) and examining a paralyzed immature black widow spider, *Latrodectus mactans* (Fabricius) (Theridiidae) which was lying just inside the entrance. Subsequent examination showed the spider to have been mutilated. This observation indicates that *T. festiva* may utilize the open

In addition to the diagnostic characters given in the keys, the genus is recognized by the small size, yellowish to cream-colored pronotal stripe and lack of erect hair. The females possess red and black bodies and clear wings with extensive apical infuscation. The males have short, truncate antennae and flattened, blade-like hind tibial spurs.

Little is known about the biology of *Tastiotenia*, but Evans (1961) found evidence that burrows of other wasps are used and that widow spiders of the genus *Latrodectus* are taken as prey.

burrows of other aculeate Hymenoptera and may prey upon theridiid spiders. Further biological studies might help to clarify the taxonomic relationships of this seemingly anomalous genus and species.



Map 15. California distribution of *Tastiotenia festiva* Evans. Inset: overall distribution.

Genus *Agenioideus* Ashmead

Occurring in every zoogeographic region of the world, *Agenioideus* exhibits extraordinary structural diversity. The New World fauna contains seven species distributed among four subgenera. Three of these subgenera occur in North America. All three are represented in California, each with one species. The fourth subgenus, *Enbanksia* Evans contains two Brazilian and one Panamanian species.

In general, the species of this genus bear a superficial resemblance to members of the pepsine tribe Ageniellini. They are small wasps of slender build and delicate appendages. The integumental color of most U.S. species is black, some with limited pale markings, while one austral species that ranges into Arizona is reddish. The wings may be infuscate or hyaline with bands. The subdiscoidal vein of the anterior wing reaches to or nearly to the wing margin, and the second recurrent meets

the subdiscoidal nearer the apex than in most other Nearctic genera. The propodeum of the females is sometimes rugose, and in the males the apex of the metasoma is pale dorsally. The New World species have been reviewed by Evans (1950, 1965, 1966, 1968).

Information on the biology of *Agenioideus* is sketchy. Those species for which any biological information is available seem to be rather generalized spider hunters, nesting in sandy ground or in pre-existing cavities of various kinds. Biological information on the genus for North America has been summarized by Evans and Yoshimoto (1962).

Agenioideus rubicundus Evans, described from Mexico, is known from the United States [Arizona: Pima Co., Sabino Canyon, X-28-1958, J.W. MacSwain (CIS)]. The species is thus included in the following key but is not treated further.

KEY TO NORTH AMERICAN SPECIES
OF *AGENIOIDEUS*

- | | | | |
|---|--------------------------|--|--------------------------|
| 1. Females | 2 | 5. Third Antennal segment about 3X as long as wide; SGP nearly flat; genitalia (fig. 72) with gonostyli slender, slightly curved (subgenus <i>Ridestus</i>) | 6 |
| Males | 5 | Third antennal segment not over 2.5X as long as wide; SGP strongly compressed, keeled; genitalia (figs. 73, 74) with gonostyli elbowed | 7 |
| 2. Apical tarsal segments with a median row of spines ventrally (subgenus <i>Ridestus</i>) | 3 | 6. Integument red, occasionally with some black on mesosoma | <i>rubicundus</i> Evans |
| Apical tarsal segments without a median row of spines ventrally | 4 | Integument entirely black | <i>biedermani</i> Banks |
| 3. Integument red | <i>rubicundus</i> Evans | 7. Posterior tibia with a white spot; genitalia (fig. 74) with aedeagus constricted subapically (subgenus <i>Agenioideus</i>) | <i>humilis</i> (Cresson) |
| Integument black | <i>biedermani</i> Banks | Posterior tibia without a white spot; genitalia (fig. 73) with aedeagus not constricted subapically (subgenus <i>Gymnochaeres</i>) | <i>birkmanni</i> (Banks) |
| 4. Anterior wing hyaline with apical and subapical infuscate bands; tarsal comb present; posterior tibia often with a white spot (subgenus <i>Agenioideus</i>) ... | <i>humilis</i> (Cresson) | | |
| Anterior wing more or less uniformly infuscate; tarsal comb absent; posterior tibia without a white spot (subgenus <i>Gymnochaeres</i>) | <i>birkmanni</i> (Banks) | | |

Agenioideus (*Agenioideus*) *humilis* (Cresson)
(Fig. 74; map 16)

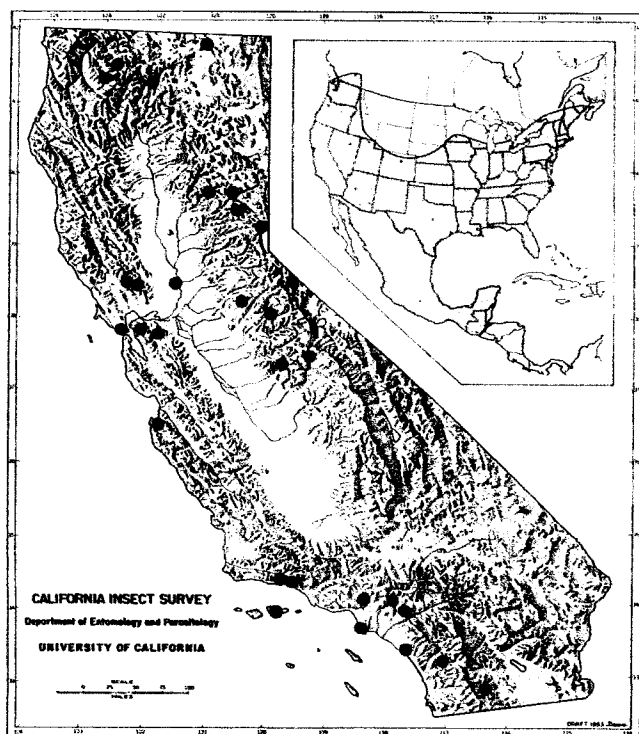
Pompilus humilis Cresson 1867:91. Holotype female, New York, no further data (ANSP).

Geographic range (map 16). — Widely distributed, from southern Canada and throughout the United States, south to Guatemala.

California distribution (map 16). — Although widespread, the species is not commonly encountered. We have seen 63 females and 55 males from the Coast Ranges, Sierra Nevada and Siskiyou Mountains. Apparently *humilis* is absent from the north coast and the deserts of California. There is one record from the Central Valley: Davis, 1 ♀, IX-15-1949 (E.I. Schlinger, UCD), and a single record from Santa Cruz Island: Canada del Medio, U.C. Res. Sta., 1 ♂, VIII-26-1971 (C. Remington, PM).

Seasonal occurrence. — From the records we have seen, the species is most frequently collected in June through September. Evans (1950:198) stated that most of the records he had seen were for spring and early summer in the southern part of the range and midsummer farther to the north.

Agenioideus humilis is readily separated in both sexes from the other Pompilini by the markings on the anterior wing. There is a narrow curved band just before the apex and a spot in the region of the marginal, submarginal and third discoidal cells. From the other two species of *Agenioideus* in our fauna, it is easily distinguished by the wing banding and by characters given in the key.



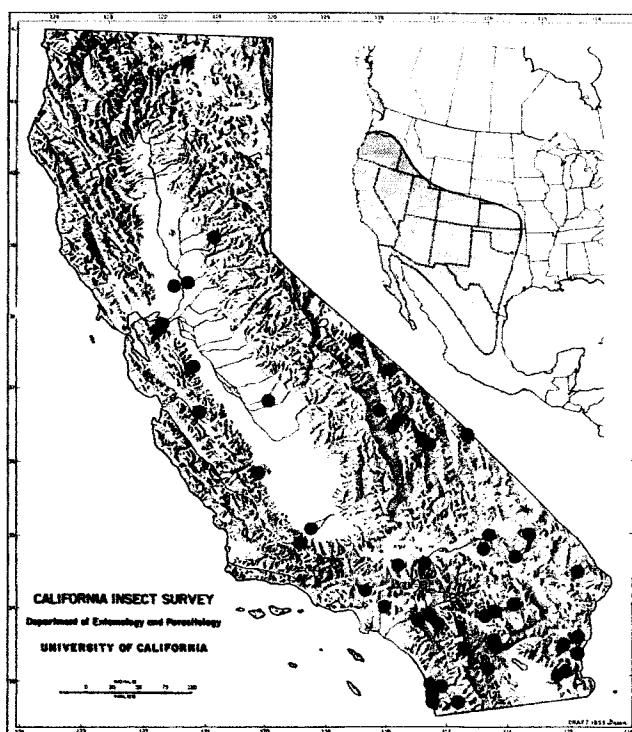
Map 16. California distribution of *Agenioideus (Agenioideus) humilis* (Cresson). Inset: overall distribution.

Biology. — There are no records of adult feeding at flowers or honeydew secretions. Probably this accounts for the relative scarcity in collections of this widespread species. It is possible that females sometimes feed on body fluids of the spiders they attack, although there is no evidence, as yet, to corroborate this.

Evans and Yoshimoto (1962) summarized the earlier published prey records for *humilis*. A California record of *Araneus bispinosus* (Keyserling) is given by Wasbauer (1983). All prey thus far recorded have been orb-weaving spiders of the family Araneidae. Adults have been reared from cocoons in pulverized sandstone at the base of a cliff at Mt. Diablo, California. In addition to the pompilid, an unidentified bombyliid fly and mutillid wasp larva were found in cocoons (Hurd, 1947). Details of prey capture are given by Eberhard (1970) who found the wasp attacking *Araneus cornutus* Clerck on the windows and shingled walls of a cottage at Rensselaerville, New York. Krombein (1953a) reported on prey transport and nest construction. The prey in this case was *Acacesia hamata* (Hentz).

Agenioideus (Ridestus) biedermanni (Banks)
(Figs. 71, 72; map 17)

Pompilus mexicanus Taschenberg, 1869:52. Holotype female, "Mexico" (Zool. Inst., Halle, Germany). Preoccupied by *mexicanus* Cresson, 1867.



Map 17. California distribution of *Agenioideus (Ridestus) biedermanni* (Banks). Inset: overall distribution.

Psammochares biedermanni Banks, 1910:116. Holotype male, Arizona: Parmerlee (MCZ).

Psammochares striatulus Banks, 1910:119. Holotype female, Arizona: Parmerlee (MCZ).

Psammochares transversalis Banks, 1910a:248. Holotype female, Arizona: Parmerlee (MCZ).

Arachnophroctonus anahuacensis Bradley, 1944a:10. New name for *mexicanus* Taschenberg, 1869.

Geographic range (map 17). — Arizona east to Kansas, south to the Mexican states of Baja California and Hidalgo. We have seen 77 females and 133 males.

California distribution (map 17). — Seemingly characteristic of xeric areas, this species occurs throughout the deserts of southern California, the Great Basin, inner Coast Ranges and the Central Valley.

Seasonal occurrence. — An early record for this species is a male taken on February 16 at Williams Spring, Organ Pipe Cactus National Monument, Arizona (P.H. Arnaud, CAS). Females have been taken as late as November 19 at Riverside, California (E.I. Schlinger, UCD). The number of records in each month from March through October indicates that the species is probably multivoltine.

Both males and females are superficially very similar to *A. (Gymnochares) birkmanni*. Males can be distinguished most readily by proportions of the third antennal segment which is about 3 times as long as wide in *biedermanni* and not over 2.5 times as long as wide in *birkmanni*. In females of *biedermanni* the apical segment of the anterior tarsus has a median ventral row of spines which is lacking in *birkmanni*.

Biology. — Males have been found visiting honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata* in southern California and honeydew of *Tachardiella cornuta* on *Flourensia cernua* near Rodeo, New Mexico. Both sexes have been taken on flowers of *Asclepias erosa*; females on *Baileya multiradiata*, *Cercidium* sp., *Chrysothamnus albidus* and *Solidago* sp.; males on *Baccharis sarothroides*, *Chilopsis* sp., *Chrysothamnus* sp., *Croton californicus* and *Prosopis juliflora*.

The nesting biology of *A. biedermanni* is unreported. There is one published account of prey and its transport. Evans (1959a) reported on a female found with a male of *Loxosceles devius* Gertsch and Mulaik (Loxoscelidae). The wasp was walking backwards up a clay bank dragging the spider along sideways by one of the hind legs.

Agenioideus (Gymnochaeres) birkmanni (Banks)
(Fig. 73; map 18; graph 7)

Psammochares birkmanni Banks, 1910:116. Holotype male, Texas: Lee Co. (MCZ).

Gymnochaeres texana Banks, 1944:170. Holotype male, Texas: Austin (MCZ).

Geographic range (map 18). — Northern Oregon east to New Jersey and south to Oaxaca, Mexico.

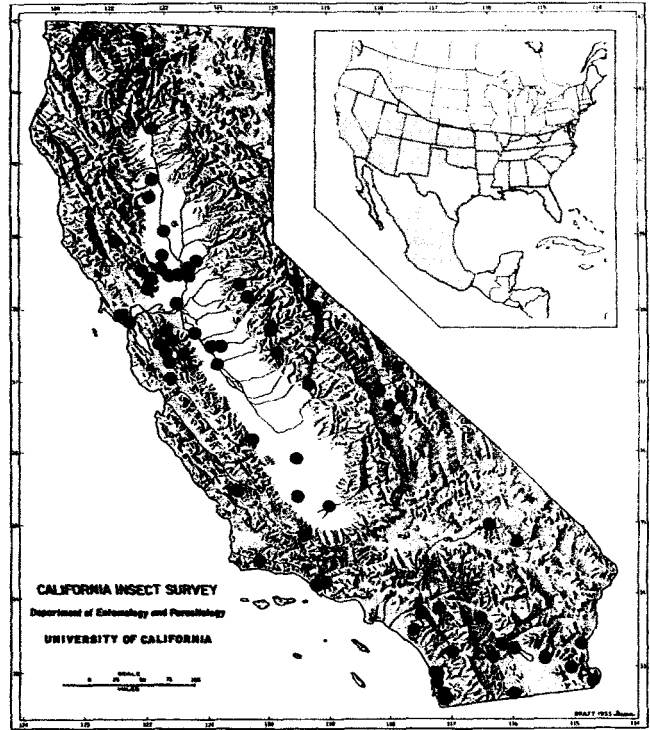
California distribution (map 18). — This species occurs over most of the state, mainly in the Transition, Upper and Lower Sonoran Life Zones. It has been taken from below sea level near the Salton Sea to 2,500 m in the Sierra Nevada. We have examined 98 females and 264 males.

Seasonal occurrence (graph 7). — Collection records indicate the appearance of this species as early as March and its persistence until December. The majority of records are for June to September, with a definite peak in September.

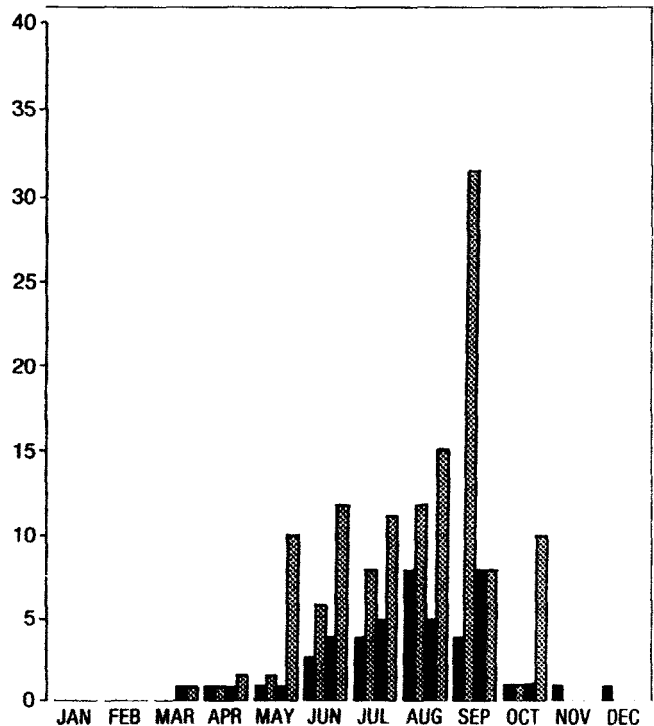
A. birkmanni superficially resembles *A. biedermanni* (see discussion of the latter).

Biology. — Males have been taken visiting honeydew on the following: galls of *Disholcaspis eldoradensis* on *Quercus lobata*, leaves of *Populus trichocarpa* and *Chrysothamnus* sp. Males have also been taken on extra-floral nectaries of *Gossypium hirsutum* and *Helianthus* sp. Floral visitation records include females taken at *Asclepias* sp., *Chrysothamnus* sp., and *Foeniculum vulgare* and both sexes at *Atriplex semibaccata* and *Croton californicus*.

The nesting biology is not known but Kurczewski and Kurczewski (1968a) record the gnaphosid spider *Herpyllus vasifer* (Walckenaer) taken as prey in Hardin County, Texas.



Map 18. California distribution of *Agenioideus (Gymnochaeres) birkmanni* (Banks). Inset: overall distribution.



Graph 7. Seasonal occurrence of *Agenioideus (Gymnochaeres) birkmanni* (Banks). Black columns represent females; gray columns are males.

Genus *Sericopompilus* Howard

As currently understood, *Sericopompilus* consists of three species, two of which are confined to the southern Nearctic and one which extends from the southern United States as far south as Costa Rica. Only one of these, *neotropicalis* (Cameron), the more widespread species, occurs in California.

In gross appearance the members of this genus somewhat resemble species of *Agenioideus*, and the resemblance is more than superficial, for a number of fundamental traits align the two genera along with *Episyrus*, *Austrochares*, and *Poecilopompilus* in a well defined assemblage. These traits include the apical position of the second recurrent vein in the anterior wing, the dorsolateral expansions of the postnotum, the strong convergence of the compound eyes dorsally in the females and the pale integumental markings of the males.

From other genera in this assemblage, *Sericopompilus* is separable by the combination of dentate tarsal claws, cubitus of the posterior wing meeting the media proximad of the apex of the submedian cell, lack of ventral spines on the apical

tarsal segments of the females and slender metasoma of the males.

The most recent taxonomic treatments of the genus are those of Evans (1950, 1966).

The species most northerly in its distribution, *S. apicalis* (Say) is the only one on which biological observations have been made. Studies on this wasp have been summarized by Evans and Yoshimoto (1962). Hunting most often takes place in vegetation, with paralysis of the prey usually complete and permanent. Paralyzed spiders are often left in vegetation above ground while the female explores for a suitable place to construct the nest. Nesting is in open situations with light, friable soil. Females dig their burrows from the surface or start them from inside rodent burrows or other natural cavities. Evans and Yoshimoto list five families (Anyphaenidae, Thomisidae, Salticidae, Oxyopidae and Araneidae) and eleven genera as prey. Kurczewski and Kurczewski (1973) record an additional prey genus in the Araneidae. Adults of both sexes have been taken feeding at flowers and on honeydew.

Sericopompilus neotropicalis (Cameron)
(Figs. 10, 15; map 19)

Pompilus neotropicalis Cameron, 1893:203. Holotype female, Guatemala: San Geronimo (BMNH).

Pompilus guatemalensis Cameron, 1893:206. Holotype male, Guatemala: San Geronimo (BMNH).

Psammochares posticatus Banks, 1910:119. Holotype male, Texas: Lee Co. (MCZ).

Psammochares fuscipennis var. *georgiana* Banks, 1911a:238. Holotype female, Georgia: Bainbridge (MCZ).

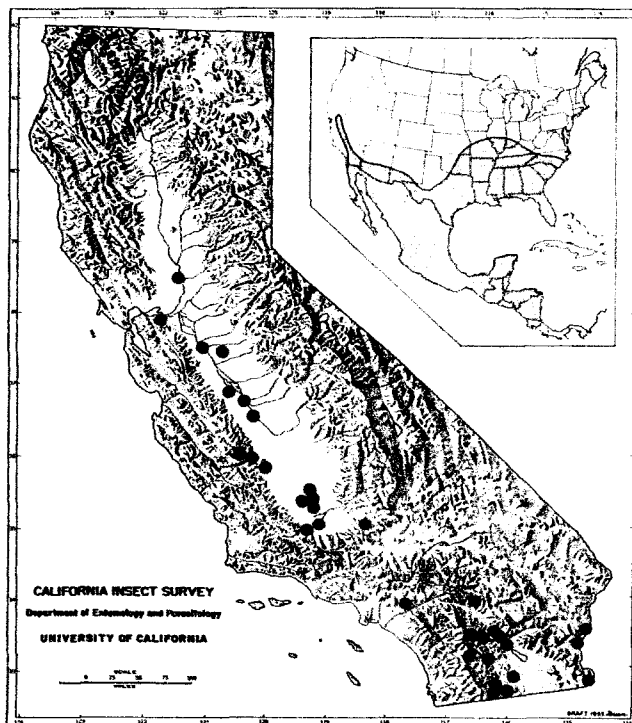
Geographic range (map 19). — Central Valley of California, southern portions of Arizona, New Mexico and Texas, central Illinois and North Carolina south to Costa Rica.

California distribution (map 19). — Primarily a Lower Sonoran element, *S. neotropicalis* is confined to the Central Valley and the deserts in California. We have examined 181 females and 129 males, of which 53 females and 27 males are from California.

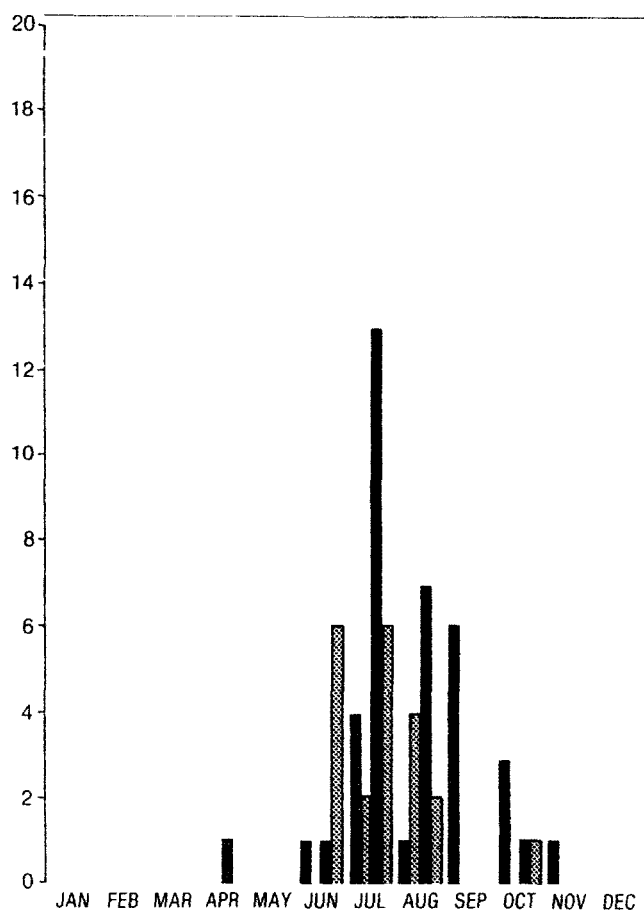
Seasonal occurrence (graph 8). — Early and late season capture dates for California are San Diego County, Borrego, 1 ♀, April 25, 1954 (M. Wasbauer, CIS) and Kings County, 2 mi. southwest Kettleman City, 1 ♀, November 15, 1974 (J.A. Powell, CIS). There are multiple records for June through October with the peak in July.

The black thorax and entirely red abdomen of the female, the yellow spots anteriorly on the pronotum, mostly hyaline wings, large ocelli and broad yellow band on the middle basitarsus in the

male distinguish this species from *apicalis* (Say) and *angustatus* (Cresson), the other members of *Sericopompilus* in the United States.



Map 19. California distribution of *Sericopompilus neotropicalis* (Cameron). Inset: overall distribution.



Biology. — *S. neotropicalis* is frequently collected at flowers or other nectar sources and occasionally at honeydew. Males have been taken at extrafloral nectaries of *Gossypium hirsutum* and *Helianthus annuus*, and both sexes have been taken visiting honeydew of *Tachardiella cornuta* on *Flourensia cernua*. Floral visitation records are males: *Asclepias erosa*; females: *Baccharis* sp., *Chrysothamnus* sp., *Cleomella* sp., *Eriogonum fasciculatum* and *inflatum*, *Gutierrezia* sp., *Haplopappus Hartwegi*, *Koeberlinia spinosa*, *Melilotus* sp., *Pectis papposa* and *Wislizenia refracta*; both sexes: *Asclepias subverticillata*, *Baccharis glutinosa*, *Croton californicus*, *Lepidospartum* sp., and *Tamarix gallica*. Evans (1950) reports the species as a visitor of *Sphaeralcea angustifolia* flowers.

The nesting behavior has not been reported and there is but one record of prey, a female from Cochise County, Arizona which was pinned with a female of *Misumenops* sp. (Thomisidae) (Wasbauer, 1983).

Graph 8. Seasonal occurrence of *Sericopompilus neotropicalis* (Cameron). Black columns represent females; gray columns are males.

Genus *Episyron* Schiodte

Episyron is a cosmopolitan genus, occurring in all major zoogeographic regions. The Nearctic fauna consists of five species, one of which enters South America. All these species except one, which occurs in the west, are widespread in the United States. Two are separable into several geographic populations that have been treated as subspecies. Representatives of all five species are found in the California fauna.

The genus, although forming a close-knit group with several other genera, is immediately distinguishable from all other Nearctic spider wasps by the presence of specialized, appressed, scale-like pubescence on the first metasomal tergum and parts of the thorax and propodeum.

By contrast, within *Episyron*, the species are all quite uniform morphologically, and not easily separable. There appear to be no constant differences in the male genitalia of at least the Nearctic forms, so males as well as females must be allocated mainly on the basis of color, pubescence and more subtle characters, including measurement ratios. The most recent taxonomic work on Nearctic species is that of Evans (1950).

Biological information is available on four of the five Nearctic species of *Episyron*. Evans and Yoshimoto (1962) summarized the published information and provided new data on one species.

Wasps of this genus, like those of the preceding, seem to prefer open, somewhat sandy situations, frequently around watercourses. All species studied to date, hunt in vegetation and show preference for Araneidae as prey, almost to the exclusion of other spider families. Paralysis of the prey is complete and usually permanent. Females of all species transport their paralyzed spiders by backing over the ground dragging them behind or by carrying them in flight. Often, a single individual will alternate between these methods of transport. The spider is usually placed off the ground on a plant during nest construction and often visited one or more times during the course of excavation. The nest consists of a short, oblique burrow terminating in a single enlarged cell. After the spider has been entombed, an egg is laid on its abdomen. Position of the egg is variable. The burrow is filled rapidly and the tip of the wasp's abdomen is used to pack the soil. Nesting is sometimes gregarious, females nesting in the same small area on successive days.

KEY TO CALIFORNIA SPECIES AND SUBSPECIES OF *EPISYRON*

1. Females 2
Males 6
2. Anterior basitarsus with 4 comb spines; UID about 0.85 X LID; vertex not strongly raised above tops of eyes.....
quinenotatus hurdi Evans
Anterior basitarsus with 3 comb spines; either UID less than 0.78 X LID or vertex raised in an arc above tops of compound eyes..... 3
3. At least posterior legs partly reddish; pronotum with a pale band posteriorly.....*conterminus posterus* (Fox)
All legs entirely black; pronotum without a pale band posteriorly..... 4
4. Length of third antennal segment subequal to or greater than UID; ocelli with front angle about or very slightly greater than a right angle.....
biguttatus californicus (Banks)
Length of third antennal segment 0.9 or less the UID; ocelli forming a broad triangle, the front angle noticeably greater than a right angle..... 5
5. Head, mesosoma and T1 at most very slightly hairy; pronotum long, posterior margin arcuate; head thin, lenticular, temples reduced.....*snowi* (Viereck)
Head, mesosoma and T1 conspicuously hairy; pronotum shorter, posterior margin slightly angulate; head with temples well developed.....*oregon* Evans
6. Antenna with length of penultimate segment not over 1.5 X its greatest width; middle and posterior tibial spurs nearly pure white; mandible with a whitish spot near middle of outer surface; head and pronotum with hair mostly pale 7

- Antenna with length of penultimate segment 1.5-2.5 X its greatest width; middle and posterior tibial spurs dirty white to black; mandible without a whitish spot; head and pronotum with hair mostly dark 8
7. Wings milky translucent; pronotum as long or nearly as long as mesonotum, usually without a yellow band posteriorly; antenna with distal segments notably constricted at base (fig. 80); legs black. *snowi* (Viereck)
Wings nearly clear hyaline except at apex; pronotum shorter than mesonotum, with a pale yellow band on posterior margin; antenna with distal segments not or scarcely constricted at base (fig. 79); legs often reddish
conterminus posterus (Fox)
 8. Vertex strongly raised in an arc above tops of compound eyes; temples more strongly developed (fig. 78); apical metasomal tergum black, at most with a slight pale suffusion*oregon* Evans
Vertex not strongly raised above tops of compound eyes; temples not well developed (fig. 77); apical metasomal tergum with a large whitish spot 9
 9. Apex of anterior tibia and base of posterior tibia with or without pale markings; pronotum with posterior margin distinctly angulate (fig. 75).....
quinenotatus hurdi Evans
Apex of anterior tibia black, without pale markings; base of posterior tibia with a pale spot or stripe; pronotum with posterior margin arcuate or feebly angulate (fig. 76).....
biguttatus californicus (Banks)

Episyrion quinenotatus hurdi Evans (Fig. 75; map 20; graph 9)

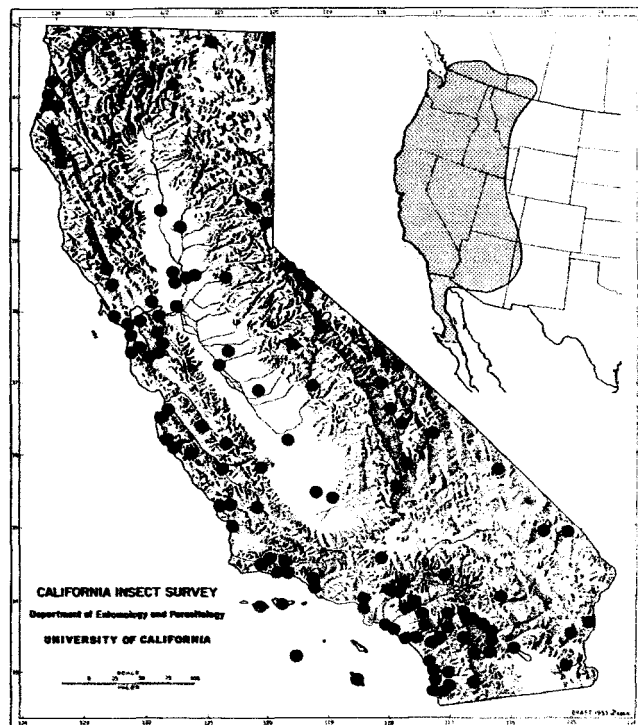
Episyrion quinenotatus hurdi Evans, 1950:221. Holotype female, California, Contra Costa Co.: Antioch (CAS).

Geographic range (map 20). – Southern British Columbia south to Baja California, east to southern Alberta, Idaho, Utah, Arizona and western New Mexico.

California distribution (map 20). – Widespread throughout the state at elevations from sea level to about 1,500 m, in the Lower and Upper Sonoran and Transition zones. In addition to mainland localities, the subspecies has been taken on the Channel Islands: San Clemente (China Pt., Eel Pt., sand dune area); San Nicolas (Celery Cyn., Fennel Cyn., Vizcaino Pt., Cyn. between Celery and Mineral Cyn., sand spit to cyn. below sewage ponds); Santa Cruz (Canada del Medio, Prisoner's Harbor); Santa Rosa (Beachers Bay). We have examined 324 females and 315 males of this relatively abundant wasp.

Seasonal occurrence (graph 9). – A midsummer form, it has been taken from March to October, most commonly in June, July and August.

Episyrion quinenotatus and *E. biguttatus* are quite closely related species. The females, although appearing superficially nearly identical, are separable by several reliable characters as given in the key, but as was true 30 years ago (Evans,



Map 20. California distribution of *Episyrion quinenotatus hurdi* Evans. Inset: overall distribution.

1950:218), "Even today really precise characters for separating the males of *quinquenotatus* and *biguttatus* are not known." Differences in most external morphological traits seem to be lacking and there are no discernable differences in the genitalia. The only characters for separating males of the two species are the shape of the posterior margin of the pronotum (which is somewhat variable) and minor color features.

The larval morphology of the subspecies *hurdi* is unknown, but Evans (1959:439) described and figured the larva of the nominate subspecies.

Biology. — A number of adult feeding records are available for *hurdi*. Evans (1950:222) gives several floral visitation records: *Daucus carota*, *Cicuta* sp., *Cleome serrulata*, *Cirsium* sp., *Eriogonum* sp., *Solidago* sp. and *Asclepias* sp. From specimens we have examined, we add the following for females: *Baccharis* sp., *Eriogonum latifolium auriculatum*, *Melilotus albus*, *Tetradymia canescens* and water hemlock; for males: bull thistle, *Chrysothamnus viscidiflorus*, *Dalea polyadenia*, *Eriogonum latifolium nudum*, *Larrea* sp., *Lotus* sp., *Psoralea lanceolata*, *Tamarix* sp., and *Tetradymia comosa*; for both sexes: *Heliotropium curassavicum* and *Wislizenia refracta*. In addition, females have been recorded visiting extra-floral nectaries of *Helianthus* sp.

There is no published information on the nesting biology of *hurdi*. Evans (1950) recorded a male pinned with an immature *Epeira* sp. (Araneidae). A number of observations have been

published on the prey and nesting behavior of the nominate subspecies in the eastern U.S. Evans and Yoshimoto (1962) summarized this information. Subsequent studies have provided some additional information (Evans, 1963, 1970; Kurczewski and Kurczewski, 1968, 1968a).

Prey consists of species in six genera of araneid spiders. Paralysis of the prey is complete and usually permanent. Females construct their nests in sand or loose, sandy soil. They transport their prey by walking backwards over the ground, dragging the spider by the base of one posterior leg or often flying with the prey. During transport, prey is often placed in the crotch of a plant while the female wasp inspects the nest. The spider is dragged into the burrow entrance by one of its legs. The nest consists of an oblique burrow from 4 to 8 cm in length. The cell varies from 8 to 12 mm in length and from 5 to 9 mm in width. The spider is arranged in the cell facing the entrance and the egg is laid obliquely to longitudinally on the lateral to ventral surface of the abdomen. Filling of the burrow is accomplished by biting and scraping sand from the sides and entrance of the burrow. The fill is packed down by rapid blows with the end of the metasoma. The egg hatches in about two days, and larval development is complete in four to six days.

Epsiyron oregon Evans
(Fig. 78; map 21)

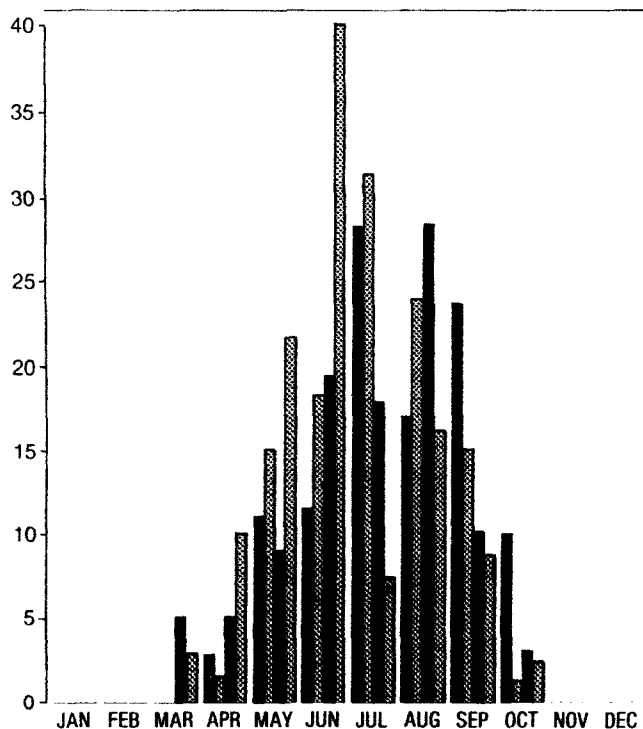
Epsiyron oregon Evans, 1950:231. Holotype female, Oregon, Klamath Co.: Lamis Mill, Eagle Ridge, Klamath Lake (CAS).

Geographic range (map 21). — Southern Yukon to southern California east to southern Alberta and western Wyoming. There are no Mexican records for this species, but it has been taken in San Diego County, California so it undoubtedly occurs in Baja California.

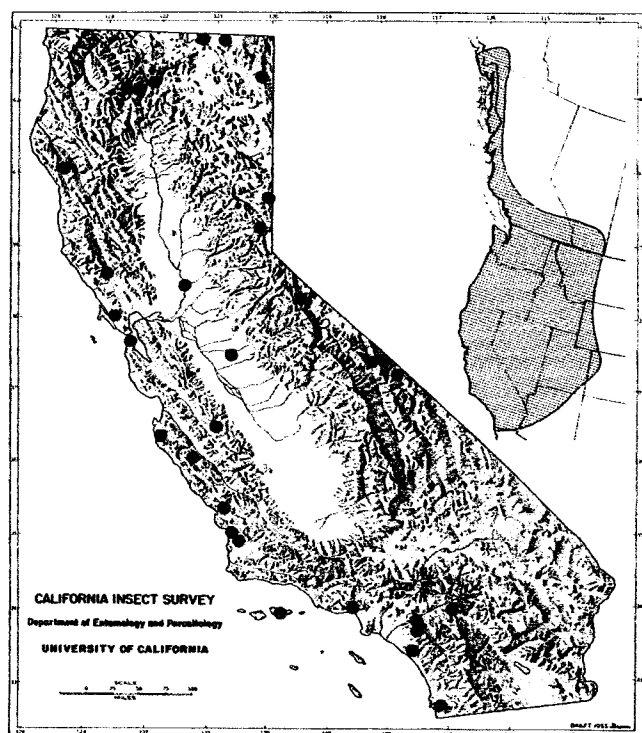
California distribution (map 21). — Widespread throughout the state in Upper Sonoran and Transition zones, sometimes entering the Canadian, *Epsiyron oregon* is absent from the southern California deserts and is represented by only two records from the Central Valley. It occurs from sea level to 3,050 m in the Sierra Nevada and is found characteristically in clearings and other openings in forested areas. There is one record from Santa Cruz Island: Canada del Medio, 2 ♂♂, June 18, 1967 (A.S. Menke, UCD). We have seen 45 females and 59 males.

Seasonal occurrence. — The species has been found as early as March 31 at Bitterwater, San Benito County, California and as late as November 13 at Ehrenberg, Yuma County, Arizona. Both sexes are most commonly encountered from May to August.

This species is closely related to *Epsiyron quinquenotatus* and *E. biguttatus*. The females have only three comb spines on the anterior basitarsus and a wide head with the vertex



Graph 9. Seasonal occurrence of *Epsiyron quinquenotatus hurdi* Evans. Black columns represent females; gray columns are males.



Map 21. California distribution of *Episyron oregon* Evans. Inset: overall distribution.

arcuately elevated above the tops of the eyes. The ocelli are in a broad triangle, the body is quite hairy and the posterior margin of the pronotum is somewhat angulate. The males have relatively long antennal segments and well developed temples and the tibial spurs and apical metasomal tergum are dark or only slightly pale.

Biology. — As do other species of *Episyron*, *E. oregon* frequently visits flowers. We have seen the following records. Females: *Chrysothamnus viscidiflorus*, *Malacothrix glabrata*, *Pastinaca sativa* and *Urtica holosericea*. Males: *Calochortus catalinae*. Both sexes: *Foeniculum vulgare*.

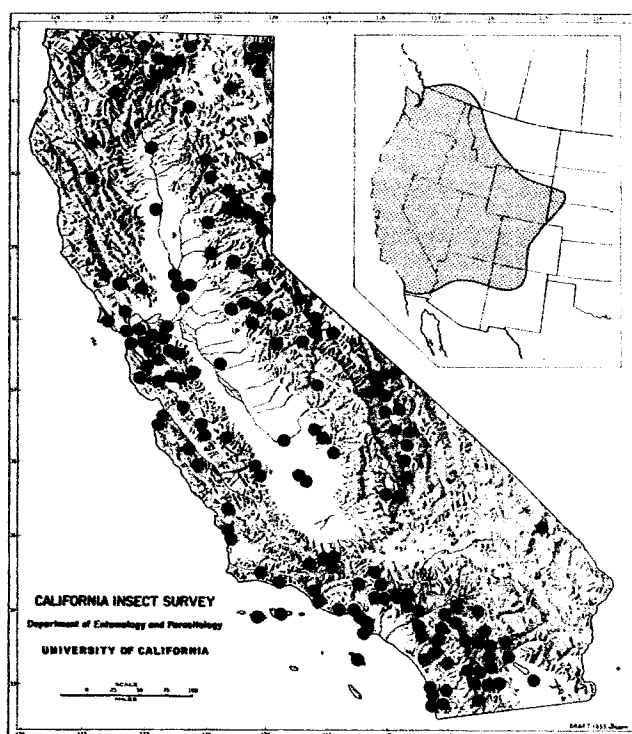
Provisioning behavior has not been studied, but Evans (1970) found a female transporting a male *Araneus trifolium* (Hentz) across a sandy road in an evergreen forest near Jackson Hole, Wyoming.

Episyron biguttatus californicus (Banks)
(Figs. 16, 76, 77; map 22; graph 10)

Psammochares californica Banks, 1910:117. Holotype male, California: Claremont (MCZ).

Geographic range (map 22). — Western United States from southern British Columbia south to southern California, east to northern New Mexico and western South Dakota. *E. biguttatus biguttatus* occurs over most of the eastern United States, and there is a southern population, *E. b. montezuma* (Cameron) in southern Arizona, New Mexico and western Texas south through the Central Plateau of Mexico to Veracruz and Guerrero.

Males of *montezuma* exhibit extensively pale pubescence and have the wings hyaline or only very slightly darkened except at the apex (Evans, 1966). California populations vary



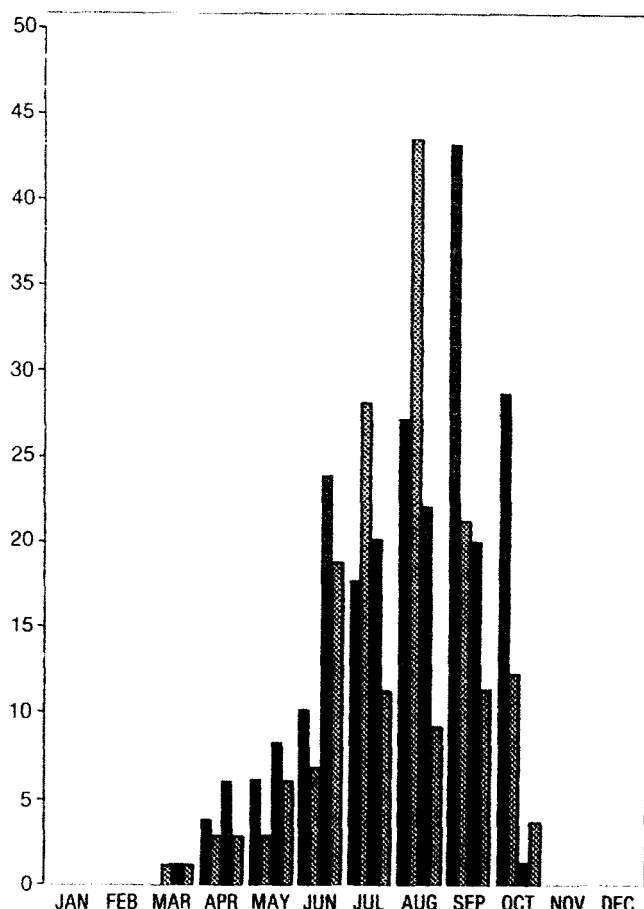
Map 22. California distribution of *Episyron biguttatus californicus* (Banks). Inset: overall distribution.

considerably in the amount of wing darkening. Specimens from southern California often have nearly hyaline wings. The generally lighter wings of southern California males may be due to introgression of genes from populations of *montezuma* from the south and east, but the body pubescence of these males is uniformly dark, so we are not inclined to assign any California material to *montezuma*.

California distribution (map 22). — *biguttatus californicus* is sympatric over most of its range in California with the closely related *E. quinquenotatus hurdi*, although the former is less frequently collected in the Mojave and Colorado deserts. It has been taken from sea level to over 2,100 m in the Sierra Nevada, and is known from the Channel Islands. Santa Catalina (Cape Cyn., Cherry Vy., Middle Cyn.); Santa Cruz (Canada Cervada, La Cascada, Central Vy. HQ, Prisoner's Harbor, Willow Cove); Santa Rosa (Carrington Pt.).

Seasonal occurrence (graph 10). — Early and late season records are Davis, California, 1 male, March 12, 1959 (F.D. Parker, UCD) and Sacramento, California, October 24, 1965 (M.S. Wasbauer, MSW). Of the 303 females and 199 males we have examined, peak numbers of both sexes were taken in August and September.

Biology. — Evans (1950) mentioned that this subspecies is a frequent visitor of flowers and provides the following floral visitation records: *Cicuta* sp., *Eriogonum* sp., *Cleome* sp. and *Solidago* sp. We have seen flower records as follows: Females: *Cuscuta pentagona*, *Encelia* sp., *Eriogonum fasciculatum* and *parvifolium*, *Foeniculum vulgare*, *Melilotus albus*, *Salvia* sp., and water hemlock. Males: *Acacia Greggii*, *Baccharis glutinosa*, *Chrysothamnus nauseosus*, *Cryptantha intermedia*, *Prosopis juliflora*, *Rhamnus* sp., and



Graph 10. Seasonal occurrence of *Episyron biguttatus californicus* (Banks). Black columns represent females; gray columns are males.

Salix sp. Both sexes: *Baccharis pilularis*, *Chrysothamnus viscidiflorus*, *Croton californicus* and *Wislizenia refracta*. Males have been taken at extra-floral nectaries of *Helianthus* sp.

The nesting biology of *californicus* has not been studied. Wasbauer and Powell (1962) provided a record of prey, *Neoscona naiba* Chamberlin and Gertsch from Cochise County, Arizona. The locality of this record, however, indicates that the wasp was not *californicus* but *montezuma*. Wasbauer and Powell also summarized the more extensive information on prey and nesting behavior in *Episyron biguttatus biguttatus*, and Kurczewski and Kurczewski (1968, 1968a) have added significantly to our knowledge of the prey of this eastern subspecies.

Episyron conterminus posterus (Fox)
(Fig. 79; map 23; graph 11)

Pompilus posterus Fox, 1893:115. Holotype female, Southern Florida (ANSP).

Pompilus exactus Cameron, 1893:202. Holotype female, Mexico, Yucatan: Temax (BMNH).

Pompilus temaxensis Cameron, 1893:208. Holotype male, Mexico, Yucatan: Temax (BMNH).

Pompilus porus Fox, 1894:98. Lectotype female, Mexico, Baja California: San Jose del Cabo (CAS).

Geographic range (map 23). — Costa Rica to central California, eastward through southern Arizona, southern New Mexico and southern Texas to southern New York.

California distribution (map 23). — Central Valley and inner Coast Ranges north to Sacramento and Lake counties, Mojave and Colorado deserts, and southern California montane. This subspecies has been found at coastal localities only in southern California and seems to be characteristic of deserts, inland valleys and low arid mountains to elevations of about 1,200 m. We have examined 141 females and 189 males of which 61 females and 43 males represent California localities.

Seasonal occurrence (graph 11). — There are collection records from April to December, the greatest number June to September. The long season of activity indicates multiple broods.

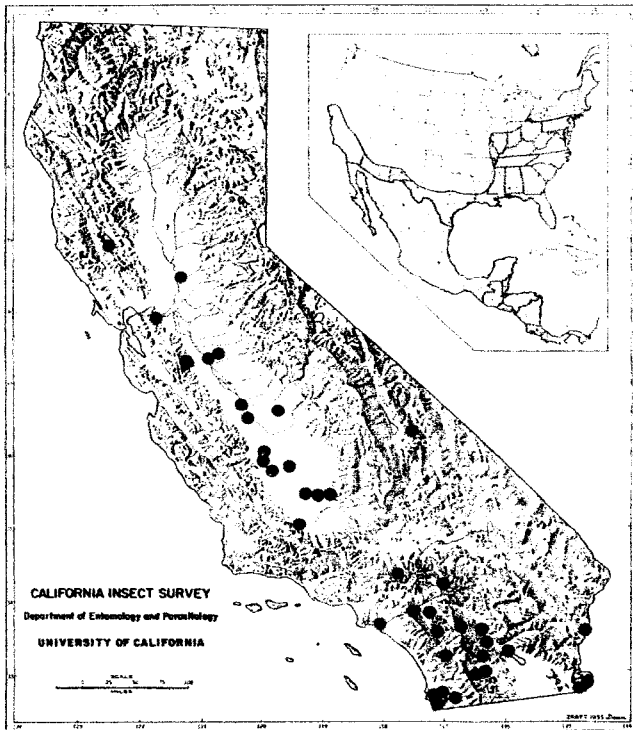
The subspecies *posterus* represents a northern population of a species extending southward into Argentina. Evans (1966) has seen specimens of the nominate subspecies from Argentina, Brazil, Bolivia and Peru.

Both sexes of *posterus* are easily separable from other *Episyron* in California. At least the posterior pair of legs of the female and of most California males is red. The pubescence and erect hair on the body are pale in both sexes. Additionally, in the males the tibial spurs of the middle and posterior legs are white, and there is at least evidence of a yellow integumental stripe along the posterior margin of the pronotum. Females also have this stripe but in some it may be reduced or absent. Yellow integumental markings on the third metasomal tergum may be present or absent.

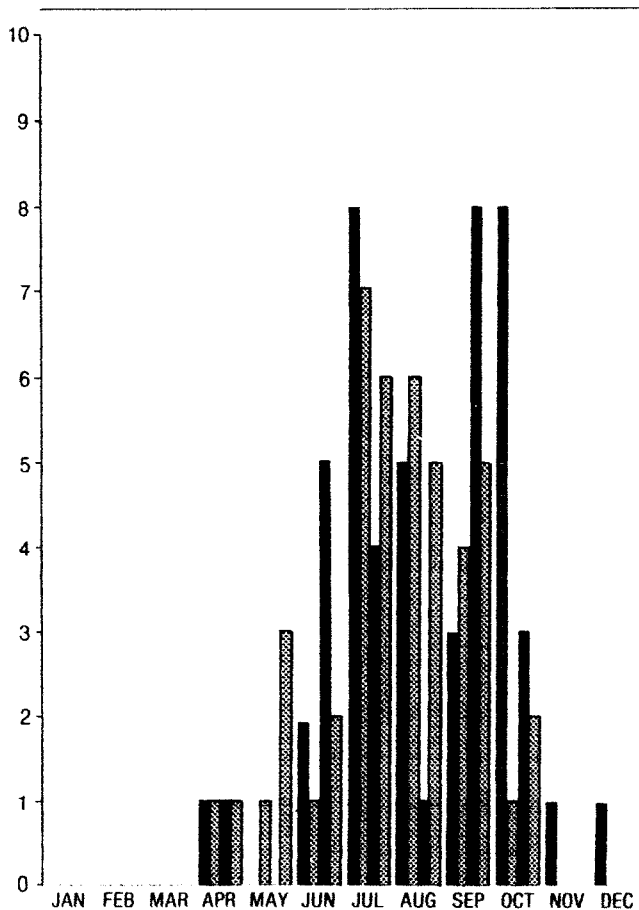
There is variation in color traits of *posterus*. In the female the anterior wing varies from uniformly dark to nearly hyaline with a darker apical band. All the legs may be red or only the posterior pair. In occasional specimens the anterior legs are black, the middle and posterior ones red. Females from some parts of the range, especially Mexico, may have a yellow spot on the mesoscutum. This spot is rare or absent in California specimens. California males usually have the femora at least partially black. The tibiae of all three leg pairs may be red or I black, II and III red or I and II black, III red or all black. None of this color variation appears to segregate geographically.

The larva has been described by Evans (1959).

Biology. — Adult feeding records are numerous. Females have been taken at honeydew of *Tachardiella cornuta* on *Flourensia cernua* and of *Disholcaspis eldoradensis* galls on *Quercus lobata*; flowers of *Eriogonum* sp., *Haplopappus sonorensis* and *Tamarix gallica*. Males have been collected from extra-floral nectaries of *Gossypium hirsutum* and *Helianthus* sp. and flowers of *Anethum graveolens*, *Anthemis cotula*, *Baccharis glutinosa*, *Chrysothamnus nauseosus*, *Cressa*



Map 23. California distribution of *Episyrcon conterminus posterus* (Fox). Inset: overall distribution.



Graph 11. Seasonal occurrence of *Episyrcon conterminus posterus* (Fox). Black columns represent females; gray columns are males.

truxillensis, *Haplopappus tenuisectus*, *Lepidium* sp. and *Prosopis* sp. Both sexes are recorded from flowers of *Baccharis* sp., *Celosia floribunda*, *Foeniculum vulgare*, *Melilotus albus*, *Prosopis juliflora* and *Wislizenia refracta*. In addition to these records, Evans (1950:225) reports *posterus* from flowers of *Ceanothus microphyllus*, *Chilopsis* sp. and *Thysanella fimbriata*.

Observations on the provisioning behavior have been made by Krombein (1952, 1953, 1958, 1959). He described aspects of nest construction, burrow and cell configuration, prey transport and parasitism. Araneid spiders of six genera were found to be provisioned by the wasp. Additional prey records have been provided by Wasbauer and Powell (1962), Kurczewski and Kurczewski (1968, 1968a) and Kurczewski (1981).

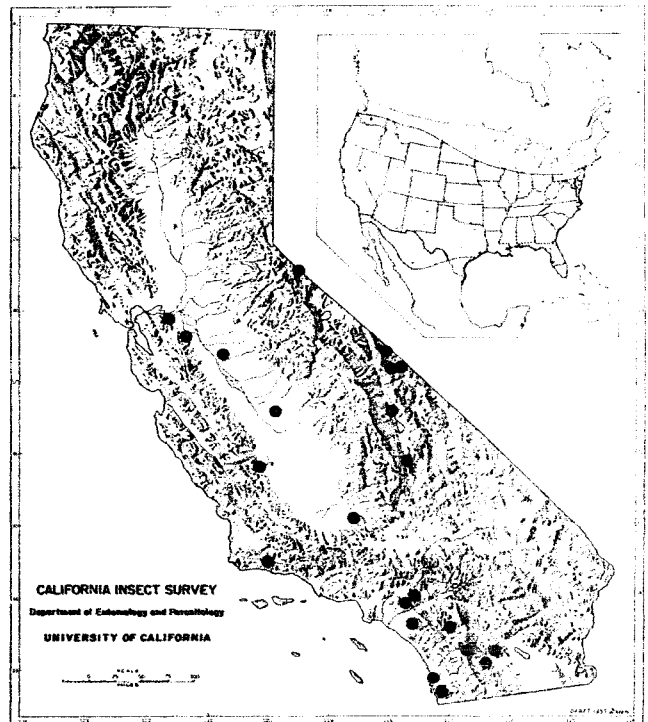
Episyrcon snowi (Viereck) (Fig. 80; map 24; graph 12)

Anoplius (Episyrcon) snowi Viereck, 1906:202. Holotype male, Kansas: Morton Co. (UK).

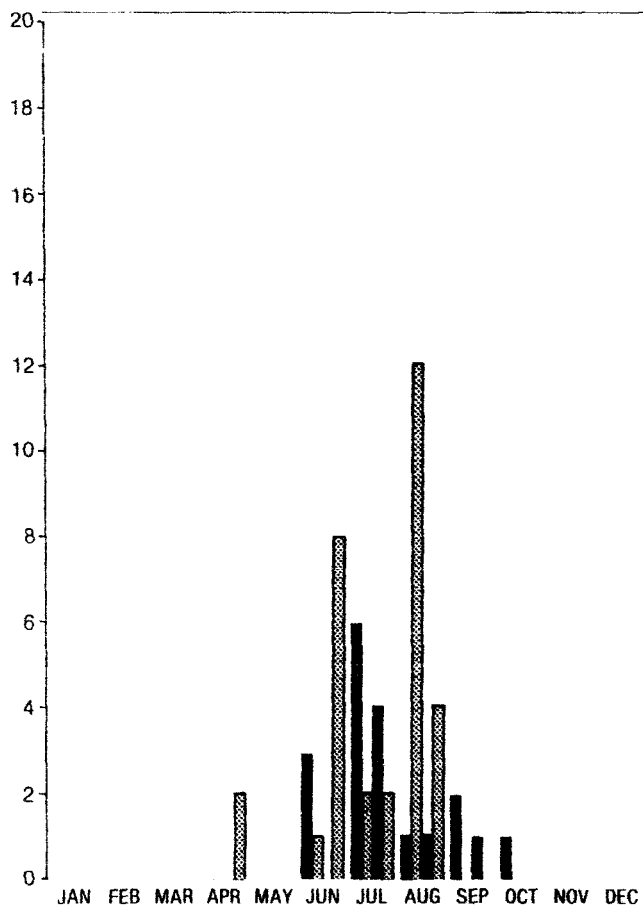
Psammochares maneei Banks, 1910:117. Holotype female, North Carolina: Southern Pines (MCZ).

Episyrcon laevis Banks, 1933:4. Holotype female, Texas: Lee Co., Fedor (MCZ).

Geographic range (map 24). — Transcontinental from southern Washington to northern New Jersey, south to Florida and northern Mexico.



Map 24. California distribution of *Episyrcon snowi* (Viereck). Inset: overall distribution.



Graph 12. Seasonal occurrence of *Episyrphus snowi* (Viereck). Black columns represent females; gray columns are males.

California distribution (map 24). — Central California (Contra Costa County) south through the inner Coast Ranges, Central Valley and Great Basin (Mono County) to Riverside and San Diego counties. *E. snowi* is found only on the western fringes of the Mojave and Colorado deserts. Althoughh relatively widespread in the state, *E. snowi* is not often collected. We have examined 57 females and 127 males of which only 18 females and 16 males are from California localities.

Seasonal occurrence (graph 12). — Collection dates are from April 24, 1 ♂, at Borrego, San Diego Co. (J.G. Rozen, CIS) to October 12, 1 ♀, junction of Santiago Canyon and Silverado Canyon, Santa Ana Mt., Orange County (M.E. Irwin, UCR). All the records available to us from over the entire range of the species fall between April and October, with the majority in June, July and August.

Recognition characters for the females are the lack of abundant erect hair on the body, thin lenticular head with a broad ocellar triangle, long pronotum with an arcuate posterior margin and presence of three comb spines on the anterior basitarsus. The posterior wings of females often show a noticeable milky translucence but this is not as pronounced as in the males, which are characterized by a yellow spot on the outer surface of the mandible, long pronotum, white tibial spurs and both pairs of wings milky translucent.

Biology. — Evans (1950) states that *E. snowi* is usually taken on flowers and gives as floral visitation records: *Baccharis*, *Gossypium*, *Polytaenia Nuttallii*, *Solidago*, *Stillingia* and *Tamarix*. Records we have seen indicate a wide range of adult feeding. Females have been taken visiting honeydew produced by *Tachardiella cornuta* on *Flourensia cernua* and at flowers of *Anaphalis margaritacea*, *Aster* sp., *Chrysothamnus albidus*, *Haplopappus Hartwegi* and *tenuisectus*. Males are recorded visiting extra-floral nectaries of *Helianthus annuus*, honeydew on *Chrysothamnus* sp. and flowers of *Asclepias subverticillata*, *Baccharis* sp., *Cleome lutea*, *Eriogonum* sp., *Gutierrezia californica*, *Lepidium lasiocarpum*, *Melilotus albus* and *Tetradymia canescens*. Both sexes have been taken at flowers of *Koeberlinia spinosa* and *Wislizenia refracta*.

Observations on the provisioning behavior have been made by Rau (1922) in Missouri and Krombein (1953) in North Carolina. Recorded prey are the araneid spiders *Cyclosa conica* (Pallas) and *Neoscona benjamina* (Walck).

Genus *Poecilopompilus* Howard

Closely related to *Parabatozonus* and *Batozonellus* of the Old World, *Poecilopompilus* is confined to the Nearctic and Neotropical Regions. The two species inhabiting the United States are widespread and geographically separable into subspecies. Both species occur in California, one with a single subspecies, the other with two.

As is true of the preceding, this genus is easily recognized. The majority of species are brightly patterned with yellow and red and resemble some species of the vespid genus *Polistes*. Structurally, *Poecilopompilus* is separated from other members of the complex by the lack of scale-like pubescence,

presence of dorsal spines on the anterior tibiae and ventral spines on the apical tarsal segments of the female. The tarsal claws of both sexes are toothed, except in some instances the front tarsal claws of the female are bifid.

The biology of only one North American species of *Poecilopompilus* has been studied in any detail, the widespread *P. interruptus interruptus* (Say), and the ethological pattern appears to be much as it is in the genus *Episyrphus*. A summary of the biological studies which have been done to date is given under the species heading.

KEY TO CALIFORNIA SPECIES AND SUBSPECIES OF *POECILOPOMPILUS*

1. Female: Anterior tarsus with claws bifid, mid and posterior tarsi with claws toothed; compound eyes strongly convergent dorsally, UID 0.50-0.55 X LID. Male: Clypeus with apical margin convexly rounded (fig. 45); aedeagus with a pair of strongly divergent lobes at apex (fig. 47) *algidus coquilletti* (Provancher)
- Female: All tarsi with claws toothed; compound eyes not as strongly convergent dorsally, UID 0.6 or more X LID. Male: Clypeus (fig. 46) with apical margin truncate;

aedeagus (fig. 48) scarcely differentiated into lobes at apex 2

2. Mesosoma with brownish or reddish markings; metasoma distinctly banded with yellow and brown or red *interruptus interruptus* (Say)
- Mesosoma mostly black with some yellow areas, rarely with brownish or reddish markings; metasoma more uniformly yellow, not distinctly banded with brown or red *interruptus semiflavus* Evans

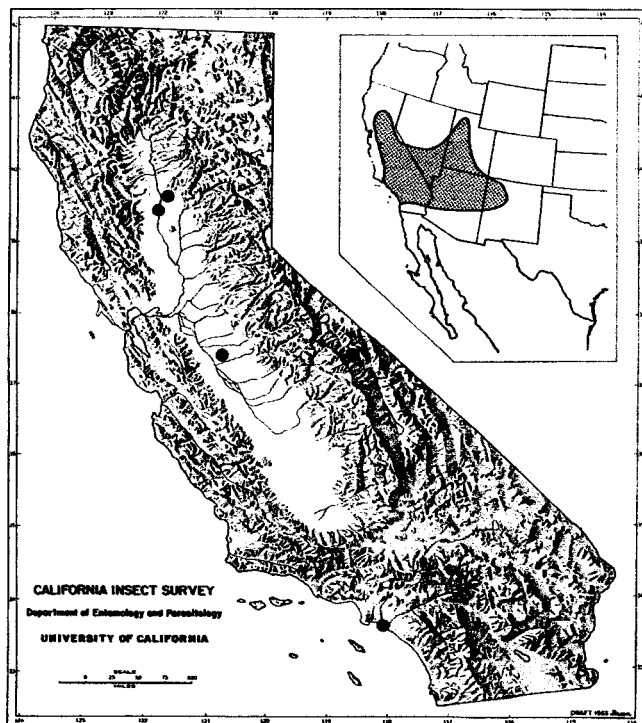
Poecilopompilus algidus coquilletti (Provancher) (Figs. 45, 47; map 25)

Pompilus coquilletti Provancher, 1887:261. Holotype male, California: Anaheim (UL).

Batazonus flavipennis Banks, 1921:20. Holotype female, Utah: Salt Lake City (MCZ).

Geographic range (map 25). — Northern Arizona and southern California, north to northern California and northern Utah, east to northwestern New Mexico. We have seen specimens from southern Arizona and near Durango, Mexico with most of the thorax black, indicating a broad zone of intergradation with *algidus willistoni* (Patton).

California distribution (map 25). — Although material of other subspecies of *Poecilopompilus algidus* is relatively abundant, *coquilletti* is not often encountered. We have examined 3 females and 6 males from the following California localities: Butte Co.: Chico, 1 ♀, IX-21-65 (T. Haig, MSW). Glenn Co.: 2 mi. N. Glenn, 2 ♂♂, VII-23-60 (M. Wasbauer, MSW).



Map 25. California distribution of *Poecilopompilus algidus coquilletti* (Provancher). Inset: overall distribution.

Orange Co.: Newport Bay, 3 ♂♂, 1 ♀, VI-25-41, V-31-40 (P.D. Hurd, CIS). Stanislaus Co.: Turlock, 1 ♀, VI-3-54 (R.R. Snelling CAS). Mono Co.: Sherwin Summit (Old 395), 1 ♂, IX-1-65 (P. Rude, CIS).

Females of *P. algidus coquilletti* may be distinguished from those of the two subspecies of *interruptus* in California by the cleft anterior tarsal claws and strongly dorsally convergent eyes; the males by the convex apical clypeal margin and flaring apical lobes of the aedeagus.

Biology. — Males have been taken at flowers of *Baccharis* sp., *Chrysothamnus viscidiflorus*, *Heracleum lanatum* and *Melilotus albus*, females at flowers of *Melilotus* sp.

The provisioning behavior is unreported, but Kurczewski (1981) reported on hunting, nest construction, provisioning and prey of the nominate subspecies in Florida.

Poecilopompilus interruptus interruptus (Say) (Figs. 46, 48; map 26; graph 13)

Ceropales interrupta Say, 1837:365. Holotype male, Indiana (lost).

Pompilus navus Cresson, 1867:105. Holotype female, Georgia (ANSP).

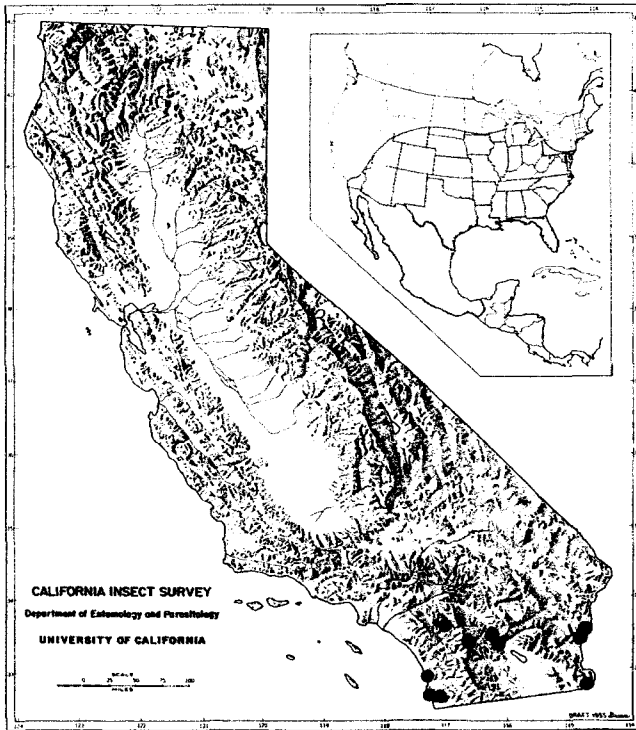
Pompilus ichneumoniformis Patton, 1879:351. Holotype female, Kansas (lost). Preoccupied by *ichneumoniformis* Smith, 1864:268.

Pompilus ichneumonoides Dalla Torre, 1897:8. New name for *ichneumoniformis* Patton, 1879.

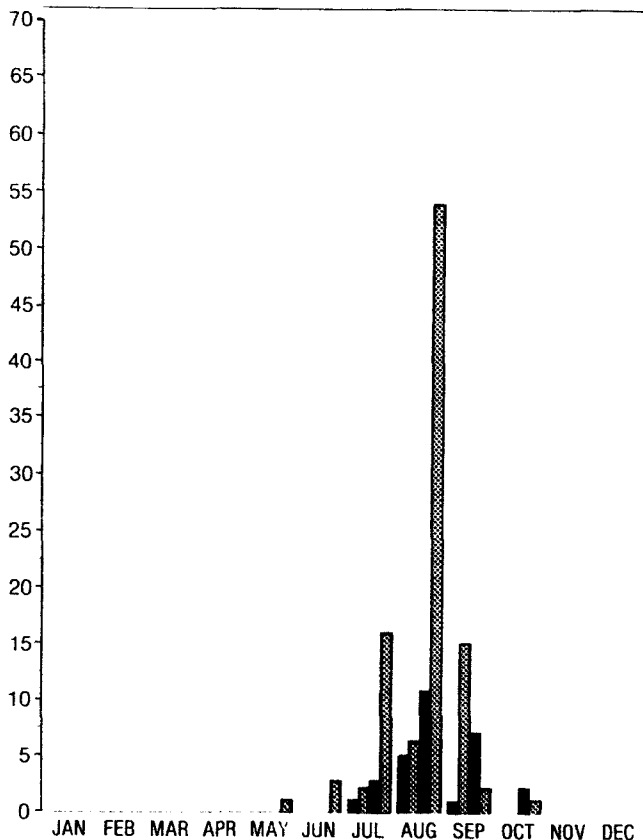
Geographic range (map 26). — Southern California northward and eastward through Utah, Wyoming, South Dakota, southern Wisconsin, northern Michigan to Maryland and south through Mexico to Chiapas.

California distribution (map 26). — Extreme southern portion of state, including Orange, Riverside, San Diego and Imperial counties, from sea level to 1,585 m.

Seasonal occurrence (graph 13). — The flight period for this subspecies over its entire range is March to November. In California, early and late season dates are May 24 at Friant, Fresno County and October 22 at Bard, Imperial County. Of the 25 females and 103 males we have examined from California, the majority have been collected in July to September with a definite peak for both sexes in August.



Map 26. California distribution of *Poecilopompilus interruptus* (Say). Inset: overall distribution.



Graph 13. Seasonal occurrence of *Poecilopompilus interruptus* (Say). Black columns represent females; gray columns are males.

Features useful in separating *Poecilopompilus interruptus* from *P. algidus* are given in the discussion of *P. algidus coquilleti*. Although *interruptus* is quite variable over its entire range, specimens from the western United States are generally paler than those from eastern populations. The ranges of *interruptus interruptus* and *interruptus semiflavus* do not appear to overlap and they may be separated by color. In typical *interruptus* the mesosoma is at least partially red, and the metasomal terga are usually conspicuously banded with yellow and red. In *semiflavus* the ground color of the mesosoma is almost uniformly black except for the usual yellowish maculations. It contrasts strongly with the metasoma which is more uniformly yellow, especially posteriorly, with reduced red banding or with the bands lacking.

Biology. — There are a number of adult feeding records for this subspecies. Females have been collected at extra-floral nectaries of *Gossypium hirsutum* and both sexes at extra-floral nectaries of *Helianthus annuus*. Evans (1950) has provided a number of floral visitation records. In addition to those, we have seen the following for females: *Chrysothamnus* sp., *Medicago sativa*, *Psilostrophe Cooperi* and *Wislizenia refracta*; for males: *Eriogonum fasciculatum* and *Thomasii* and *Ribes aureum*; for both sexes: *Acacia angustissima* and *Penstemon oreocharis*. There is evidence that females feed at least occasionally on body juices of captured spiders (Evans and Yoshimoto, 1962). These authors have summarized the published information available on the nesting biology and provided a list of the araneid spiders taken as prey. Kurczewski and Kurczewski (1968) give an additional prey record.

Poecilopompilus interruptus semiflavus Evans
(Map 27)

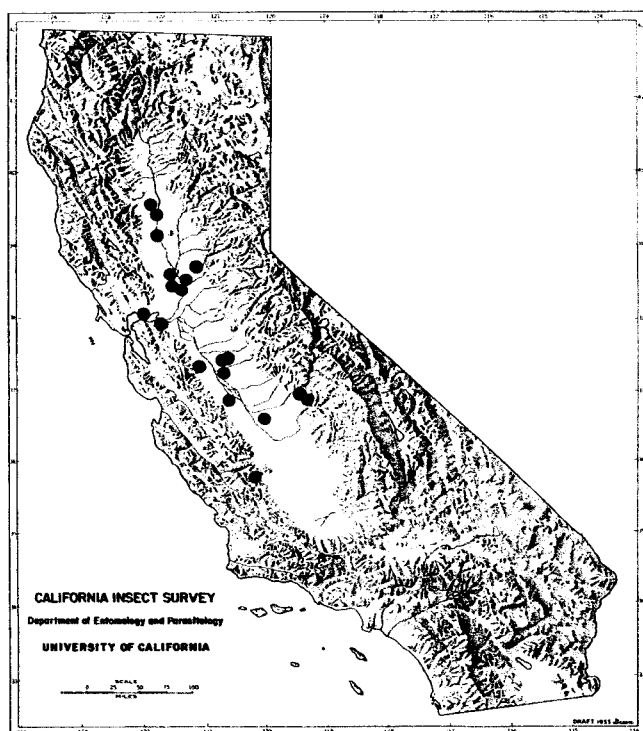
Poecilopompilus interruptus semiflavus Evans, 1966:224.
Holotype female, California: Davis (CAS).

Geographic range. — California.

California distribution (map 26). — Found only in the Central Valley of California, this is one of the most geographically restricted of any spider wasp in the North American fauna. It probably occurs throughout the Valley but has been recorded from Glenn County on the north to Kings County on the south.

Seasonal occurrence. — Adult capture records are from May 25, 1 ♀ at Davis, Yolo Co. (A.S. Menke, UCD) to October 6, 1 ♀, 14 mi. SW Avenal, Kings Co. (R.R. Snelling, CDFA).

A discussion of features used to separate *P. interruptus interruptus* from *P. interruptus semiflavus* is given under the former heading.



Biology. — Adults of both sexes are known to visit the following flowers: *Foeniculum vulgare*, *Heracleum lanatum* and *Wislizenia refracta*.

No information has been published on the nesting behavior, but Evans and Yoshimoto (1962) presented a prey record of *Neoscona vertebrata* McCook from Davis, California that undoubtedly applies to this subspecies.

Map 27. Overall distribution of *Poecilopompilus interruptus semiflavus* Evans.

Genus *Tachypompilus* Ashmead

There are relatively few species of *Tachypompilus*, but the genus is widespread, occurring in the Ethiopian, Oriental, Nearctic and Neotropical regions. In the United States there are two polytypic species, each with populations extending into Central America and (in one case) northern South America. Both are represented in the western United States, each with a subspecies in California.

Most *Tachypompilus* are large reddish brown wasps, often marked with black and occasionally with yellow, rarely nearly all black. The frons bears a small but distinct tubercle just above and between the antennal bases. The labrum is exposed to some extent beneath the apex of the clypeus. The posterior face of the propodeum is distinct, either flattened or somewhat concave, the lateral margins with a slight to marked rounded swelling or occasionally a distinct tooth. The tarsal claws of the female are toothed; those of the male bifid.

Information on the biology of *Tachypompilus* species has been summarized by Evans and Yoshimoto (1962). From the small amount of data available, it appears that members of the genus are

somewhat generalized spider hunters, taking mainly large Lycosidae and Pisauridae. Iwata (1976) mentioned reports of *T. analis* (Fab.) preying on *Heteropoda venatoria* L. (Heteropodidae) in the Orient. Females grasp the prey by the chelicerae or pedipalps and drag it along the ground walking backwards. Nesting often takes place under trees or houses. Dry, powdery soil is preferred for nest construction. The nest is merely a shallow depression which the female wasp excavates by raking with the anterior legs and tamping down with the metasoma. The spider is dragged into the depression and an egg deposited on the abdomen, near the base. The depression is then filled by raking in soil and tamping with the metasoma. The wasp then covers the filled nest with bits of debris.

Evans (1966) reported *T. unicolor cerinus* from southern California, and we have seen specimens which show some of the traits of *cerinus* but intergrade with *unicolor unicolor*. Accordingly, although *cerinus* is included in the following key, it is not treated further.

KEY TO CALIFORNIA SPECIES AND SUBSPECIES OF *TACHYPOMPILUS*

1. Female: Antenna with third segment 0.9-1.2 X UID; compound eyes not strongly convergent dorsally, UID 0.85-1.0 X LID. Male: Antenna with third segment not over twice as long as greatest width; compound eyes divergent dorsally, UID 1.05-1.15 X LID (*unicolor*)..... 2
- Female: Antenna with third segment at least 1.3 X UID; compound eyes more strongly convergent dorsally, UID 0.72-0.86 X LID. Male: Antenna with third segment more than twice as long as greatest width; compound eyes not or scarcely divergent dorsally, UID 0.90-1.03 X LID *ferrugineus torridus* (Smith)

2. Wings entirely infusate, somewhat violaceous, often darker at apex; body (especially of males) often with black portions of mesosoma (southern California, British Columbia, Idaho, North Dakota, northern Utah)..... *unicolor unicolor* (Banks)
- Wings nearly clear hyaline or slightly yellowish, narrowly darkened at apex; body usually nearly uniformly reddish (Texas, New Mexico and Utah south to Costa Rica) *unicolor cerinus* Evans

Tachypompilus unicolor unicolor (Banks) (Map 28; graph 14)

Arachnophroctonus unicolor Banks, 1919:239. Lectotype female, Washington: Wenass Valley (MCZ).

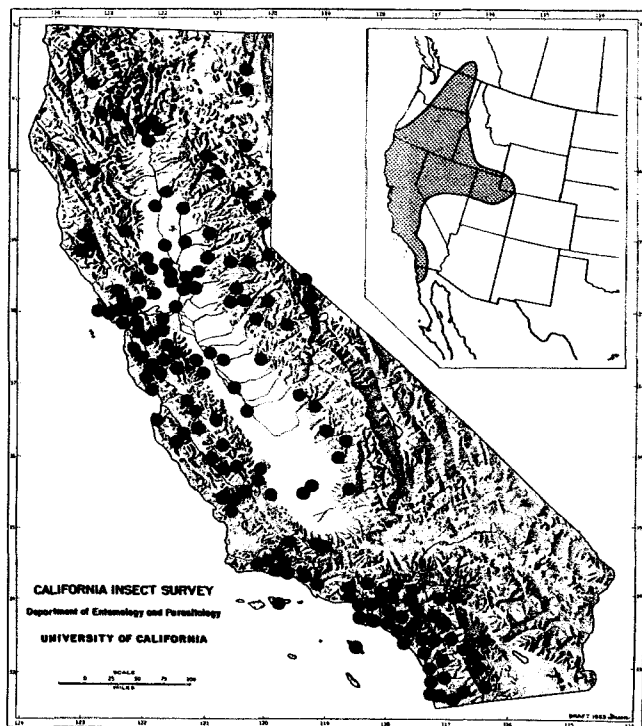
Arachnophroctonus latifrons Banks, 1939:229. Holotype female, Washington: Wenass Valley (MCZ).

Geographic range (map 28). — Southern California north to the Okanagan Valley, British Columbia, east through southwestern Idaho to western South Dakota and northern Utah.

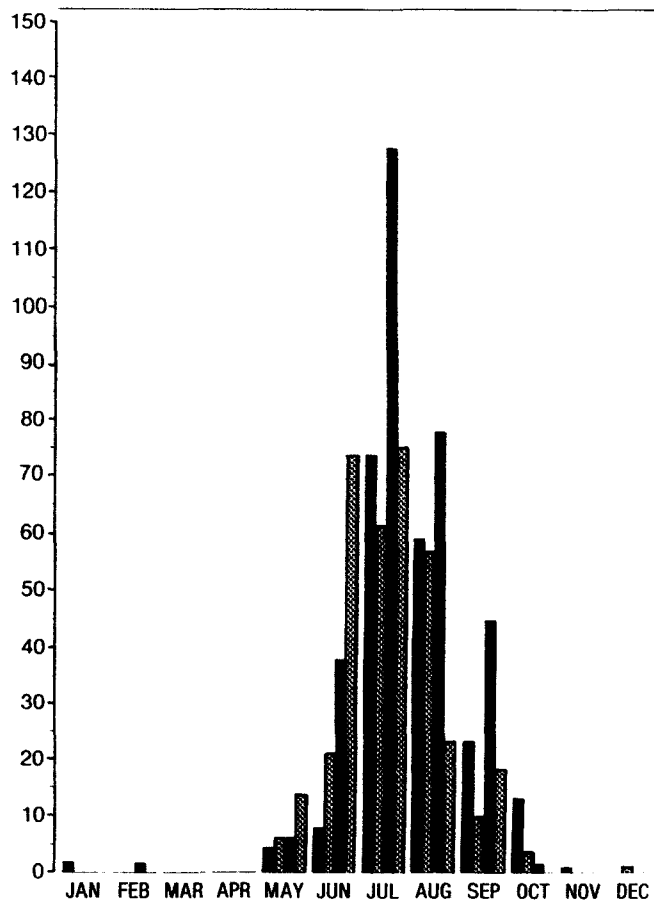
California distribution (map 28). — Widespread over most of the state in the Upper Sonoran and Transition zones at elevations from sea level to over 2,100 m. Channel Islands records are: Santa Cruz (Canada Cervada, Canada del Medio,

La Cascada, Canyon 2 mi. W Sandstone Pt., Central Valley Coches Prietos, Valley Anchorage); Santa Catalina (Cape Cyn., Cherry Vy., Middle Cyn.). It is absent from the southern Great Basin and deserts of southern California. To the south and east, it is replaced by the subspecies *cerinus* Evans.

Seasonal occurrence (graph 14). — For the 519 females and 378 males we have examined, almost all records are May to October, with a sharp peak in July and August.



Map 28. California distribution of *Tachypompilus unicolor unicolor* (Banks). Inset: overall distribution.



Graph 14. Seasonal occurrence of *Tachypompilus unicolor unicolor* (Banks). Black columns represent females; gray columns are males.

Tachypompilus unicolor unicolor is separable from *T. unicolor cerinus* by the degree of wing darkening and secondarily by the amount of black on the mesosoma. The nominate subspecies has much darker, often violaceous wings and the mesosoma is often partially black, especially in the males. The subspecies *cerinus* has clear or yellowish hyaline wings with a darker marginal band. The body is usually nearly entirely red. Specimens from southern California exhibit considerable variation in these characters. In the vicinity of San Diego County and in Baja California Sur, individuals appear with entirely red bodies and wings which are darker than in typical *cerinus*. We have seen no specimens from California which we could place without question as *cerinus*.

Biology. — Adults feed at honeydew secretions and flowers. Females have been taken at honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata* and at flowers of *Asclepias erosa*, *Baccharis sarothroides*, *Chrysothamnus* sp., *Lepidospartum squamatum* and *Wislizenia refracta*. Males have been collected at flowers of *Calochortus catalinae*, *Hemizonia fasciculata*, *Rhamnus californica* and *Xanthium spinosum*. Both sexes visit extra-floral nectaries of *Helianthus* and have been taken at flowers of *Atriplex semibaccata*, *Cicuta* sp., *Eriogonum fasciculatum* and *gracile* and *Foeniculum vulgare*.

The nesting behavior of *unicolor* is unreported.

Tachypompilus ferrugineus torridus (Smith)
(Figs. 9, 11; map 29)

Pompilus torridus Smith, 1862:396. Holotype female, Mexico (no further data) (BMNH).

Arachnophroctonus ferrugineus var. *unicolor* Banks, 1944:168. Holotype female, Arizona: Oak Creek Canyon (MCZ). Preoccupied by *unicolor* Banks, 1919.

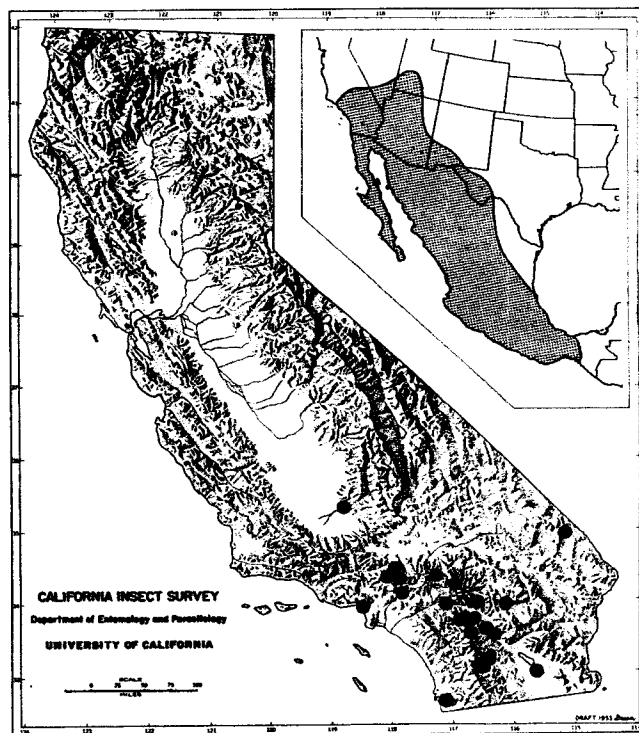
Tachypompilus ferrugineus yavapai Evans, 1950:263. New name for *unicolor* Banks, 1944.

Geographic range (map 29). — Sonoran zones of southern California, southern Utah, Arizona, southwestern New Mexico, western Texas south to Chiapas, Mexico.

This subspecies is the westernmost of nine named populations of *ferrugineus* which extend across the United States and south through the Caribbean Region, Central and South America.

California distribution (map 29). — Foothills of the southern Sierra Nevada, southern California montane and southeastern deserts to elevations of 1,525 m.

Seasonal occurrence. — The 59 females and 56 males we have examined were collected from March to December, the majority having been taken July to October.



Map 29. California distribution of *Tachypompilus ferrugineus torridus* (Smith). Inset: overall distribution.

Characters separating *torridus* from *unicolor*, the only other *Tachypompilus* in California, are given under the latter species.

Biology. — Both sexes of *torridus* have been collected at aphid honeydew and at flowers of *Haplopappus squarrosus*. Females have been taken at flowers of *Celosia floribunda* and males at *Eriogonum fasciculatum*, *Koeberlinia spinosa* and *Melilotus albus*.

The nesting biology of *torridus* is unreported, but the eastern subspecies *ferrugineus* has been reported on by several authors (Evans and Yoshimoto, 1962).

Genus *Anoplius* Dufour

Anoplius, in the broad sense, is worldwide in distribution and is one of the largest and most diverse genera in the Pompilidae. Evans (1951) and several recent European workers have expanded the limits of the genus to encompass as subgenera a number of groups formerly considered of generic rank. The Nearctic fauna thus consists of six sub-

genera and over 40 species. All these subgenera and many of the species extend well into Central America. Evans (1966) has described an additional subgenus, *Cameronoplius*, endemic to Mexico.

Members of the genus form an abundant and conspicuous segment of the California spider wasp fauna. Eighteen species in five subgenera have

been recorded from the state.

The genus contains mostly medium to large-sized wasps. The majority of species are completely dark, but a few, such as *americanus* and *apiculatus*, have varying amounts of red on the metasoma.

Most structural features of fundamental importance align *Anoplius* with the genus *Pompilus*, another widespread and apparently successful group. *Anoplius* is unique, however, in that the females always possess at least a few stout, inflexible spines on the last visible metasomal tergum and the tarsal claws of the male are bifid. Females of *Pompilus* lack these spines although

sometimes they have slender, flexible hairs and the tarsal claws of the males are toothed.

In a group as large and diverse as this one, it is difficult to generalize on the biology. Where generalizations seem appropriate, they are given under the subgeneric headings.

Because of the size of the genus in California, separate keys to the species are provided under the subgeneric headings. Neither of the two U.S. species of *Anopliodes* has been recorded from the state. This subgenus is included in the following key but is not treated further.

KEY TO UNITED STATES SUBGENERA OF *ANOPLIUS*

1. Females 2
Males 7
2. Anterior leg without tarsal comb (fig. 96); anterior wing with tM usually meeting M distad of origin of Ba
Anoplius Dufour
Anterior leg with a tarsal comb (fig. 95) 3
3. Clypeus with anterior margin distinctly emarginate (fig. 83); pronotum with posterior margin arcuate; head and mesosoma with abundant erect hairs
Lophopompilus Radoszkowski
Clypeus with anterior margin entire (fig. 82), or if emarginate, pronotum with posterior margin angulate or head and mesosoma not or scarcely hairy 4
4. Anterior wing with tM meeting M distad of origin of Ba (fig. 84); SM3 usually petiolate; tarsal comb with spines not over twice as long as width of tarsus; wings never entirely dark
Pompilinus Ashmead
Anterior wing with tM meeting M at or basad of origin of Ba (fig. 86) (if rarely slightly distad, tarsal comb with spines more than twice as long as width of tarsus or wings entirely dark) 5
5. Anterior wing with MC long, not more than its length from apex of wing, R nearly evenly arched; SM3 wider on R than SM2
Anopliodes Banks
Anterior wing with MC variable in length, R angled at tCu3; SM3 narrower on R than SM2 6
6. Clypeus with apical margin emarginate medially; frons narrow, MID/TFD not over 0.56
Notiochares Banks
Clypeus with apical margin truncate or slightly concave, or if emarginate, frons broad, MID/TFD 0.57-0.60
Arachnophroctonus Howard
7. SGP with a basal plumose process (figs. 90, 98)
Lophopompilus Radoszkowski
SGP without a basal plumose process (figs. 99, 100) 8
8. S4 with a medioapical patch of dense, specialized pubescence (fig. 88); SGP with apex deeply notched (fig. 99)
Notiochares Banks
- S4 without a patch of specialized pubescence; SGP without a deep apical notch (figs. 101, 106) 9
9. Anterior tarsus with ultimate segment not produced on inner margin, the sides nearly parallel (fig. 139); wings dark apically, subhyaline at base; genital capsule with basal hooklets absent (fig. 125)
Anopliodes Banks
Anterior tarsus with ultimate segment asymmetrical, produced on inner margin (fig. 81) (if barely so, wings dark at base as well as apex); genital capsule with basal hooklets present (fig. 115) 10
10. Anterior wing with tM meeting M at or slightly basad of origin of Ba (fig. 86) 11
Anterior wing with tM meeting M beyond origin of Ba (fig. 84) 12
11. Propodeum in profile with a long, slightly sloping anterior portion and a short, rather abrupt posterior declivity (fig. 93); either wings entirely deeply infuscate, or propodeum without more than short inconspicuous erect hairs
Arachnophroctonus Howard
Propodeum in profile with a nearly even slope (fig. 94); wings hyaline or subhyaline, darker at apex, and propodeum with conspicuous dark hairs
Anoplius Dufour
12. Propodeum in profile with a long, slightly sloping anterior portion and a short, rather abrupt posterior declivity (as in fig. 93); anterior wing with SM3 nearly always petiolate; genitalia with gonostyli long, projecting beyond digitus, usually broadened toward apex (fig. 118)
Pompilinus Ashmead
Propodeum in profile with a nearly even slope (fig. 94); anterior wing with SM3 rarely petiolate; genitalia with gonostyli not projecting beyond digitus, or if so, much broader at base than at apex (figs. 121, 127)
Anoplius Dufour

Subgenus *Lophopompilus* Radoszkowski

The large, widely distributed wasps of this subgenus are found in the Holarctic Region. There are five species in North America. Two of these extend south into Mexico and west into California.

Recognition characters are the large size, strongly hirsute body, arcuate posterior margin of the pronotum, emarginate clypeus of the female, and the presence of a basal process on the subgenital plate of the male.

Despite the size and abundance of at least some of these wasps, no detailed biological information is available for any of them. Evans and Yoshimoto (1962) have summarized existing knowledge on the biology.

Most of the species are frequent visitors of flowers. A degree of niche specificity is apparent, for there are some species restricted to open fields and meadows and others found only in deciduous woodlands or in sandy areas along streams. All species thus far studied prey on large, errant spiders. Nest construction takes place in pre-existing cavities in the ground, except that *A. cleora* may construct its nest either from a pre-existing hole or dig from the surface of the soil. Most data indicate that the spider prey is brought to the nesting area before the cell is constructed.

KEY TO CALIFORNIA
SPECIES OF *LOPHOPOMPILUS*

Female: Anterior basitarsus with three short comb spines; clypeus with apical emargination rather broad. **Male:** OOL considerably greater than POL; eyes scarcely convergent above, UID/LID about 0.95; frons convex between compound eyes; genitalia with gonostylus deflected outward before apex (fig. 109).....
aethiops (Cresson)

Female: Anterior basitarsus with four longer comb spines (rarely with a very short fifth); clypeus with apical emargination narrow, sharply defined. **Male:** OOL equal to or only slightly greater than POL; eyes more convergent above, UID/LID about 0.90; frons rather flat between compound eyes; gonostylus not deflected outward before apex (fig. 117).....*cleora* (Banks)

Anoplius (Lophopompilus) aethiops (Cresson)
(Figs. 90, 98, 109; map 30; graph 15)

Pompilus aethiops Cresson, 1865a:451. Lectotype male, Colorado (ANSP).

Psammochares ilione Banks, 1910a:249. Holotype, Virginia: Falls Church (MCZ).

Lophopompilus azotus Banks, 1929:326. Holotype female, South Dakota: Springfield (MCZ).

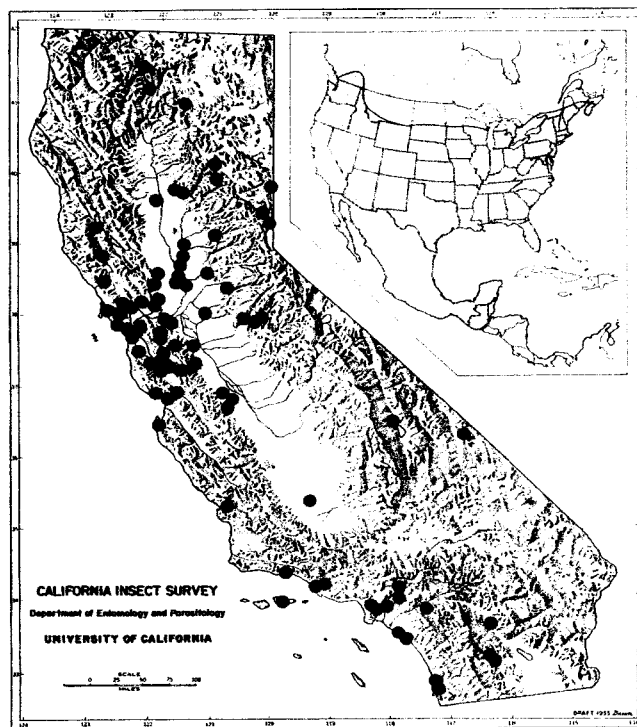
Geographic range (map 30). — Transcontinental in southern Canada and the United States, south through Mexico to Guatemala.

California distribution (map 30). — Widespread and relatively abundant in valley and foothill situations throughout most of the state, but rarely encountered in the true deserts. It has been found on the Channel Islands [one record: Christi Beach, Santa Cruz Island, 1 ♂, IX-15-64 (E.I. Schlinger, UCR)].

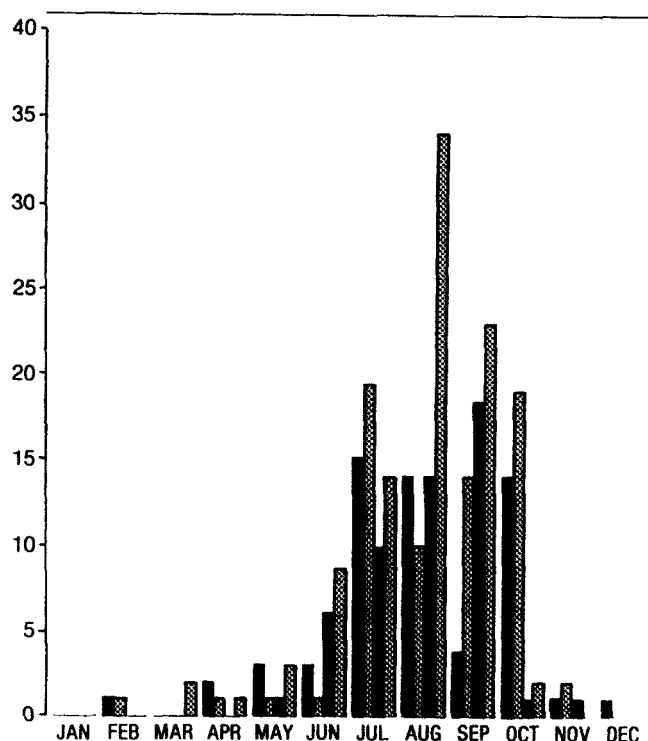
Seasonal occurrence (graph 15). — Primarily a midsummer species. Most of the 227 females and 327 males we examined were taken in July, August and September, although specimens have been collected throughout most of the year. Early and late flight dates in California are February 2, one female at Llagus Creek, Santa Clara County (K.E. Frick, CIS) and December 7, one female, Plymouth, Amador County (W.E. Simonds, MSW). The long flight period suggests multiple generations in some areas at least.

The two all black North American species in the subgenus *Lophopompilus*, *aethiops* and *cleora*, are quite similar. Both occur in California and may be

distinguished by the characters given in the key. Males are most easily separated by the shape of the gonostyli which curve outwardly at the apex in *aethiops* and are straight in *cleora* (figs. 109, 117).



Map 30. California distribution of *Anoplius (Lophopompilus) aethiops* (Cresson). Inset: overall distribution.



Graph 15. Seasonal occurrence of *Anoplus (Lophopompilus) aethiops* (Cresson). Black columns represent females; gray columns are males.

Biology. — Adult feeding is commonly witnessed in this species. Females have been taken at extra-floral nectaries of *Helianthus annuus* and at flowers of *Asclepias subverticillata*, *Eriogonum latifolium nudum*, *Haplopappus Gooddingii* and *Tamarix* sp. Males have been found visiting honeydew on aphid infested *Cirsium lanceolatum* and the flowers of *Asclepias* sp., *Chrysothamnus* sp., *Cleome* sp., *Croton californicus*, *Gutierrezia sarothrae*, *Melilotus albus*, *Pastinaca sativa*, *Ribes aureum* and *Solidago* sp. Both sexes are frequently collected at flowers of the introduced weed sweet fennel (*Foeniculum vulgare*) in lowland areas of the state. Evans (1951) provided additional flower visitation records as follows: *Conium maculatum*, *Daucus carota*, *Eupatorium perfoliatum* and *Sphaeralcea angustifolia*.

Only fragmentary observations are available on the nesting biology of *aethiops*. Evans and Yoshimoto (1962) reported on the prey transport activities of two individuals at Ithaca, New York. Known prey are with one exception wolf spiders of the genus *Lycosa*. They are: *L. carolinensis* Walckenaer, *L. frondicola* Emerton, *L. gulosa* Walckenaer, *L. helluo* Walckenaer, *L. santrita* Chamberlain and Ivie and *Schizosoma ochreata* (Hentz) (Evans, 1951; Kurczewski, 1975; Kurczewski and Kurczewski, 1968, 1968a).

Anoplus (Lophopompilus) cleora (Banks)
(Figs. 83, 95, 117; map 31)

Psammochares cleora Banks, 1917:108. Holotype female, California: Los Angeles (MCZ).

Geographic range (map 31). — Transcontinental in the United States and from southern British Columbia and New Brunswick south to Puebla, Mexico.

California distribution (map 31). — Like the preceding, this species is widespread in valley and foothill areas throughout the state and is rarely encountered in the deserts. It is less commonly collected than *aethiops*. We have seen 109 females and 78 males of which 68 females and 48 males represent California localities. In addition to nearby coastal areas, it has been taken on Santa Cruz Island (1 ♀, V-18-1919, Slevin, CAS and 4 ♀♀, IX-14/15-1964, E.I. Schlinger, P. Rauch, UCR).

Seasonal occurrence. — The season of adult activity for this species is April through November. Early and late season records are: April 4, 1968, 1 ♀, 65 mi. N. Jct. Borrego Sprs. Rd. and Di Giorgio Rd., San Diego County (S. and S. Frommer, UCR) and November 27, 1921, 1 ♀, Needles, San Bernardino County (Kusche, CAS). There are no peak months of adult activity, so there is little doubt the species is multiple brooded.

This large, somewhat hairy species is relatively distinctive and is easily recognized by the subgeneric characters. It is difficult to separate only from the closely related *aethiops* which shares much the same range. Characters for the separation of these two species are given in the key and in the discussion of *aethiops*.

Evans (1959) has described what is probably the penultimate larval instar of this species.



Map 31. California distribution of *Anoplus (Lophopompilus) cleora* (Banks). Inset: overall distribution.

Biology. — Adults of *Anoplius cleora* are not often taken visiting flowers which may account for their relative scarcity in collections. Probably they feed on the body juices of spiders they have captured. Our records show that males have been found at flowers of *Croton* sp. and females at *Buddleia cordata*. Both sexes have been taken on *Foeniculum vulgare*. Evans (1951) reports taking adults on *Baccharis* and *Solidago*.

Evans and Yoshimoto (1962) reported on the nesting behavior of populations in Kansas and New York in some detail. Nests are constructed in sandy areas, with the burrow started from a pre-existing hole or cavity or from the surface of the sand. The burrows extend to 30 cm and are sometimes curved. Spider prey are captured in the

general area where nesting takes place and are transported in a more or less vertical position, with the cephalothorax off the ground, the wasp grasping one of the posterior coxae and walking backwards. The spider is placed in a terminal cell with the cephalothorax facing the cell entrance. The egg is laid longitudinally or obliquely on the side of the abdomen near the base. The wasps seem to show a preference for the wolf spider, *Arctosa littoralis* (Hentz) as prey, although Kurczewski and Kurczewski (1968) reported *cleora* also taking the lycosids *Trochosa avara* Keyserling and *Lycosa helluo* Walckenaer. Maggots of *Senotainia litoralis* Allen (Sarcophagidae) which feed on the provisioned spiders have been found in the cells of the wasp.

Subgenus *Notiochares* Banks

This primarily Neotropical subgenus occurs widely in Central and South America. Two species, *amethystinus* (Fabricius) and *lepidus* (Say), extend northward into the southern United States, *amethystinus* entering southern California.

Although similar to *Lophopompilus* in the large size, robust body and the emarginate clypeus of the female, *Notiochares* is easily separated by the angulate posterior margin of the pronotum, lack of abundant erect hair on the head and mesosoma, the semicircular patch of velvety pubescence on the fourth metasomal sternum of the male and the subgenital plate which lacks a basal process and is deeply notched at the apex.

The only member of the genus which has been studied to any extent biologically is *A. (N.) lepidus atramentarius* of the eastern United States. Evans and Yoshimoto (1962) reported that both sexes are frequent flower visitors. Females capture spiders

specifically to feed on them and have been observed cutting off and mutilating legs or other parts of the body to feed on exuding blood. Spiders taken by the wasps for provisioning have all been of the genus *Lycosa* (Lycosidae). The nest sites appear to be small bare areas surrounded by tall vegetation, and female wasps characteristically begin their burrows at the surface of the soil. Burrows are vertical, sometimes becoming oblique, 7 to 10 cm deep, terminating in an oval cell. The spider is placed in the cell with the cephalic end facing the cell entrance. The legs extend into the burrow and during filling the soil is packed against them. The egg is laid diagonally on the ventrolateral portion of the abdomen near its base. The burrow is filled and tamped with the end of the metasoma. In some cases, bits of debris are dragged over the filled burrow.

Anoplius (Notiochares) amethystinus (Fabricius) (Figs. 88, 99; map 32)

Sphex amethystinus Fabricius, 1793:210. Holotype female, Virgin Islands: St. Croix (lost?).

Pompilus anceps Cresson, 1865:130. Holotype male, Cuba (ANSP). Preoccupied by *anceps* Smith, 1862.

Pompilus cubensis Cresson, 1867:93. New name for *anceps* Cresson, 1865.

Pompilus propinquus Fox, 1891:339. Holotype female, Jamaica: Kingston (USNM). Preoccupied by *propinquus* Smith, 1879.

Pompilus dux Dalla Torre, 1897:286. New name for *propinquus* Fox, 1891.

Pompilus amethystinoides Strand, 1911:147. New name for *amethystinus* Tasch. believed to differ from *amethystinus* Fabricius.

Pompilus philadelphicus var. *floridensis* Banks, 1917:106. Holotype female, Florida: Gulfport (MCZ).

Geographic range (map 32). — Southern Florida, Arizona and California south to the West Indies, Western Mexico and Panama. Evans (1966:253) recognized a subspecies, *exclusus* (Smith), occurring from Panama south to northern Argentina.

California distribution. — This species enters California only marginally in the extreme southeastern corner of the state. We have seen only two California records: Imperial Co.: Palo Verde, 1 ♀, XII-20-1963 (M.E. Irwin, UCR); Westmorland, 1 ♀, 1 ♂, V-31-1932 (CIS).

This large, robust species resembles *Anoplius aethiops* and *cleora* in size and in the emarginate



clypeus of the female but the lack of abundant erect hair, intense blue color and subgeneric characters as given in the key easily distinguish *amethystinus* from those species.

This is a large, conspicuous species and is fairly common over much of its range, but surprisingly nothing has been reported on its biology.

Map 32. Overall distribution of *Anoplius (Notiochares) amethystinus* (Fabricius).

Subgenus *Arachnophroctonus* Howard

Originally, Howard (1901) included two species, *tropicus* Fabricius and *atrox* Dahlbom but did not designate a type. Subsequently, Ashmead (1902) erroneously designated *ferrugineus* Say, a species belonging in *Tachypompilus*. Thus, the name *Arachnophroctonus* was consistently misapplied until Pate (1946) designated *Sphex tropicus* Fabricius as the type, realigning the name with Howard's concept.

Members of this cosmopolitan subgenus are found in tropical and subtropical regions. The group is well represented in South America and a number of species have been described from that area by Banks (1947) under the name *Psammochares*. There are eight Nearctic species, with California records for four.

The essential characteristics which will serve to separate California species of *Arachnophroctonus* from those of other subgenera are the transverse median vein of the anterior wing intersitral or slightly proximad of the origin of the basal vein on the median vein, the lack of abundant erect hair on

the pleura of the mesosoma; in the female, the truncate apical margin of the clypeus, the presence of a tarsal comb; in the male, the long dorsal portion and short, steeply sloping portion of the propodeum, the lack of a pilose process at the base of the subgenital plate and the absence of a velvety pubescent patch on the fourth metasomal sternum.

Evans and Yoshimoto (1962) have reviewed the biology of species occurring in the northeastern states. In general, members of this subgenus frequently visit flowers and nest in sandy soil. The nest is often started from a pre-existing cavity in the soil and consists of a short, simple burrow with an enlarged terminal cell. Prey consists primarily of lycosid spiders. Paralysis of the spider is light and temporary, recovery taking place in a few hours to a few days. The prey is often concealed while the wasp searches for a place to begin its nest. The position of the wasp's egg on the spider varies to some extent between the species studied. Excavation and filling activities are accomplished very quickly and seem to differ little between species.

KEY TO CALIFORNIA SPECIES OF THE SUBGENUS *ARACHNOPHROCTONUS*

1. Females 2
Males 5
2. Metasoma with integument entirely black; propodeum with a distinct flattened or concave posterior declivity (figs. 113, 114) and numerous conspicuous dark hairs posterolaterally 3
Metasoma with integument at least partly reddish; propodeum rounded posteriorly, the declivity indistinct (figs. 111, 112) and at most a few short, inconspicuous hairs posterolaterally 4
3. Head very broad; compound eyes divergent above, UID greater than LID (fig. 82); propodeum somewhat protuberant on each side of a short, steep declivity (fig. 114) *xerophilus* Evans
Head not unusually broad; compound eyes convergent above, UID less than LID; propodeum not protuberant on each side of declivity (fig. 113) *nigritus* (Dahlbom)
4. Tarsal comb with spines short, not more than slightly longer than width of tarsus, apical spine of basitarsus not over one-third length of second tarsal segment; propodeum without a well defined median linear impression (fig. 111); base of T1 at most slightly impressed *americanus ambiguus* (Dahlbom)
Tarsal comb with spines at least 1.5 times as long as thickness of tarsus, apical spine of basitarsus more than half length of second tarsal segment; propodeum with a distinct median linear impression (fig. 112); base of T1 with a distinct sulcus
apiculatus apiculatus (Smith)
5. Propodeum with a number of dark, erect hairs; body with appressed pubescence dark, occasionally pale on pronotum anteriorly; wings strongly infuscate; anterior wing with SM3 usually quadrangular (fig. 86) 6
Propodeum with erect hair either pale or absent; body with extensive pale appressed pubescence; wings hyaline or subhyaline; anterior wing with SM3 usually triangular or petiolate 7
6. S4 and S5 with dense brushes of short erect hairs (fig. 91); head not unusually broad; compound eyes convergent above, UID/LID 0.82-0.92 *nigritus* (Dahlbom)
S4 and S5 without dense brushes of erect hairs; head very broad; compound eyes divergent above, UID/LID 1.2-1.3 *xerophilus* Evans
7. Pronotum with posterior margin black, usually with a band of coarse silvery or glaucous pubescence; genitalia (fig. 115) with apex of digitus devoid of hairs
apiculatus apiculatus (Smith)
Pronotum with a pale yellow integumental stripe on posterior margin, without noticeable silvery or glaucous pubescence; genitalia (fig. 110) with apex of digitus bearing a dense group of long hairs
americanus ambiguus (Dahlbom)

Anoplius (Arachnophroctonus) nigritus (Dahlbom) (Figs. 81, 86, 91, 113; map 33; graph 16)

Pompilus nigritus Dahlbom, 1843:47. Holotype male, North America. Incorrectly reported as "Patria ignota, forte Africa ad Promontor. B. Sp." (ZI).

Pompilus relativus Fox 1893:114. Holotype female, New Jersey: Ocean County (ANSP).

Psammochares (Allocyphonyx) hesione Banks, 1910a:250. Holotype male, Kansas: Douglas County (MCZ).

Psammochares difficilis Banks, 1926:201. Holotype female, Virginia: Falls Church (MCZ).

Anoplius confraternus Banks, 1926:201. Holotype female, Ontario: Ridgeway (MCZ).

Psammochares henshawi Banks, 1939:226. Holotype female, Washington: Ainsworth (MCZ).

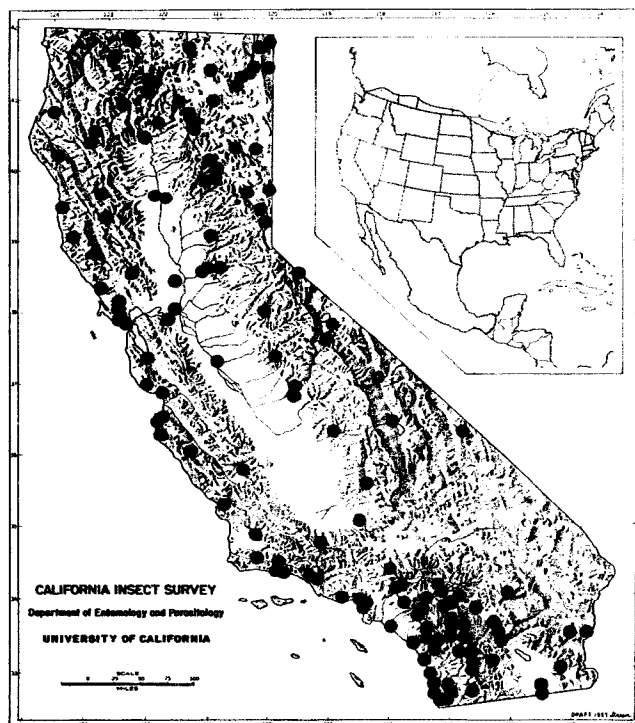
Arachnophroctonus occidentalis Dreisbach, 1954:437. Holotype male, California: Redwood City (CAS). NEW SYNONYMY.

Arachnophroctonus (!) *variegatus* Dreisbach, 1957:72. Holotype male, New Mexico (AMNH).

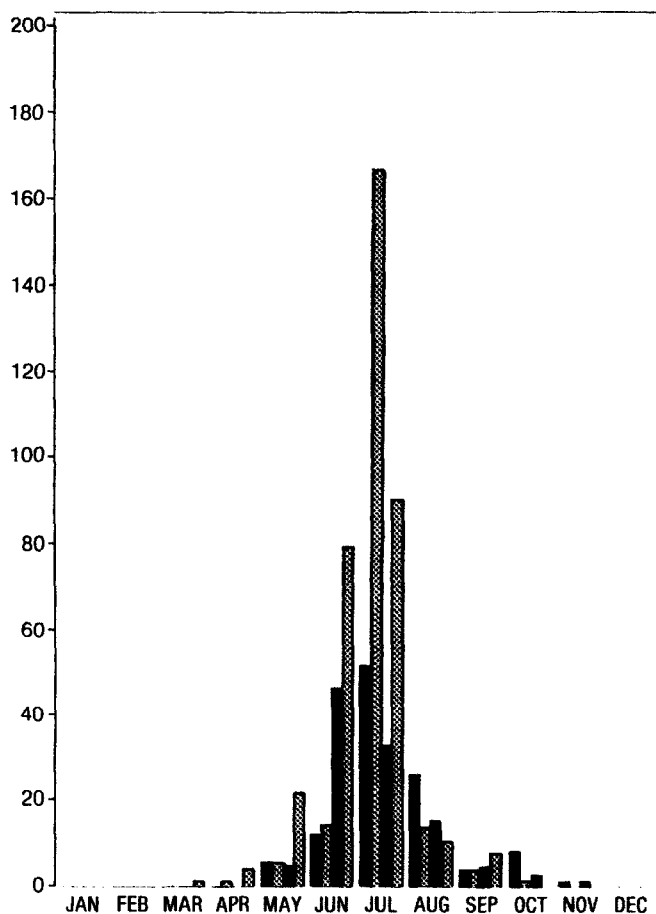
Anoplius (Arachnophroctonus) nigritus Day, 1977 (1976):71. New combination and synonymy with *relativus* Fox.

Geographic range (map 33). — Across southern Canada and the United States, south through Baja California and mainland Mexico along the central plateau to Chiapas.

California distribution (map 33). — Widespread over most of California at elevations from sea level to 2,440 m but not known from the Channel Islands.



Map 33. California distribution of *Anoplius (Arachnophroctonus) nigritus* (Dahlbom). Inset: overall distribution.



Graph 16. Seasonal occurrence of *Anoplius (Arachnophroctonus) nigritus* (Dahlbom). Black columns represent females; gray columns are males.

Seasonal occurrence (graph 16). — Adults of this species are on the wing from March to November. Collection records indicate a peak of adult activity in July. We examined 421 females and 724 males, mostly from California localities.

Anoplius nigritus is easily recognized. It alone among the large, dark-winged species of *Arachnophroctonus* possesses a ventral hair brush on the metasoma of the males. In this regard it is similar to *imbellis* Banks, *toluca* (Cameron) and *dreisbachi* Evans, the males of which also have ventral hair brushes. It is separable from these by the subgeneric characters, especially the shape of the propodeum which is long, low and suddenly steepened behind. Females are recognized by the large size, uniformly dark wings, lack of abundant erect body hair and truncate clypeus.

Dreisbach proposed the name *occidentalis* in 1954 based on a series of males collected at Redwood City, San Mateo County. We have examined the type series which exhibits small differences in the genitalia. The parapenial lobes are stouter and the hairs at the apex of the digitus are shorter, finer and more closely set, occurring in a slightly different pattern than in other popula-

tions of *nigritus*. In addition, the subgenital plate is somewhat constricted near the base. The hairs at the apex of the basis volsellaris are very short and fine instead of long and setiform. The differences are slight; they occur only in a restricted geographic area and as far as we can determine are confined to one sex. For these reasons we have elected not to accord specific status to *occidentalis*.

Biology. — Adults of *nigritus* are commonly found feeding at flowers and honeydew secretions. Females have been taken at honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata* and visiting flowers of *Asclepias fascicularis*, *Baileya multiradiata*, *Cicuta maculata*, *Eriogonum fasciculatum*, *Foeniculum vulgare* and *Helenium* sp. Males are recorded at flowers of *Acacia Greggii*, *Achillea millefolium*, *Buddleia* sp., *Hemizonia pungens*, *Croton californicus*, *Chrysanthamnus nauseosus*, *Dalea albiflora*, *Daucus carota*, *Dyssodia coccinea*, *Gutierrezia sarothrae*, *Melilotus albus*, *Polytaenia Nuttallii*, *Rhus laurina*, *Robinia* sp., *Senecio Douglasii*, *Sphaeralcea angustifolia* and *Yucca* sp. Both sexes have been taken at extra-floral nectaries of *Helianthus annuus* and at flowers of *Asclepias erosa*, *Colubrina texensis*, *Eriogonum gracile* and *Guardiola tulocarpus*. Evans (1951) provides the following additional flower visitation records: *Conium maculatum*, *Solidago* sp., *Baccharis glutinosa*, *Petalostemum occidentale*, *Vicia* sp., *Tamarix* sp., *Polygonum* sp., *Angelica* sp., *Cleome serrulata*, *Monarda* and *Euphorbia marginata*.

Evans (1951), Evans and Yoshimoto (1962), Kurczewski and Kurczewski (1968, 1973) and Kurezewski (1981) made observations on the provisioning activities of *nigritus*. Females construct nests in sandy or clay soil. The burrows are short (13 to 18 cm), straight and terminate in an enlarged cell. Hunting and capture of prey takes place before nest construction. Large spiders are used and are transported by the wasp grasping the base of a posterior leg with its mandibles and walking backward toward the burrow. The spider is pulled into the burrow abdomen first. The provisioned nest is filled by biting and scraping soil from the sides of the burrow and packing with blows of the end of the metasoma. When the filling is nearly complete, soil is raked in from outside the entrance. The spider is placed in the cell facing the entrance and the egg is laid obliquely on the side of the abdomen about halfway from the base.

The following spiders have been recorded as prey: *Agelenopsis naevia* (Walckenaer) and *pennsylvanica* (Koch) (Agelenidae); *Arctosa littoralis* (Hentz), *Geolycosa missouriensis* (Banks) and *wrighti* (Emerton), *Lycosa avida* Walckenaer, *lenta* (Hentz) and *rabida* Walckenaer (Lycosidae).

Anoplius (Arachnophroctonus) xerophilus Evans
(Figs. 82, 114; map 34)

Anoplius (Arachnophroctonus) xerophilus Evans, 1947:10.
Holotype male, New Mexico: Steins (CU).

Geographic range (map 34). — Desert areas of southern California, southern Nevada, southwestern Utah, southern Arizona, southwestern New Mexico and western Texas south to the Mexican states of Baja California, Durango and Nuevo Leon.

California distribution (map 34). — Fresno and Inyo counties south through the deserts at sea level to 670 m.

Seasonal occurrence. — This is not a commonly collected species. We have seen 43 females and 49 males of which only 14 females and 22 males are from California localities. Early and late months of capture are April and November, at Borrego, San Diego County, but these represent isolated records and the majority of California specimens have been taken from July to October.



Map 34. California distribution of *Anoplius (Arachnophroctonus) xerophilus* Evans. Inset: overall distribution.

Anoplius xerophilus in a comparative sense is a specialized species, and it exhibits some unusual features such as the very broad head, posteriorly produced sides of the propodeum forming a concave posterior declivity and the distinctive male genitalia. These features distinguish it readily from other species of *Anoplius*.

Biology. — Part of the type series of *xerophilus* was taken at a sweet exudate on the pods of catclaw. Females have been collected on the flowers of *Chilopsis* sp. and *Eriogonum fasciculatum*

polifolium; males at the flowers of *Asclepias* sp., *Chrysothamnus* sp., *Cleome serrulata*, *Robinia* sp. and *Yucca elata*. Both sexes have been taken at flowers of *Baccharis* sp.

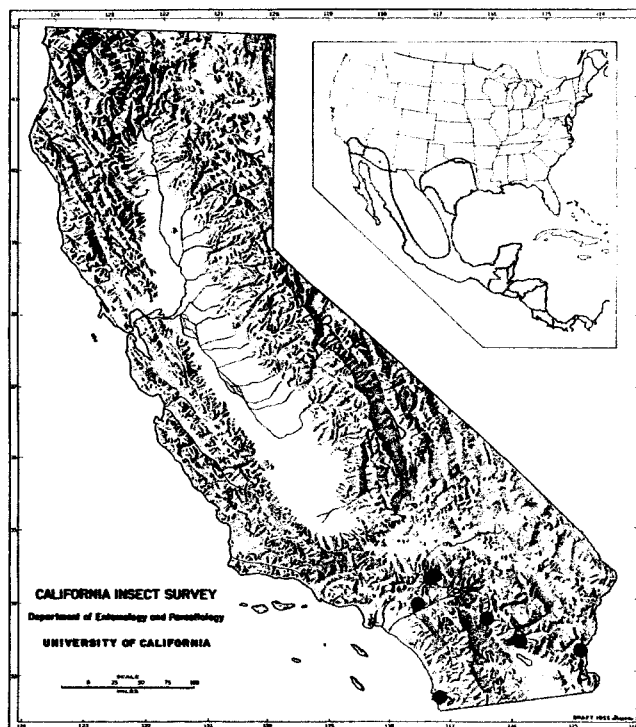
The provisioning behavior of this species has not been reported.

Anoplius (Arachnophroctonus) apiculatus apiculatus (Smith)
(Figs. 112, 115; map 35)

Pompilus apiculatus Smith, 1855:157. Holotype female, Mexico: Veracruz (BMNH).

Geographic range (map 35). — Southern California, southern Arizona and Texas south through lowland areas of Mexico to Panama.

California distribution (map 35). — 5 ♀♀, 5 ♂♂. Imperial Co.: 2 mi. S. Palo Verde, 1 ♀, X-18-59 (J.W. MacSwain, CIS). Riverside Co.: Box Canyon, 1 ♀, IV-11-43 (Weston, SDM); Thousand Palms, 1 (sex ?) IV-9-55 (W.R. Richards, CNC). San Bernardino Co.: Mojave River-Apple Valley, 2 ♂♂, VI-29-40 (J.W. MacSwain, CIS); Mojave Narrows Reg. Park, 1 ♂, X-1-72 (S. and S. Frommer, UCR); Colton, 1 ♂, X-18-09 (E.C. Van Dyke, CAS). San Diego Co.: San Diego, 1 ♂, 1 ♀, X-12-53, VIII-5-54 (H. Hill, SDM), 2 ♀♀, VIII-2-54 (H. and M. Evans, MCZ).



Map 35. California distribution of *Anoplius (Arachnophroctonus) apiculatus apiculatus* (Smith). Inset: overall distribution.

Anoplius apiculatus and *A. semirufus* (Cresson) form the *apiculatus* species group of Evans (1951:258). The group is characterized by the long spines of the tarsal comb, extensive silvery pubescence on the body, white hairs on the head and propleura, impressed median line on the

propodeum and median basal sulcus on the first metasomal tergum. Additionally, the metasoma of both sexes in the two species is marked with red at least on the basal segments. *Anoplius semirufus* occurs east of the Rocky Mountains.

Anoplius apiculatus has been regarded as comprising three subspecies on the basis of color and pubescence, but these subspecies are distinguishable only in the females. Of the three, *apiculatus apiculatus* is the most widespread. The other two, *apiculatus autumnalis* (Banks) and *a. pretiosus* (Banks), are confined to the eastern United States.

Although the larva of the nominate subspecies has not been described, Evans (1959) described and figured larvae of *apiculatus autumnalis* (Banks) and discussed briefly larvae of *apiculatus pretiosus* (Banks).

Biology. — There is no biological information available on this subspecies except that it is commonly found along sandy washes, stream banks and seashore situations. However, both the other subspecies have been the subjects of some biological work (Evans, Lin and Yoshimoto, 1953; Krombein, 1952; Evans and Yoshimoto, 1962).

Females do not visit flowers but on several occasions have been observed feeding on the blood of captured spiders. Prey consists almost exclusively of *Arctosa littoralis* (Hentz) (Lycosidae). In addition to the records presented by the authors cited above, Kurczewski and Kurczewski (1968) provided a number of records of the same wolf spider used as prey. The spider is captured and dragged to the nesting site where, during nest construction, it is partially covered with sand. The burrow is short and relatively straight, varying from 4 to 17 cm in length. The terminal cell is about 4 by 15 mm and the spider fits snugly into it with the cephalothorax facing the entrance and the anterior legs extending into the burrow. The egg of the wasp is laid diagonally on the side of the spider's abdomen slightly anterior to the middle. Filling is accomplished by scraping sand from the walls of the burrow and later raking it in from outside. Some time is spent smoothing sand over the filled burrow so that no evidence of it remains. Paralysis of the prey is temporary and full recovery occurs in a few hours. The snug fit of the spider in the cell and the anterior legs extending into the burrow to be surrounded by fill are probably adaptations for preventing the recovered spider from moving about and dislodging the egg.

This species is victimized by the miltogrammine sarcophagid fly, *Senotainia littoralis* Allen which larviposits on the spider. It is also attacked by the cleptoparasitic pompilid, *Evagetes mohave* (Banks). See discussion of biology under that species.

Anoplius (Arachnophroctonus) americanus ambiguus (Dahlbom)
(Figs. 93, 110, 111; map 36)

Pompilus ambiguus Dahlbom, 1845:452. Holotype female, Mexico (Univ. Lund, Sweden).

Pompilus coruscus Smith, 1855:156. Holotype female, Santo Domingo (BMNH).

Pompilus juxta Cresson, 1865:129. Holotype female, Cuba (ANSP).

Pompilus subargenteus Cresson, 1865:129. Holotype male, Cuba (Gundlach Coll., Havana).

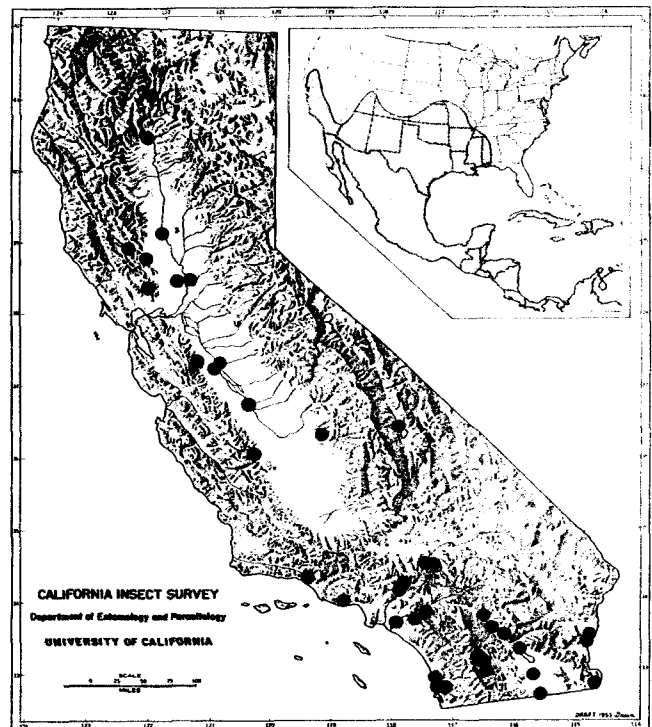
Anoplius puella Banks, 1941:121. Holotype male, Texas: Galveston (MCZ).

Pompilinus orthodes Banks, 1944a:112. Holotype female, British Guiana: Georgetown (MCZ).

Anoplius varunus Banks, 1947:419. Holotype male, British Guiana: New Amsterdam (MCZ).

Geographic range (map 36). — North coast of South America, Antilles, Central America north to California, Utah, Kansas and Alabama.

California distribution (map 36). — Warm, low areas in the inner coast hills, through the Central Valley to the arid southern California coast, low areas in the southern California montane and through the Colorado Desert. We examined 189 females and 152 males, the majority from California.



Map 36. California distribution of *Anoplius (Arachnophroctonus) americanus ambiguus* (Dahlbom). Inset: overall distribution.

Seasonal occurrence. — In California, this subspecies occurs primarily in summer, with records from May 1 at Rumsey, Yolo County to October 12 at Santee, San Diego County. We have seen Mexican records spanning the year from January to November.

The two California species in the subgenus *Arachnophroctonus* which have red on the

metasoma are *americanus ambiguus* and *apiculatus apiculatus*. California females of these species are separable by characters of color and pubescence as well as by traits presented in the key. In *ambiguus*, the red on the metasoma is restricted to the first three terga, and the body pubescence is dark. In *apiculatus* the entire metasoma is red and the pubescence is pale over most of the body. The males are separated most conveniently by the integumental color of the posterior margin of the pronotum. In *ambiguus*, there is a pale (yellow or cream) integumental stripe; in *apiculatus* the entire pronotum is black, although there is a band of pale pubescence on the apical margin.

Anoplius a. ambiguus is a highly variable subspecies and Evans (1966) has discussed polymorphism in the males. There are differences in the integumental color of the metasoma and the amount of erect hair on the metasomal sterna, and there appear to be four forms: RS (metasoma partly red, erect hair on venter relatively short and sparse); RH (metasoma partly red, erect hair on venter long, dense, forming distinct brushes); BS (metasoma entirely black, erect hair short and

sparse); BH (metasoma entirely black, erect hair in brushes). There is a partial geographic segregation of these forms, and all the California specimens we have examined are the RS form, which is the most widespread.

Biology. — Adults are occasionally taken at plants. Males have been collected at flowers of *Cucurbita moschata*, *Hyptis Emoryi* and *Pluchea* sp. Females have been taken at extra-floral nectaries of *Helianthus* sp. and flowers of *Baccharis* sp. Both sexes are recorded visiting extra-floral nectaries of *Gossypium hirsutum*. Evans (1951) records this subspecies at flowers of *Baccharis sarothroides* and *Polygonum* sp. No complete observations of the provisioning behavior have been made, but Evans and Yoshimoto (1962) reported on hunting, prey transport and nest construction. Known prey are Lycosidae: *Arctosa littoralis* (Hentz), *Schizocosa crassipes* Walckenaer and Oxypidae: *Peucetia viridans* Hentz (Hurd and Wasbauer, 1956; Evans and Yoshimoto, 1962). The cleptoparasitic spider wasp *Evagetes mohave* is known to parasitize *Anoplius americanus ambiguus* (see discussion under *mohave*).

Subgenus *Pompilinus* Ashmead

This homogeneous group is found throughout the range of the genus *Anoplius* and is particularly well represented in the Nearctic Region. There are 17 Nearctic species, most of which also occur in Mexico and Central America. One species (*litoreus* Evans) is found only on sea beaches and is endemic to the west coast of Mexico. Banks (1947) included four South American species in *Pompilinus*, but one of them is assignable to *Arachnophroctonus* and the status of the others is uncertain.

Closely allied with *Arachnophroctonus*, the group is distinguished in our fauna by only one invariable character — in the anterior wing, the position of the transverse median vein which meets the median distad of the intersection of the basal vein.

Evans (1951) stated that because of the small differences separating *Pompilinus* and *Arachnophroctonus*, the two groups might not be kept, justifiably, as discrete entities. Day (1974), working with the Old World fauna, found that the characters separating these groups break down. On the basis of this, he proposed synonymy of *Pompilinus* with *Arachnophroctonus*. However,

the subgeneric separation works well for the California fauna and provides a convenient means of separating groups of species.

Nearctic species fall into two groups characterized by the shape of the gonostyli and presence or absence of ventral hair brushes on the metasoma of the males. The six California species all belong to the group in which the ventral hair brushes are absent and the gonostyli are broader apically than near the base.

Because of the pronounced similarity of the species in external features, the subgenus is a difficult one. The differences between the species are quite subtle in the females and although minor external characters may be used for the males, examination of the genitalia and subgenital plate provides the best means for separating them.

The biology of species of *Pompilinus* is incompletely known. There are detailed studies of a few species such as that of Evans, Krombein and Yoshimoto (1955) on *fraternus* (Banks), a species of the eastern U.S. However, until additional information is accumulated on other species, generalizations do not appear warranted.

KEY TO CALIFORNIA SPECIES OF THE SUBGENUS *POMPILINUS*

1. Females2
Males7
2. Metasoma with integument red or orange on 1 or 2 basal segments *cylindricus* (Cresson)
Metasoma entirely black3
3. Anterior basitarsus with 3 or (more commonly) 4 strong comb spines which are longer than the width of the tarsus at their base *californiae* Evans
Anterior basitarsus with 3 short comb spines which are no longer than width of tarsus at their base4
4. Propodeum with a number of noticeable erect hairs dorsolaterally *tenebrosus* (Cresson)
Propodeum without erect hairs or with only a few short scarcely noticeable hairs on sides5
5. Antennal segment 3 at most 0.69 UID, slightly shorter than combined lengths of segments 1 and 2
estellina (Banks)
Antennal segment 3 usually greater than 0.69 UID, slightly longer than combined lengths of segments 1 and 26
6. Front moderately broad, MID/TFD 0.57-0.60; pronotum with posterior margin indistinctly angulate medially ...
insolens (Banks)
Front narrow, MID/TFD 0.53-0.56; pronotum with posterior margin distinctly angulate medially
clystera (Banks)
7. SGP flat, with a pair of carinae which are slightly convergent posteriorly, apex evenly rounded (fig. 105); genitalia with apex of digitus rounded (fig. 126)
tenebrosus (Cresson)
8. SGP widest near the middle, evenly tapering to an acute apex (fig. 101); genitalia with digitus not evenly rounded apically (figs. 118, 119)8
9. SGP widest beyond the middle, not evenly tapering to acute apex (figs. 100, 102); genitalia with gonostylus less slender, without pronounced squama; digitus slender, rounded or curved at apex (figs. 118, 120)9
10. Genitalia with gonostylus broad, the apex subtruncate (fig. 122); SGP somewhat convex but not sharply elevated medially (as in fig. 107) *insolens* (Banks)
Genitalia with gonostylus narrower, rounded or subacute at apex (figs. 116, 120); SGP more or less sharply elevated medially (figs. 100, 102)10
11. Propodeum with some erect hair; aedeagus very broad with a rounded apical lobe (fig. 116) *californiae* Evans
Propodeum without or with very few erect hairs; aedeagus narrow basally without a rounded apical lobe (figs. 118, 120)11
12. Aedeagus strongly expanded at apex into a pair of truncate lobes (fig. 120); SGP strongly expanded laterally, narrowed suddenly at apex to an angulate median projection (fig. 102) *estellina* (Banks)
Aedeagus not as strongly expanded at apex (fig. 118); SGP narrower, subacute (fig. 100) *clystera* (Banks)

Anoplius (Pompilinus) insolens (Banks) (Fig. 122; map 37; graph 17)

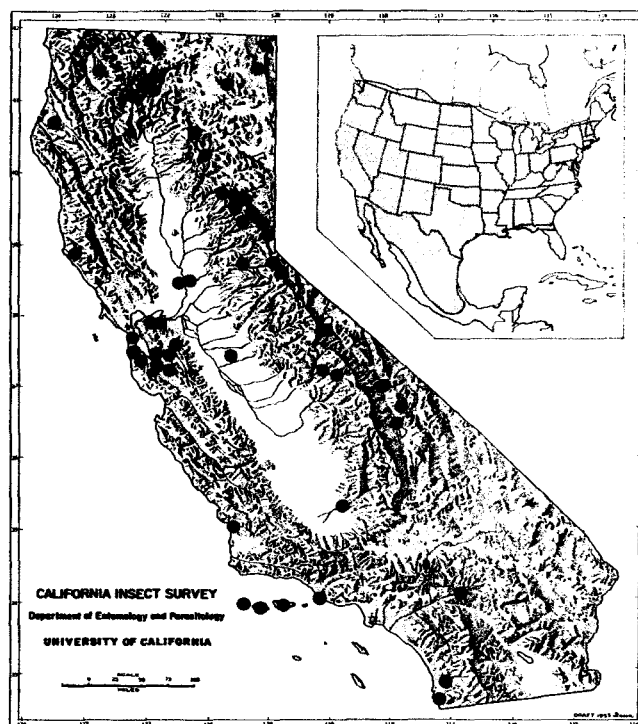
Pompiloides insolens Banks, 1911 (1912):226. Holotype female, North Carolina: Black Mt. (MCZ).

Geographic range (map 37). — Transcontinental in southern Canada and the United States, south along the Mexican Central Plateau to the state of Veracruz.

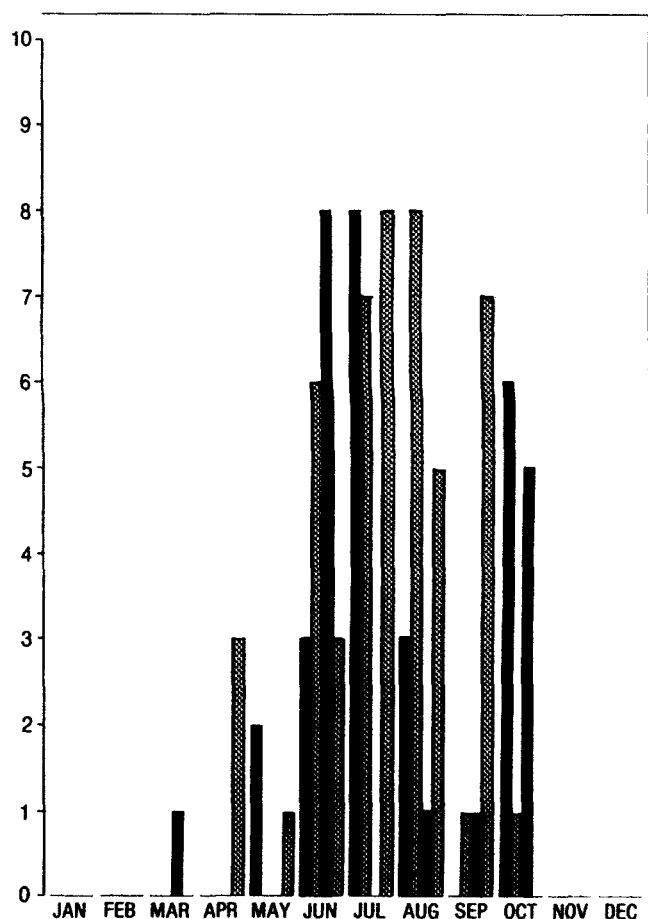
California distribution (map 37). — Not abundant in collections, but widespread over most of California in the Upper Sonoran to Transition zones and at elevations from near sea level to about 3,050 m. It is absent from the southeastern deserts but has been taken on the Channel Islands. San Miguel: near Green Mtn., 1 ♀, VIII-29-1978 (S. Miller, SBM). Santa Cruz: Canada del Medio, 4 ♀♀, 1 ♂, VI-20-1967 (D.S. Horning, A.S. Menke, UCD); 1 ♀, VII-17-1967 (C. and J. Remington, PM); Coches Prietos, 1 ♀, VI-17-1967 (A.S. Menke, UCD); Christi Beach, 1 ♀, VI-19-1967 (D.R. Miller, UCD). Santa Rosa: Beechers Bay, 1 ♀, VI-6-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).

Seasonal occurrence (graph 17). — This is a midsummer species, and most of the California records are for June, July and August, although they extend from March 28 near Bakersfield, Kern County to October 24 at Antioch, Contra Costa County and Daly City, San Mateo County. We examined 156 females and 67 males, of which 50 females and 44 males are from California.

This species and *A. clystera* are closely related. The females are difficult to separate and the major difference between the two species is in the width of



Map 37. California distribution of *Anoplius (Pompilinus) insolens* (Banks). Inset: overall distribution.



Graph 17. Seasonal occurrence of *Anoplius (Pompilinus) insolens* (Banks). Black columns represent females; gray columns are males.

the head and the degree of angulation of the posterior margin of the pronotum (see key). The males differ in features of the genitalia but are most easily separated by the form of the subgenital plate. In *insolens* it is convex but not sharply elevated medially, while in *clystera* there is a definite median ridge (fig. 100). The two species are separated ecologically to a degree also, with *insolens* more likely encountered in higher montane situations.

Biology. — Evans (1951) lists the following adult floral visitation records: *Achillea millefolium*, *Asclepias*, *Chrysanthemum leucanthemum*, *Chrysothamnus*, *Cleome lutea*, *Daucus carota*, *Eriogonum*, *Pastinaca sativa*, *Petalostemum occidentale* and *Sphaeralcea angustifolia*. From our records, we add the following. Females: *Cleomella* sp., *Gutierrezia microcephala* and *sarothrae*, *Melilotus albus*, *Wislizenia refracta*. Males: *Umbellularia* sp. Both sexes: *Baccharis Douglasii*, *Eriogonum latifolium nudum*.

The only information available on the nesting behavior of *insolens* consists of two prey records.

Evans (1951) reported a female dragging a female of the salticid spider *Maevia vittata* (Hentz) along the ground at East Hartford, Connecticut. Wasbauer (1983) lists a female from Smithfield, Utah which was pinned with a female of *Tibellus gertschi* Chamberlin and Ivie (Philodromidae). A specimen from Benson Ward, Cache Co., Utah, collected August 8, 1967 is labeled "Nest in *N. melanderi* burrow." It may be that this species utilizes small depressions including the nests of *Nomia* and other aculeate Hymenoptera from which to start its own burrows.

Anoplius (Pompilinus) tenebrosus (Cresson)
(Fig. 105; map 38; graph 18)

Pompilus tenebrosus Cresson, 1865a:453. Holotype female, Colorado (ANSP).

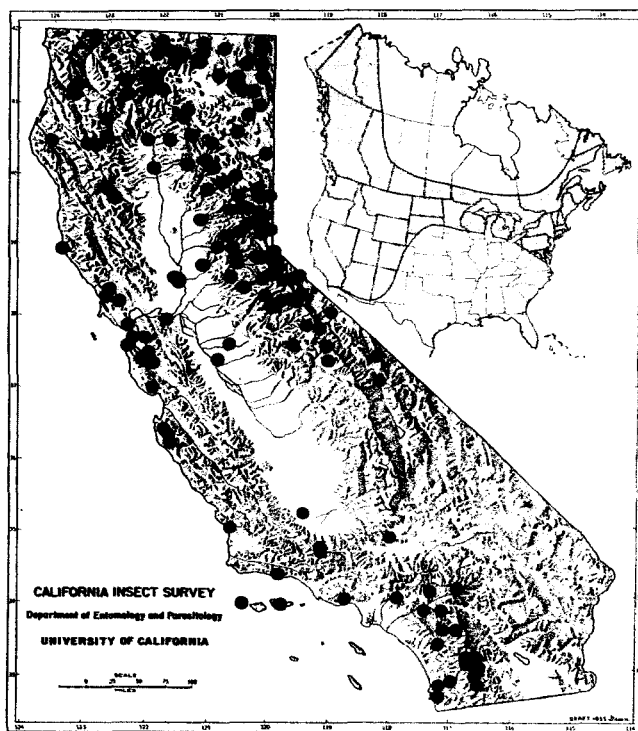
Pompilus compactus Provancher, 1895:111. Holotype female, Canada, British Columbia: Vancouver (UL).

Pompiloides canadensis Banks, 1919a:82. Holotype male, Canada, Nova Scotia: Truro (CU).

Pompilinus drakei Dreisbach, 1958:62. Holotype male, New York: Cranberry Lake (AMNH).

Geographic range (map 38). — Across the continent in Canada and the United States mainly in the Canadian and Transition zones, from the Yukon and Northwest Territories east to Newfoundland and south to southern California, Arizona and New Mexico.

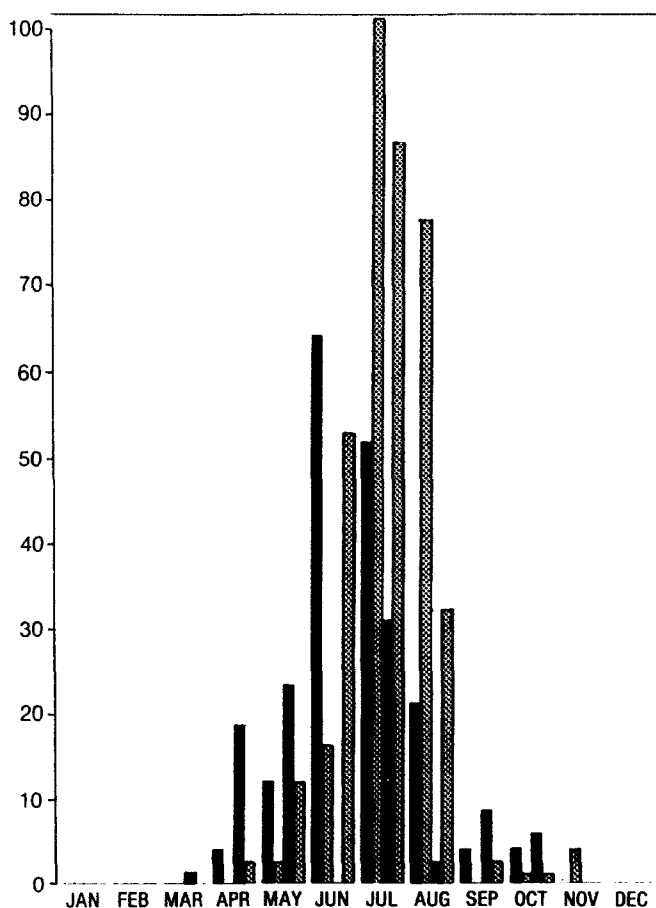
California distribution (map 38). — This species is one of the more common elements in the California pompilid fauna. It is found from sea level to over 3,050 m and occurs primarily in



Map 38. California distribution of *Anoplius (Pompilinus) tenebrosus* (Cresson). Inset: overall distribution.

mountainous situations. There are numerous records from the Sierra Nevada, Coast Ranges, Siskiyou Mountains and the Great Basin montane. It appears to be absent from the southern Sierra Nevada but occurs in the coastal mountains of southern California. There are a few records from the Central Valley and from the islands of San Miguel: Cuyler Harbor, 1 ♀, VII-11-1970 (A.A. Grigarick, R.O. Schuster, UCD), and Santa Cruz: Canada del Medio, 1 ♀, IX-22-1968 (R.O. Schuster, UCD); Christi Beach, 1 ♀, IX-27-1978 (M. Buegler, CIS).

Seasonal occurrence (graph 18). — We examined 594 females and 812 males. Of the 350 females and 432 males we have seen from California localities, the great majority have been taken in July and August, although records extend from late March to the middle of November. There is probably a single early summer generation in most localities. Both Evans (1970) and Kurczewski and Kurczewski (1973) report that females collected in the spring show signs of worn wings and probably overwinter as adults.



Graph 18. Seasonal occurrence of *Anoplius (Pompilinus) tenebrosus* (Cresson). Black columns represent females; gray columns are males.

Because *tenebrosus* is so common and widespread, it is fortunate that both sexes are easily recognized. Females are among the larger *Pompilinus* and are characterized by the short comb spines on the anterior tarsi and long, erect hair on the propodeum. The males have a distinctive subgenital plate. It is flat and has a ventral pair of longitudinal subparallel carinae which

converge anteriorly (fig. 105). This feature is usually visible without dissection.

Biology. — Although adults of this species have not been recorded visiting honeydew secretions or extra-floral nectaries, they are commonly taken on flowers. Evans (1951) records the following plant hosts: *Angelica*, *Cleome*, *Eryngium* and *Solidago*. We have seen the following floral visitation records. Females: *Arctostaphylos* sp., *Asclepias fascicularis*, *Chrysothamnus nauseosus consimilis* and *viscidiflorus*, *Eriogonum* sp., *Erythronium grandiflorum*, *Foeniculum vulgare*, *Gutierrezia californica*, *Melilotus albus*, *Ranunculus* sp., *Salix* sp., *Tellima* sp., and *Wislizenia refracta*. Males: *Cryptantha* sp., *Eryngium articulatum*, *Koeberlinia spinosa*, *Oenothera pallida* and *Senecio* sp. Both sexes: *Achillea lanulosa* and *millefolium* and *Pastinaca sativa*.

The only information published on the nesting behavior of *tenebrosus* is that of Kurczewski and Kurczewski (1973) who observed a single female constructing a nest and provisioning it. Most details are in concordance with Evans' observations (1964) of *estellina*. Prey recorded are Lycosidae: *Lycosa avida* Walckenaer (immature), *L. baltimoriana* Keyserling (immature), *L. frondicola* Emerton (female), *Alopecosa kochi* (Keyserling), *Schizocosa saltatrix* Hentz; Gnaphosidae: *Haplodrassus signifer* (Koch) (female); Thomisidae: *Thanatus formicinus* (Olivier) (female), *Xysticus ferox* Hentz (subadult ♀) and *X. gulosus* Keyserling (Evans, 1951; Evans and Yoshimoto, 1962; Wasbauer and Powell, 1962; Kurczewski and Kurczewski, 1973).

Anoplius (Pompilinus) cylindricus (Cresson) (Figs. 101, 119)

Pompilus cylindricus Cresson, 1867:92. Lectotype male, Texas (ANSP).

Arachnophila brevihirta Banks, 1945:105. Holotype female, Illinois: Chicago (MCZ).

Pompilinus truncatus Dreisbach, 1949a:15. Holotype male, Michigan: Gratiot Co. (MCZ).

Pompilinus subtruncatus Dreisbach, 1949a:17. Holotype male, Nebraska: Lincoln (UN).

Pompilinus hispidus Dreisbach, 1949a:23. Holotype male, Michigan: Tuscola Co. (MCZ).

Pompilinus clavipes Dreisbach, 1958:61. Holotype male, Texas: Conlon (MCZ).

Geographic range. — Transcontinental in Canada and the United States from the Northwest Territories to Ontario and south to Veracruz, Mexico. The species seems to be abundant in the plains states but sparse on the Pacific coast, having been recorded only from central Oregon and southern California.

California distribution. — We have seen only 6 specimens of *cylindricus* from California, all males, as follows: Inyo Co.: 25 mi. E Lone Pine, 3 ♂♂, VI-27-1980 (T.W. Schoener, C.A. Toft,

UCD); 12 mi. E Keeler, Hwy. 190, 1 ♂, VI-28-1980 (C.A. Toft, UCD). Kern Co.: 4 mi. NE Inyokern, 2 ♂♂, IV-23-1960 and IV-21-1961 (D.D. Linsdale, CIS).

Females of this species should be easy to recognize by the red on the basal metasomal terga. The females of all other California species in the subgenus *Pompilius* are uniformly black. The males can be recognized by the distinctive genitalia and subgenital plate (figs. 101, 119).

Biology. — According to Evans (1951) this species is most characteristic of inland, well-drained areas, especially sand dunes or semi-desert areas. Males come frequently to flowers and have been taken on *Solidago*, *Asclepias*, *Cleome*, *Sphaeralcea*, *Conium* and *Melilotus* and also at honeydew. Females rarely visit flowers but have been taken at *Melilotus albus*. In addition to the records given by Evans, we have seen records for females at *Senecio Longii* in Texas and at *Malacothrix* sp. in Utah.

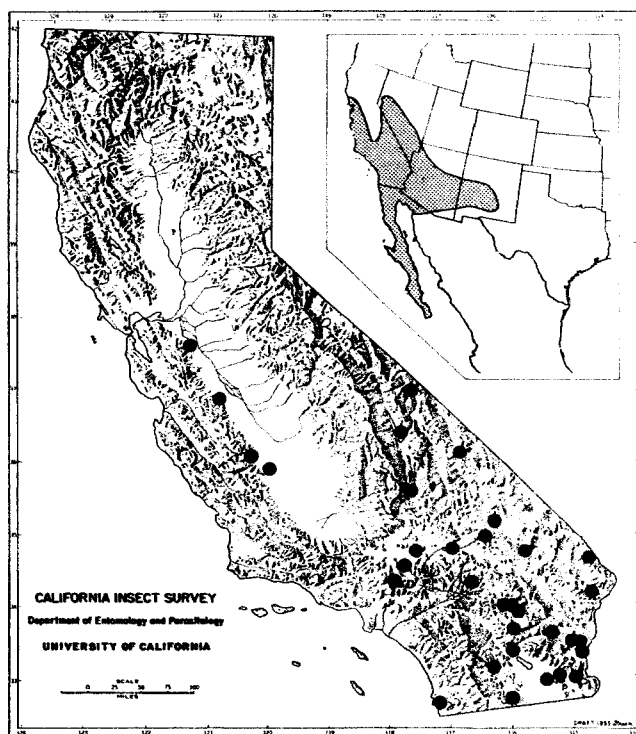
Prey and provisioning behavior of this species have been reported by Kurczewski and Kurczewski (1973), Gwynne (1979) and Kurczewski (1981). Burrowing wolf spiders of the Genus *Geolycosa* (Lycosidae) are taken as prey. The female wasp gains access to the burrow of the spider either by entering an open burrow or by digging its way in. Spiders are attacked in the burrow or may be driven out and attacked on the surface. In the latter case, the wasp drags the spider back to its own burrow. A short lateral tunnel is constructed at right angles to the burrow of the spider. The wasp then drags the spider into a terminal cell she has constructed on the lateral tunnel where oviposition takes place. After oviposition both the lateral tunnel and main burrow are filled. The egg is placed obliquely on the side of the spider's abdomen, near the base. Prey spiders are immatures of *Geolycosa* sp. (either *micranopy* Wallace or *hubbulli* Wallace), *G. wrightii* (Emerton) and *G. raphaelana* (Chamberlin).

Anoplius (Pompilius) californiae Evans
(Figs. 84, 116; map 39; graph 19)

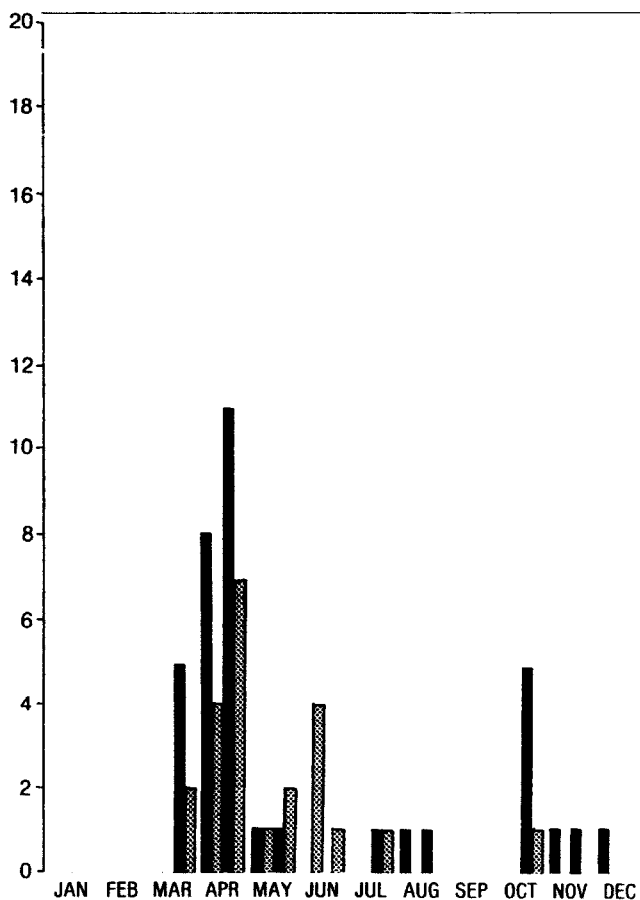
Anoplius (Pompilius) californiae Evans, 1948:128. Holotype female, Mexico: Baja California. La Paz (CAS).

Geographic range (map 39). — Central California and western Nevada east through southern Arizona to central New Mexico. This species occurs south to the tip of the Baja California peninsula but on the mainland of Mexico it has been found only in extreme northern Sonora.

California distribution (map 39). — This species is primarily a Lower Sonoran element and has not been found north of Contra Costa County. It occurs at low elevations in the San Joaquin Valley, Mojave and Colorado deserts and coastal San Diego County.



Map 39. California distribution of *Anoplius (Pompilius) californiae* Evans. Inset: overall distribution.



Graph 19. Seasonal occurrence of *Anoplius (Pompilius) californiae* Evans. Black columns represent females; gray columns are males.

Seasonal occurrence (graph 19). — There are California records in every month from March 22 at Ocotillo, Imperial County to December 5 at Needles, San Bernardino County, with the largest number for April. We have examined 36 females and 22 males from California localities.

Anoplius californiae is one of three species in the subgenus *Pompilinus* that have long, erect hair on the propodeum of the female. In females of one of these, *cylindricus*, the base of the metasoma is marked with red. Of the remaining species, *californiae* is separable from *tenebrosus* by the much longer spines of the tarsal comb. Males are best separated by features of the genitalia and subgenital plate.

Biology. — Adults of both sexes are known to feed at flowers and honeydew secretions. Evans (1951) recorded the species visiting *Tamarix gallica* and *Helianthus annuus*. We have seen the following records: females at flowers of *Cryptantha* sp., *Isomeris arborea* and *Prosopis* sp.; males at honeydew on *Chrysothamnus* sp.; both sexes at flowers of *Croton californicus*.

There is no published information on the provisioning behavior or prey of this species.

Anoplius (Pompilinus) estellina (Banks)
(Figs. 102, 120; map 40)

Pompiloides estellina Banks, 1914:303. Holotype male, California, San Diego County: Fosters (MCZ).

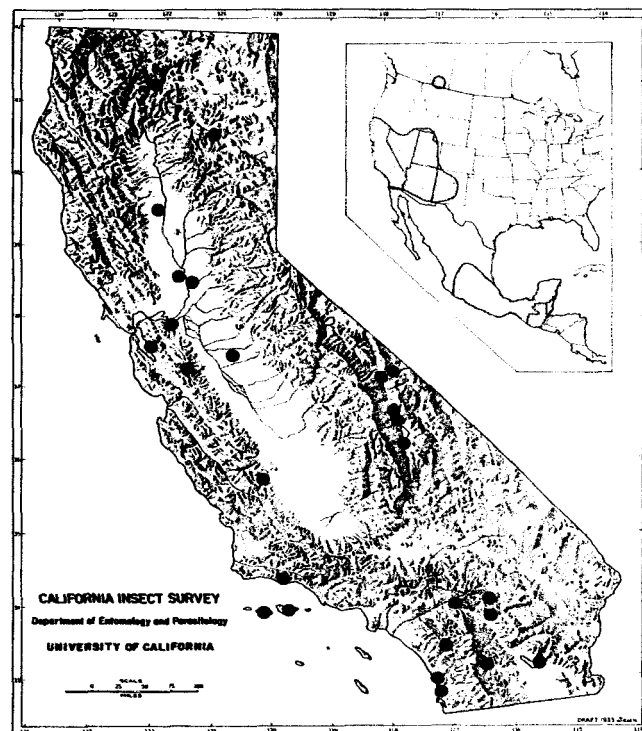
Pompilinus utahensis Dreisbach, 1952a:145. Holotype male, Utah: Castle Dale (USNM).

Pompilinus minutus Dreisbach, 1952a:147. Holotype male, Mexico, Michoacan: Tancitaro (type depository unknown).

Geographic range (map 40). — Western United States: California, Nevada, Utah and Arizona, south to Guatemala. There is a single, isolated record from southern Alberta. There are no records from a large area in northern Mexico, then a number of records from the state of Zacatecas south into Guatemala.

California distribution (map 40). — Although widespread in California, this species is not commonly collected and the records are scattered. It has been taken in the northern Sierra Nevada, Siskiyou Mountains, Central Valley, inner Coast Ranges, Owens Valley, coastal San Diego County and the Colorado Desert. Additionally, there are several records from the Channel Islands. Santa Cruz: Central Valley HQ, 1 ♂, IX-25-1978 (R. Coville, CIS); Prisoner's Harbor, 1 ♂, IV-25-1966 (R.L. Langston, CIS); Valley Anchorage, 1 ♂, IV-27-1966 (G. Frankie, CIS). Santa Rosa: West end sand dunes, 1 ♀, V-25-1977 (D.R. Miller, USNM); Windmill Cyn., north fork, 3 ♀♀, VI-7/11-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM). We have seen 37 females and 33 males of which 15 females and 20 males are California records.

Seasonal occurrence. — This species is on the wing throughout most of the summer. Early and late dates of collection are April 25, 1966 at Prisoner's Harbor, Santa Cruz Island, Santa Barbara County (R.L. Langston, CIS) and October 6, 1959 at 14 mi. SW Avenal, Kings County (R.R. Snelling, LACM).



Map 40. California distribution of *Anoplius (Pompilinus) estellina* (Banks). Inset: overall distribution.

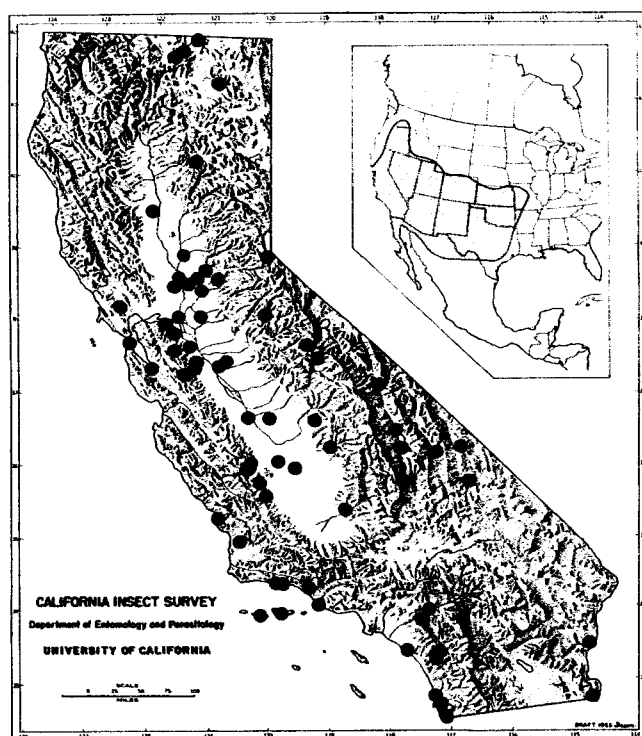
Anoplius estellina is related to *A. californiae* but is recognizable in the female by the shorter comb spines, the smaller size and the proportionately broader front. There is usually erect hair on the propodeum but it is short and sparse, not nearly as noticeable as on *californiae*. The males can be recognized by the subgenital plate which is much broadened toward the apex and the aedeagus which is produced into a pair of truncate lobes apically.

Biology. — Only one fragmentary observation has been made on the biology of *estellina*. Evans (1964) found females in the nesting area of a species of *Diadasia* in hard, stony soil at the Southwestern Research Station near Portal, Arizona. They were apparently using the *Diadasia* burrows as a start for their own nests. Prey transport was observed twice. In both cases, the spider was grasped by the base of one of the posterior legs and dragged, anterior end up, the wasp walking backward. The prey was placed on vegetation while the wasp presumably was constructing its burrow. The spiders were not recovered.

Anoplius (Pompilinus) clystera (Banks)
(Figs. 100, 118; map 41; graph 20)

Pompiloides clystera Banks, 1914:302. Holotype male, California: Stanford Univ. (MCZ).

Geographic range (map 41). — Southern Washington and northern Utah east to Missouri and south to the Mexican states of Baja California Sur and Chihuahua.

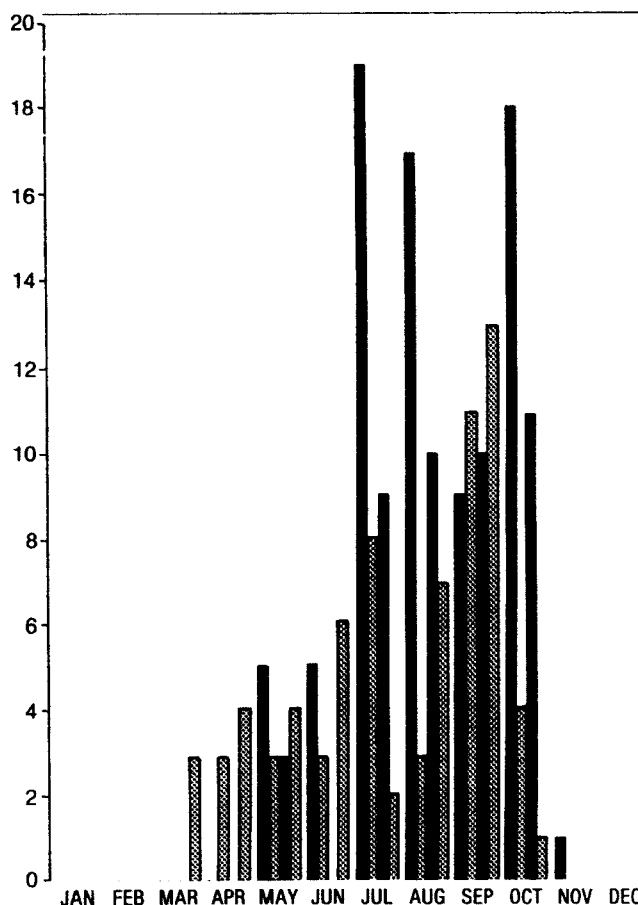


Map 41. California distribution of *Anoplus (Pompilinus) clystera* (Banks). Inset: overall distribution.

California distribution (map 41). — This species is widely distributed over the state in the Upper and Lower Sonoran zones and enters the Transition sparingly. It is abundant in the Central Valley and surrounding foothills but scarce in the true deserts and apparently absent from the north coast north of Sonoma County. It is one of the more abundantly collected elements of the pompiline fauna of Santa Cruz Island and we have seen material from Canada del Medio, Central Valley, Christi Beach, Coches Prietos, El Tigre (N slope), La Cascada, Portezuela, Prisoner's Harbor and South Ridge. It has been also taken on Santa Rosa Island: China Camp — Cluster Point area, Old Ranch Cyn., Southeast Anchorage, Torrey Pine area, Windmill Cyn., north fork.

Seasonal occurrence (graph 20). — Of the 122 females and 80 males we have studied from California, nearly all have been taken in the period April to October with early and late season records of March 7 at Banning, Riverside County and November 14 at Sloughhouse, Sacramento County.

The narrower front (MID averaging about 0.55 TFD) and more sharply angulate posterior margin of the pronotum will separate females of *clystera* from those of *insolens*. Males are characterized by the combination of narrowly raised median line of the subgenital plate (fig. 100), narrow aedeagus, subacute apex of the digitus and narrowly rounded apex of the gonostylus (fig. 118).



Graph 20. Seasonal occurrence of *Anoplus (Pompilinus) clystera* (Banks). Black columns represent females; gray columns are males.

Biology. — Both sexes are frequent flower visitors. Females have been taken on *Chrysothamnus viscidiflorus*, *Daucus carota*, *Eriogonum latifolium*, *Lepidospartum* sp., *Melilotus albus* and *Solidago* sp.; males on *Colubrina texensis*, *Eriodictyon californicum*, *Gossypium hirsutum* (probably at extra-floral nectaries), *Heliotropium*, and *Raphanus* sp.; both sexes at *Asclepias* sp., *Prosopis* sp. and *Wislizenia refracta*. Evans (1951:308) gives the following additional plant visitation records: *Bifora americana*, *Chaerophyllum Teinturieri*, *Cleome serrulata*, *Conium maculatum*, *Solanum* sp., *Tamarix* sp. and *Verbesina* sp.

No information has been published on the provisioning behavior.

Subgenus *Anoplius* Dufour

The small to medium-sized black wasps of this subgenus are primarily Holarctic in distribution with a few species entering the tropics. Two species, *nigerrimus* (Scopoli) and *tenuicornis* (Tournier), are circumpolar, occurring in both Europe and North America. The Nearctic fauna consists of 14 species, five of which also occur in Mexico and Central America. There are at least three Neotropical species which do not enter the United States. A total of seven species is recorded for California.

Females in this subgenus lack a tarsal comb and are thus distinguishable immediately from those of the other subgenera in the U.S. The males may be separated by the even slope of the propodeum and by the transverse median vein of the anterior wing meeting the median distad of the intersection of the basal vein or rarely interstitial with it. Males of four California species possess hair brushes on the venter of the metasoma and on that feature alone may be separated from California males of *Pompilinus*.

Biologically, species of this subgenus are somewhat diverse. Four of the United States species prey on semi-aquatic spiders and carry out

some of their hunting and prey transport activities over water. Other species seem to be restricted to woodland situations and still others to open areas such as meadows and fields. Nesting situations are somewhat varied. Most species nest in the ground, the females often digging their burrows from a crack or crevice in the soil while one species, *virginiensis* (Cresson), utilizes pre-existing holes in dead logs and branches (Evans and Yoshimoto, 1962). Prey selection in most species appears to be somewhat restricted, with Lycosidae the most commonly utilized prey family. *A. toluca* Cameron has been reported utilizing lycosids of several genera (Wasbauer and Powell, 1962), while *imbellis* Banks seems to be restricted mainly to the genus *Pardosa* (Wasbauer, 1957, 1983). On the other hand, *depressipes* Banks, a species of the eastern United States, utilizes only pisaurid spiders of the genus *Dolomedes* and is known to hunt and transport its prey on the surface film of the water and even to dive under the surface (Evans, 1949). The nests of the Nearctic species are usually short, simple burrows with a terminal cell. The egg of the wasp is placed vertically or obliquely on the side of the spider's abdomen, near its base.

KEY TO CALIFORNIA SPECIES OF
THE SUBGENUS *ANOPLIUS*

1. Females 2
Males 8
2. Tarsal claws bifid (fig. 87), inner claw much larger than outer claw *ithaca* (Banks)
Tarsal claws toothed, inner claw not larger than outer claw 3
3. Integument blue; length of third antennal segment usually greater than UID *fulgidus* (Cresson)
Integument black, often overlaid by bluish pubescence; length of third antennal segment less than UID 4
4. Posterior coxae with silvery pubescence dorsally; anterior basitarsus with spines of upper row less than half as long as width of tarsus at their base (fig. 97) 5
Posterior coxae without silvery pubescence dorsally; anterior basitarsus with spines of upper row stout, at least half as long as width of tarsus at their base (fig. 96) 6
5. Head and mesosoma not strongly hairy; middle and posterior coxae with little or no hair; anterior basitarsus with spines of upper row minute (fig. 97) *nigerrimus* (Scopoli)
Head and mesosoma and usually middle and posterior coxae strongly hairy; anterior basitarsus with spines of upper row somewhat longer but slender, setiform *tenuicornis* Tournier
6. Pubescence not conspicuously reflecting blue, at most obscurely violaceous; compound eyes not convergent dorsally, UID/LID 1.0-1.12; *imbellis* Banks
Pubescence conspicuously blue; compound eyes noticeably convergent dorsally, UID/LID 0.86-0.94 7
7. Front narrow, MID/TFD 0.52-0.56; pubescence less coarse and less intensely blue *dreisbachi* Evans
Front more broad, MID/TFD 0.56-0.62; pubescence coarse and more intensely blue *toluca* (Cameron)
8. Metasoma with some scattered, semi-erect hairs, never in long, dense brushes (fig. 90) 9
Metasoma with dense brushes of long erect hairs at least on S4 and S5 (figs. 89, 92) 11
9. Integument deep blue; SGP nearly flat. *fulgidus* (Cresson)
Integument black; SGP tectate 10
10. Stigma large, length at least 0.60 distance from its apex to apex of marginal cell; genitalia with digitus elbowed and gonostylus very short (fig. 123) *ithaca* (Banks)
Stigma small, length not over 0.40 distance from its apex to apex of marginal cell; genitalia with digitus gently curved; gonostylus nearly as long as digitus (fig. 124) .. *nigerrimus* (Scopoli)
11. Coxae with silvery pubescence; genitalia with digitus slender, gonostylus long, slender at apex, broad at base (fig. 127); SGP without long hairs or bristles at apex (fig. 106) *tenuicornis* Tournier
Coxae without silvery pubescence; genitalia with digitus much broader at apex, not greatly broadened at base (figs. 121, 128); SGP with long hairs or bristles at apex (figs. 107, 108) 12
12. Hair brush on S4 absent from a wide posterior area of the sternum, thus discontinuous in lateral view from that of S5 (fig. 92); genitalia with gonostylus as long or longer than digitus (fig. 128) *toluca* (Cameron)

- Hair brush on S4 absent from only a narrow posterior area of the sternum, appearing continuous, in lateral view, with that of S5 (fig. 89); genitalia with gonostylus shorter than digitus (fig. 121)..... 13
13. SGP fringed at apex with an even row of stout bristles

(fig. 103); pubescence at most obscurely violaceous

imbellis Banks

SGP not fringed at apex with an even row of bristles, somewhat bushy-haired (fig. 108); pubescence distinctly blue or green..... *dreisbachi* Evans

Anoplius (Anoplius) nigerrimus (Scopoli)
(Figs. 97, 104, 124; map 42)

Sphex nigerrima Scopoli, 1763:295. Type female, Carniola (northwestern Yugoslavia). Type lost. Neotype female, Peney, near Geneva, Switzerland (RNH).

Pompilus incisus Tischbein, 1850:8. Holotype male, Birkenfeld, Germany (ZMH).

Pompilus excerptus Tournier, 1889:159. Holotype female, Peney, near Geneva, Switzerland (MNH).

Pompilus nigerrimus var. *kohli* Verhoeff, 1892:71. Holotype male, no locality given (NR).

Anoplius wheeleri Banks, 1939:228. Holotype female, Connecticut: Colebrook (MCZ).

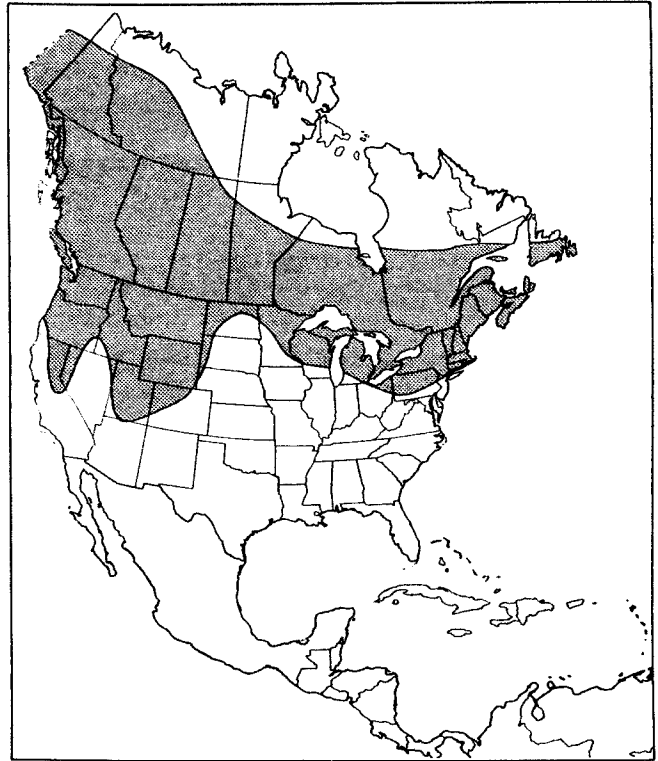
Anoplius banksi Dreisbach, 1950:579. Holotype female, Michigan: Midland County (MCZ).

Geographic range. — This is a Holarctic species occurring throughout most of Europe. In North America (map 42) it is an inhabitant of the Hudsonian and Canadian zones with a few records from the Transition. It extends across the continent from Yukon to Newfoundland and south to northern California, Utah, Colorado, Wisconsin, Michigan, Pennsylvania and Connecticut.

California distribution. — Plumas Co.: Buck's Lake, 1 ♂, VI-23-1949 (E.I. Schlinger, UCD); Quincy, 1 ♂, VI-5-1952 (E.I. Schlinger, UCD). Shasta Co.: Whitmore, 1 ♂, V-13-1949 (Chandler, CAS). Sierra Co.: Sierraville, 1 ♂, VII-9-1954 (R.M. Bohart, UCD). Tuolumne Co.: Strawberry, 1 ♂, VI-21-1951 (E.L. Silver, UCD); 1 ♀, VII-20-1960 (D.Q. Cavagnaro, UCD).

Seasonal occurrence. — We have examined one female and five males from California all collected in May, June and July. This meager information indicates a single spring or early summer generation.

This species together with the Californian *tenuicornis*, *ithaca* and *fulgidus* and the extralimital *depressipes*, *virginiensis* and *hispidulus* belong in the *nigerrimus* species group. The group is characterized by the very small spines of the upper row on the anterior basitarsus of the females (except *ithaca*), silvery pubescence dorsally on the posterior coxae, less strongly produced apical tarsal segment of the anterior leg of the males and absence of ventral hair brushes on the metasoma of the males (except *tenuicornis*). Features which will separate *nigerrimus* from the other members of this group are the black integumental color, the minute spines of the upper basitarsal row and strongly hairy head and mesosoma of the females, the small stigma, tectate subgenital plate (fig. 104), slender,



Map 42. Overall distribution of *Anoplius (Anoplius) nigerrimus* (Scopoli).

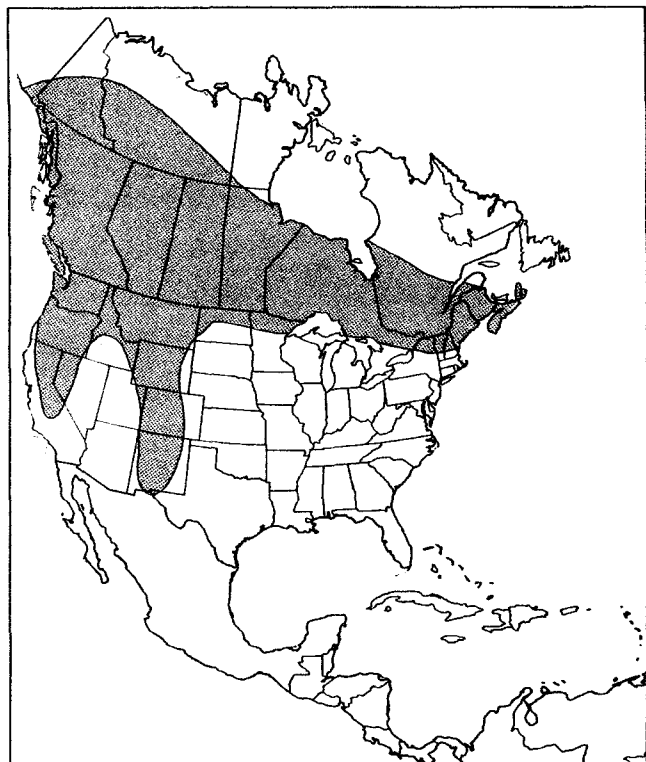
gently curved digitus and long stout gonostylus which is not broadened at the base.

Biology. — The provisioning behavior of *nigerrimus* has not been studied in the United States, but several European workers have published observations on it. These are summarized by Richards and Hamm (1939). Nests are usually constructed in various pre-existing cavities and niches including hollow twigs, bee burrows, snail shells, under stones and holes in stone walls. Under certain circumstances burrows and nest cells may be constructed in sand. The prey spiders most commonly taken are Lycosidae but there are records also of Gnaphosidae and Pisauridae.

Anoplius (Anoplius) tenuicornis (Tournier)
(Figs. 106, 127; map 43)

Pompilus tenuicornis Tournier, 1889:159. Holotype female, Alpes du Valais, Switzerland (MNH).

Pompilus piliventris Morawitz, 1889:122. Holotype male, Sun-Pan, Kansu, China (ZML).



Map 43. Overall distribution of *Anoplius (Anoplius) tenuicornis* (Tournier).

Anoplius basalis Dreisbach, 1950:578. Holotype male, Vermont: Rutland (MCZ).

Geographic range. — Holarctic. In North America (map 43) it is transcontinental in Canada and the northern United States at high elevations as far south as California and New Mexico. This is an uncommon species over its entire range in North America. Evans (1951) was able to locate only fifteen specimens during his revision of the North American species of *Anoplius*.

California distribution. — Fresno Co.: Lake Basin, 10,500', 1 ♀, VII-21-1910 (E.C. Van Dyke, CAS). Inyo Co.: Mono Pass, 12,000', 1 ♀, VIII-13-1957 (D.D. Linsdale, CIS). Tuolumne Co.: Leland Meadow, 1 ♀, VIII-5-1960 (Jessen, CIS).

Although the males possess hair brushes on the metasoma, a characteristic of the three following California species, other characters such as the weakly lobed apical segment of the anterior tarsus, extensive silvery pubescence and weakly spined anterior basitarsus of the female relate it to species of the *nigerrimus* group. The distinctive male genitalia and subgenital plate and the hairy head and mesosoma of the female will separate it from *nigerrimus*.

The biology of this species is unreported.

Anoplius (Anoplius) fulgidus (Cresson)
(Fig. 94; map 44)

Pompilus fulgidus Cresson, 1865:131. Holotype female, Cuba (ANSP).

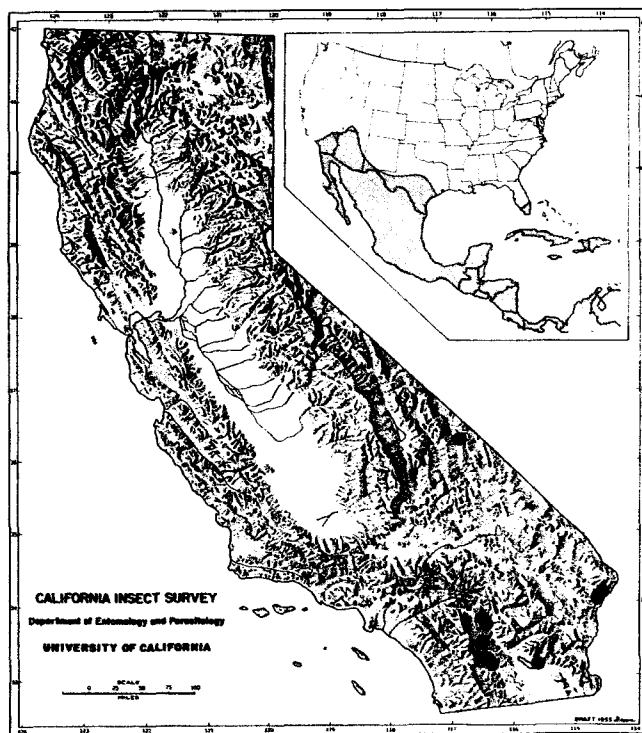
Pompilus aeneopurpureus Fox, 1891:339. Holotype female, Jamaica: Portland (ANSP).

Pompilus championi Cameron, 1893:196. Holotype female, Guatemala: Guatemala City (BMNH).

Pompilus mundulus Fox, 1897:243. Holotype female, Brazil: Chapada (CM).

Anoplius amarus Banks, 1947:416. Holotype female, Peru: Puerto Pichis (CU).

Geographic range (map 44). — A widespread tropical species extending from Argentina, Brazil and Peru northward through Central America and the Antilles to southern Florida, Texas, southern Utah and southern California.



Map 44. California distribution of *Anoplius (Anoplius) fulgidus* (Cresson). Inset: overall distribution.

California distribution (map 44). — Colorado and Mojave deserts. It is not commonly encountered in California. We have seen 25 females and 71 males. Only 20 of these are from California. Imperial Co.: Niland, 1 ♀, IX-11-1958 (E.I. Schlinger, UCD). Inyo Co.: Furnace Creek, Death Valley, 4 ♂♂, IV-1-1951 (P.D. Hurd, Jr., CIS, MCZ). Riverside Co.: Deep Cyn. Res. Sta., 1 ♀, X-11-1966 (Caton, UCR); Palm Springs, 1 ♀, IV-20-1940 (R.M. Bohart, CIS); 1 ♀, III-16-1955 (W.R. Richards, CNC); Thousand Palms, 1 ♀, III-20-1954 (LACM); 4 ♂♂, III-8 to IV-9-1955 (W.R. Richards, CNC). San Bernardino Co.: Bennett Wash, Parker Dam, 1 ♀, II-24-1951 (C.D. MacNeill, P.A. Adams, CDFA); 10 mi. NE Earp, 2 ♀♀, I-26-1957 (A.S. Menke, L. Stange, LACM). San Diego Co.: Borrego, 1 ♂, IV-27-1954 (P.D. Hurd, Jr., CIS); Warner's, 3 ♂♂, VIII-1-1921 (SDM).

Seasonal occurrence. — Records for this species are scattered throughout the year, indicating several overlapping generations.

Structurally, *Anoplius fulgidus* is quite close to other species in the *nigerrimus* group, but the distinctly blue integumental color will serve to separate both sexes from all other species in the subgenus *Anoplius*.

Biology. — Adults do not appear to be attracted to nectar sources for food and the only floral visitation record known for this species is a female taken at flowers of *Baccharis glutinosa* at Limpia Canyon, Jeff Davis Co., Texas (Evans, 1951).

Wasbauer (1955) found this species along a stream in Bexar Co., Texas in areas of heavy loam. Females hunted near the water's edge and were seen to alight on the surface film of the water. The one prey spider seen may have been used for adult feeding. It was a female of the lycosid *Pirata sedentarius* Montgomery. Another reported host, again a lycosid, is *Arctosa* sp. nr. *littoralis* (Hentz), immature female taken in Randall Co., Texas (Kurczewski and Kurczewski, 1968).

Anoplius (Anoplius) ithaca (Banks)
(Figs. 87, 123; map 45)

Psammochares ithaca Banks, 1911 (1912):224. Holotype female, New York: Ithaca (MCZ).

Anoplius selkirkensis Banks, 1919:234. Holotype female, Canada. British Columbia: Downie Creek, Selkirk Mountains (CU).

Geographic range (map 45). — Transcontinental in the Upper Sonoran and Transition zones from Yukon to Maine south to the Mexican states of Chihuahua and Nuevo Leon.



Map 45. California distribution of *Anoplius (Anoplius) ithaca* (Banks). Inset: overall distribution.

California distribution (map 45). — Northern California from Alameda County north to Humboldt and Siskiyou counties in valley, foothill and montane situations to 1,980 m. Within this area, it may be locally abundant but occurs sporadically due to narrow ecological restrictions (see under *Biology*).

Seasonal occurrence. — We have examined 58 females and 37 males from California. The period of adult activity in California is April to October with the majority of records in July and August, indicating two or more generations a year. Evans and Yoshimoto (1962) report at least two generations a year in the northeastern states and probably more farther south.

Related to *nigerrimus* and *fulgidus*, this species exhibits several unique traits which are probably related to the specific niche in which it occurs. The tarsal claws of the female are cleft, the claws of each pair of unequal size and curvature and in the anterior wing the stigma is enlarged. The males are similar to *nigerrimus* but the subgenital plate of *ithaca* is tectate and considerably larger. The stigma is enlarged, at least 0.6 as long as the distance from its apex to the apex of the marginal cell, and the genitalia are quite different. The digitus is distinctly elbowed and the gonostylus is quite short (cf. figs. 123, 124).

The larva has been described by Evans (1959).

Biology. — Although adults are rarely taken at flowers, one of us (MSW) has collected a male and a female from willow catkins at Limpia Canyon, Davis Mts., Texas.

Evans (1948b) provided an account of the biology of this species. Adults are rarely found far from water and are most frequently encountered along rocky shores of streams. Mating is brief and takes place in flight. Nests may be constructed before hunting (Evans, 1948b) or subsequently (Evans and Yoshimoto, 1962). Hunting is usually accomplished on, over and around rocks and prey is transported in rocky areas. Typically the small wolf spiders which serve as prey are grasped in the wasp's mandibles by the base of a posterior leg and dragged along, anterior end up, the wasp walking backwards. In constructing the nest, the female uses its mandibles to loosen pebbles and carry them away. The anterior legs are also used to dig out loose soil. The burrows are 4 to 15 cm in length, oblique and often started under a rock or sometimes from a depression. Paralysis of the spider is temporary. The egg is laid dorsolaterally near the base of the abdomen. Filling of the burrow is by scraping soil from the sides of the burrow and by carrying pebbles in with the mandibles. The end of the abdomen is used to tamp down the fill. Pebbles may be used to cover the filled burrow. Spiders reported as prey of *Anoplius ithaca* are all Lycosidae: *Pardosa groenlandica* Thorell, *P. lapidicina* Emerton, *P. lowriei* Kronestedt, *P. milvina* (Hentz), *P. steva* Lowrie and Gertsch,

Arctosa littoralis (Hentz) and *Lycosa* sp. (Evans and Yoshimoto, 1962; Kurczewski and Kurczewski, 1968, 1973; Ricards, 1969; Kurczewski, 1975; Wasbauer, 1983).

Anoplius (Anoplius) imbellis Banks
(Figs. 89, 96, 103, 121; map 46; graph 21)

Anoplius imbellis Banks, 1944:169. Holotype female, Oregon: Corvallis (MCZ).

Anoplius imbellis var. *major* Dreisbach, 1950:581. Holotype male, Virginia: Falls Church (MCZ).

Anoplius subimbellis Dreisbach, 1952a:155. Holotype male, Virginia: Falls Church (MCZ).

Geographic range (map 46). — Transcontinental in the Hudsonian to Lower Sonoran Zones and from Alaska south to Costa Rica. In the southern portion of its range, it occurs mainly at higher elevations. It is particularly abundant in the western United States.

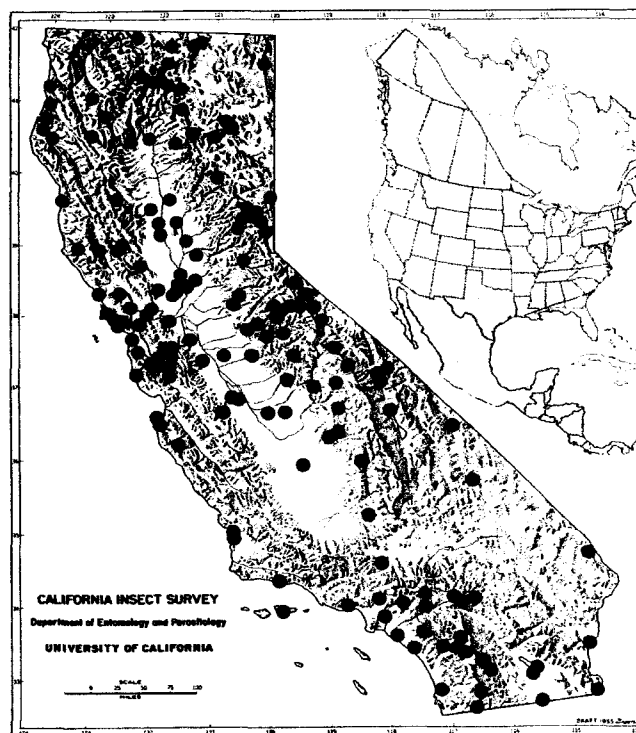
California distribution (map 46). — Widespread and abundant over most of the state from below sea level near the Salton Sea to 3,650 m near Mono Pass in Inyo County. It has been collected on Santa Cruz Island (2 ♂♂, VIII-12/17-1939, Martin and von Blocker, LACM; Canada Sauces Oeste, 1 ♂, VIII-14-1968, C. Remington, PM). Its presence in the Imperial Valley has probably been enhanced by man's modification of the environment as nearly all specimens we have seen from that region have been associated with irrigated crops (alfalfa and cotton).

Seasonal occurrence (graph 21). — This species has been taken from February to December and in significant numbers from April to October with peaks for males in July and females in August. These data indicate several generations a year in some areas. We have examined 448 females and 710 males, mostly from California.

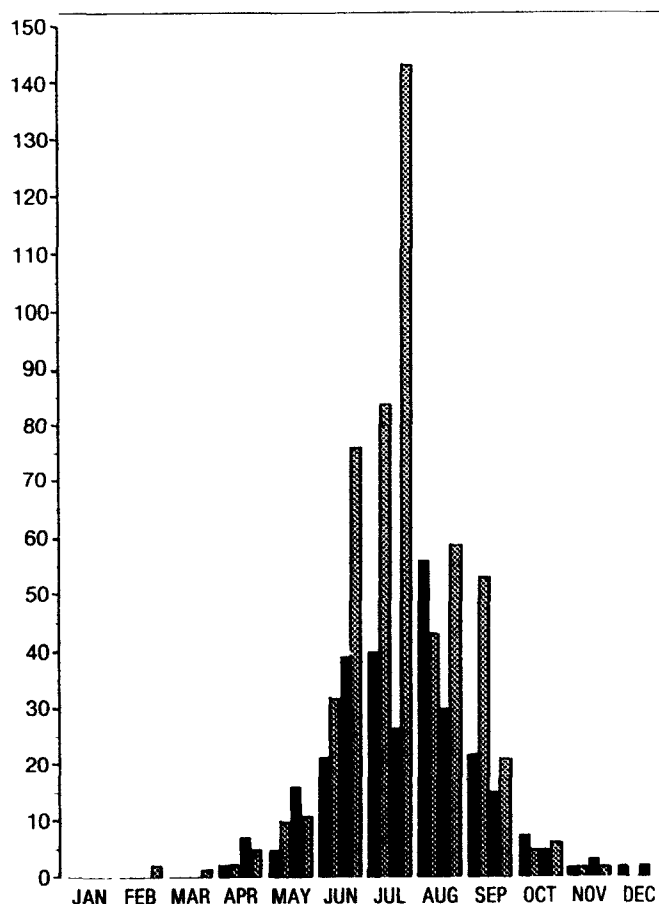
The *Anoplius illinoensis* group includes three California species, *imbellis*, *toluca* and *dreisbachi*. The group is characterized by the lack of silver pubescence on the coxae, and the anterior basitarsus of the female is strongly spined. In the male, the metasoma bears well developed ventral hair brushes, and the inner margin of the ultimate anterior tarsal segment is strongly produced.

Among these three species, only *imbellis* is entirely black, the pubescence not imparting blue or green tints. The frons of the female is broad and the eyes are not or only slightly convergent above. The male subgenital plate is fringed with evenly spaced short bristles; this feature (fig. 103) usually is visible without dissection. The genitalia have the gonostylus shorter than the digitus (fig. 121).

Biology. — Adults of the species are not often attracted to nectar sources, but females have been taken at flowers of *Melilotus* sp. and *Solidago* sp. and males at *Aster* sp., *Daucus carota*, *Eryngium articulatum*, *Gnaphalium chilense* and *Grindelia camporum*. Evans (1951) reported that both sexes occasionally visit honeydew.



Map 46. California distribution of *Anoplius (Anoplius) imbellis* Banks. Inset: overall distribution.



Graph 21. Seasonal occurrence of *Anoplius (Anoplius) imbellis* Banks. Black columns represent females; gray columns are males.

Wasbauer (1957) studied this species at two localities in California. He found that females hunt along the margin of still water in areas of heavy moist soil. Small lycosids are taken as prey. The wasps move on the surface of the water and sometimes attack their prey some distance away from land, towing the subdued spider over the surface film to shore for provisioning. Prey transport overland is carried out in the usual manner, the wasp grasping one of the posterior coxae of the spider in its mandibles and walking backwards dragging the spider along sideways. Hunting takes place before nest construction is initiated, and the paralyzed spider generally is deposited at least once either in the open or near twigs or tufts of grass while the wasp searches ahead for a suitable nesting site. The nests often are excavated in niches or crevices but may be started from the surface of the soil. They consist of a straight or curved tube 1 to 3.5 cm in length terminating at an enlarged cell 9 to 10 mm long. Paralysis of the spider is generally temporary. The egg is placed vertically on the side of the spider's abdomen near the base. After the cell is provisioned, the wasp fills the burrow by scraping in loose soil from around the entrance with its anterior legs. Larger particles are often carried in the mandibles. The tip of the metasoma is used to pack the soil.

In both Wasbauer's study areas, the wasp provisioned with a single species of prey, the wolf spider *Pardosa ramulosa* McCook. Elsewhere, the following additional prey, all Lycosidae, are now known: *Pardosa distincta* group, *Pardosa milvina* (Hentz), *Pardosa* sp., *Trochosa avara* Keyserling, *Schizocosa mccoeki* (Montgomery) and *Arctosa* sp. (Evans and Yoshimoto, 1962; Wasbauer and Powell, 1962; Kurczewski and Kurczewski, 1968; Wasbauer, 1983).

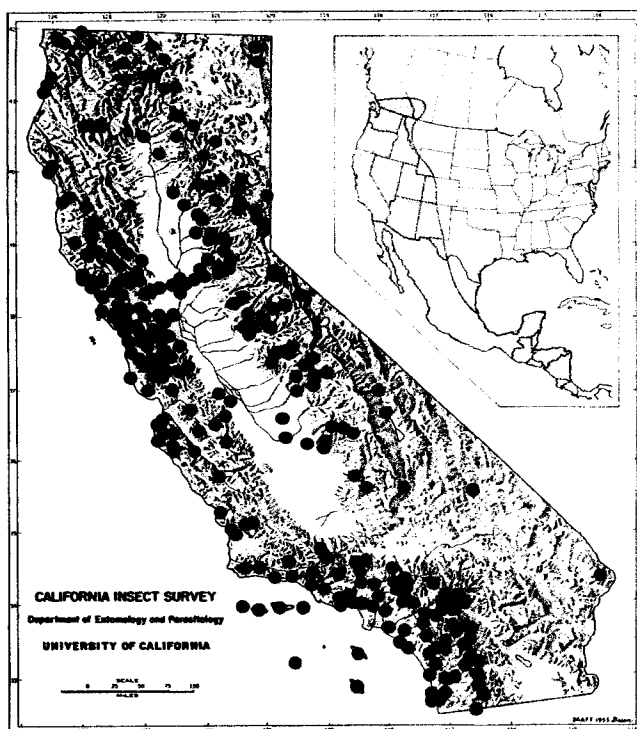
Anoplius (Anoplius) toluca (Cameron)
(Figs. 92, 107, 128; map 47; graph 22)

Pompilus toluca Cameron, 1893:195. Holotype female, Mexico, Guerrero: Xucumanatlan (BMNH).

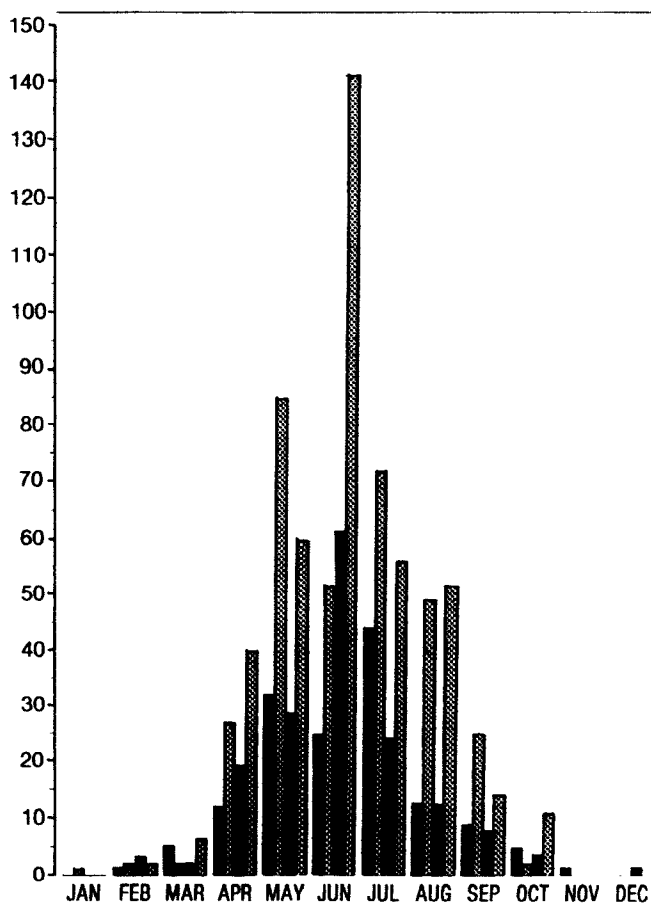
Anoplius tarsatus Banks, 1919:233. Holotype female, California: Mendocino Co., Sherwood (CU).

Geographic range (map 47). — Western North America from British Columbia and California east to Alberta and western Texas, south through western Mexico to Costa Rica. Introduced into and now common in the Hawaiian Islands.

California distribution (map 47). — Abundant in coastal foothill and lower mountain areas of the state from sea level to 2,750 m, this species is rarely encountered in the deserts and in the Central Valley is found only along watercourses. It has been taken on the following Channel Islands. San Clemente (¼ mi. N Boulder, China Pt., Eel Pt., Horse Cyn., Pyramid Cove, E face Mt. Thirst, West Cove, Wilson Cove, 7.5 mi. S Wilson Cove); San Miguel (Cuyler Harbor, W end dune fields, Willow Cr.); San Nicolas (Celery Cyn., N end dunes, Fennel Cyn., NAS HQ, Thousand Spr., Twin Rivers E. fork, Vizcaino Pt.); Santa Cruz



Map 47. California distribution of *Anoplius (Anoplius) toluca* (Cameron). Inset: overall distribution.



Graph 22. Seasonal occurrence of *Anoplius (Anoplius) toluca* (Cameron). Black columns represent females; gray columns are males.

(Campo Raton, Canada del Medio, Canada del Puerto, Canada Sauces Oeste, Central Vy., Christi Beach, Coches Prietos, Prisoner's Harbor); Santa Catalina (Avalon, Blackjack Mtn., Bull Rush Cyn., Camp Cactus, Cape Cyn., Cherry Vy., Middle Cyn.); Santa Rosa (Beechers Bay, Canada Lobos, China Camp, Southeast Anchorage, Water Cyn., Windmill Cyn.).

Seasonal occurrence (graph 22). — There are scattered records in every month, but this species appears most abundantly from April to September with a peak in June. Probably there are overlapping generations, with at least three broods in some areas.

Anoplius toluca and *A. dreisbachi* are distinct from all other California species in the subgenus *Anoplius* in possessing blue or green reflections of the body imparted by the appressed pubescence. Although the intensity of the color is generally greater in *toluca* than in *dreisbachi* this trait is subject to some variation and is valuable only to support differentiation of the two species based on other criteria. The most useful character for distinguishing the females is the width of the frons, compared with the width of the head. In *toluca* females the middle interocular distance is 0.56 to 0.62 the transfacial distance. In *dreisbachi*, it is 0.52 to 0.56. Since there is some overlap, not all females can be placed readily in one species or the other. This overlap is especially prevalent in populations from the Channel Islands, where females show the brighter refulgence characteristic of *toluca* but the ratio of MID to TFD varies greatly. We have seen no *dreisbachi* males from the Channel Islands, so are assigning all the females to *toluca*. The males are easily separated by the width of the hair brush on S4. In *toluca* there is a wide band without hairs at the posterior margin of the sternum. In *dreisbachi* this hairless band is very narrow. Thus when the venter is viewed from the side, the hair brushes on S4 and S5 appear strongly discontinuous in *toluca* and only slightly so or not at all in *dreisbachi*.

Biology. — Adult feeding is not commonly witnessed in this species, but females have been collected at flowers of *Baccharis pilularis*, *Brodiaea* sp., *Dyssodia coccinea*, *Eriogonum fasciculatum* and *Gutierrezia microcephala*. Males have been taken visiting flowers of *Ranunculus* sp., *Rubus vitifolius*, *Salix* sp., thistle, *Trifolium* sp. and *Vicia* sp. Both sexes have been collected from flower heads of *Foeniculum vulgare*.

Powell (1958) provided an account of the provisioning behavior of a female of *Anoplius toluca* at Pittsburg, Contra Costa County. The prey was *Alopecosa gertschi* Schenkel (Lycosidae). Although only a single prey spider was brought into a nest cell, further excavation was made by the wasp and upon tracing the burrow, Powell found that it was bifurcate. This may indicate that females of *toluca* sometimes construct multicellular nests, as do several other species in the subgenus

(Evans and Yoshimoto, 1962). Essig (1926) lists *Trochosa pratensis* (Emerton) as prey of this species (reported as *Psammochares luctuosus*) at Berkeley, California.

Anoplius (Anoplius) dreisbachi Evans
(Fig. 108; map 48; graph 23)

Anoplius (Anoplius) dreisbachi Evans, 1966:353. Holotype male, Washington: King Co., Bothell (MCZ).

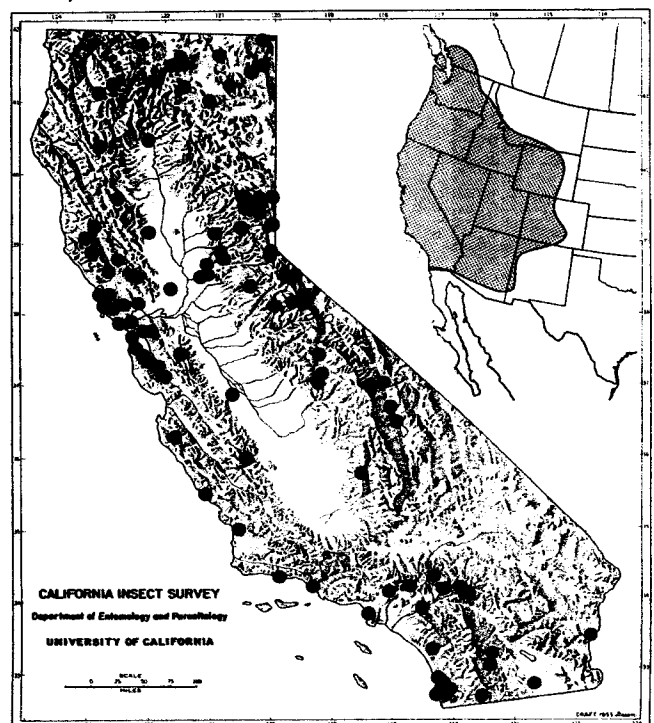
Geographic range (map 48). — Southern British Columbia to southern California, east to Colorado and Wyoming. The distribution of *Anoplius dreisbachi* is similar to that of its sister species *A. toluca* in the western U.S. The range of the latter extends through most of Central America, however, while *A. dreisbachi* has not been recorded from Mexico.

California distribution (map 48). — Great Basin Ranges, Siskiyou Mountains, Coast Ranges, Sierra Nevada and mountains of southern California at elevations to 2,620 m. There are a few records from the Central Valley and two from the Colorado Desert, but this species is an inhabitant primarily of the Upper Sonoran and Transition zones.

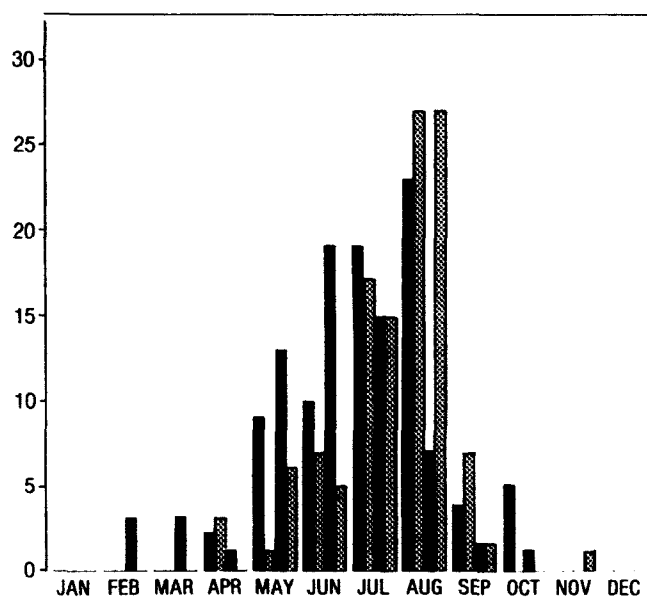
Seasonal occurrence (graph 23). — We have seen 181 females and 113 males from California. Females have been taken from February to October and males from April to November, both sexes most commonly in June, July and August. There appear to be at least two generations in many areas of the state.

The close relationship of this species with *Anoplius toluca*, also widely distributed in California, is discussed under the latter.

Biology. — The sole reference to the biology of this species is a prey record for a female of the wolf spider, *Alopecosa kochi* (Keyserling) (Wasbauer, 1983).



Map 48. California distribution of *Anoplius (Anoplius) dreisbachi* Evans. Inset: Overall distribution.



Graph 23. Seasonal occurrence of *Anoplius (Anoplius) dreisbachi* Evans. Black columns represent females; gray columns are males.

Genus *Pompilus* Fabricius

Comparable to *Anoplius* in size and diversity, *Pompilus* is worldwide in distribution. It is well represented in the New World with seven subgenera and nearly 30 species in North and Central America. The genotype *Pompilus cinereus* (Fabricius) is a widespread species which

represents a subgeneric segregate found only in the Old World.

Recent European workers (Priesner, 1966; Wolf, 1967; Wahis, 1970; and Day, 1981) have restricted the concept of *Pompilus* to include only *P. cinereus* (Fabricius) and a few closely related species. They have elevated *Arachnospila* Kincaid to generic rank and enlarged its scope to include several subgenera, among which are the Holarctic *Ammosphex* and *Anoplochaes*. On the basis of the morphological criteria employed, we are not certain that this action is justified and are thus retaining the arrangement of Evans (1951a).

Four of the subgenera occurring in the New World seem to be limited to the western Nearctic Region with intrusions into the Neotropical and may have evolved in adaptation to arid environments. The rich California fauna contains six of the seven subgenera and 18 species.

The genus is quite similar to *Anoplius* in many structural features but may be distinguished in the female by the lack of stout, inflexible spines on the apical metasomal tergum (slender, flexible setae may be present) and in the male by the toothed tarsal claws.

Species of *Pompilus* are in general rather unspecialized hunters of spiders, although the majority of records are of Lycosidae. Little is known of the biology of the North American species. The available information is summarized under the subgeneric and specific headings.

KEY TO CALIFORNIA SUBGENERA OF *POMPILUS*

1. Females 2
Males 7
2. Tarsi with ventral surface of ultimate segment bare or with apical half bare, only 1 to 3 spines near base (figs. 136, 137); pronotum with posterior margin arcuate or broadly angulate 3
Tarsi with ventral surface of ultimate segment more or less completely spined as on preceding segments (figs. 134, 135); pronotum with posterior margin rather sharply angulate 5
3. Anterior basitarsus at most 5 times as long as wide, with two comb spines; apex of metasoma without long setae *Perissopompilus* Evans
Anterior basitarsus at least 6 times as long as wide, with 3 comb spines; apex of metasoma with a few long setae 4
4. Tarsi with ventral surface of ultimate segment bare; (fig. 137); propodeum and mesopleura bare or with dark hairs *Hesperopompilus* Evans
Tarsi with ventral surface of ultimate segment bearing 1 to 3 spines near base; propodeum and mesopleura with white hairs *Xerochaes* Evans
5. Labrum extending well below apical margin of clypeus; tarsal comb absent *Anoplochaes* Banks
Labrum scarcely visible, only apical margin extending below apex of clypeus; tarsal comb present 6
6. Anterior wing with MC short, at least 1.3 times its length from apex of wing; SM2 and SM3 narrowed anteriorly (fig. 133) *Ammosphex* Wilcke
Anterior wing with MC long, about its own length from apex of wing; SM2 and SM3 wide anteriorly (fig. 132) .. *Arachnospila* Kincaid
7. Anterior tarsus with ultimate segment slender, symmetrical, not or only obscurely produced on inner margin (fig. 139) 8
Anterior tarsus with ultimate segment stout, asymmetrical, distinctly produced on inner margin (figs. 138, 140) .. 10
8. Clypeus with apical margin rounded; SGP with basal appendages (figs. 146, 148) *Hesperopompilus* Evans
Clypeus with apical margin truncate; SGP without basal appendages (fig. 153) 9
9. Postnotum dorsally much shorter than metanotum; mesopleura and propodeum with long whitish hairs *Xerochaes* Evans
Postnotum dorsally about as long as metanotum; mesopleura without long, whitish hairs, propodeum with suberect silvery setulae *Perissopompilus* Evans
10. Anterior tarsus with ultimate segment strongly produced, widest at the middle (fig. 140); aedeagus with margins toothed (figs. 161, 162) *Ammosphex* Wilcke

California distribution. — We have seen only 18 females and 10 males from California. Imperial Co.: Chocolate Mts., Ogilby Rd., 3 mi. S jct. Hwy. 78, 3 ♂♂, X-16/22-1977 (M.S. Wasbauer, MSW). Los Angeles Co.: Camp Baldy, 1 ♀, VII-11-1950 (CIS); Glendale, 1 ♂, V-3-1945 (E.I. Schlinger, UCD). San Diego Co.: 12 mi. N Escondido, 1 ♀, III-29-1966 (M.S. Wasbauer, MSW); Pala, 2 ♀♀, VIII-27-1960, McPhail trap in sycamore (C.D. Johnson, CDFA, MSW); San Diego and vicinity, 13 ♀♀, 6 ♂♂, various dates, July to October (H.A. Hill, CU, MCZ, SDM); 9 mi. S Warner Springs, 1 ♀, VIII-8-1956, *Eriogonum fasciculatum* (R.M. Bohart, UCD).

Recognition characters for this species are, in the females, the all-black body, broad front (MID/TFD 0.58-0.61), anterior wing with the marginal cell removed from the wing tip by at most 1.5 times its own length, narrow transverse postnotum, strong pulvillar comb (fig. 139) and propodeum with erect hair. The males are recognized by having three submarginal cells, the metasoma not marked with red, lack of a pale stripe on the posterior margin of the pronotum, short antennae (segment 3 at most 1.5 as long as wide) and genitalia with the aedeagus parallel-sided and with the gonostylus longer than the digitus (fig. 166).

Pompilus (Hesperopompilus) hilli Evans
(Figs. 146, 165)

Pompilus (Hesperopompilus) hilli Evans, 1957:183. Holotype male, California: Pomona Mountains (MCZ).

Geographic range. — Southern California.

California distribution. — Inyo Co.: Surprise Canyon, Panamint Mountains, 1 ♀, on *Eriogonum inflatum*, IV-24-1957 (P.D. Hurd, Jr., CIS). Los Angeles Co.: Pomona Mountains, 1 ♂, Sept. [H.C. Fall, MCZ (holotype)]. Riverside Co.: Desert Res. Center, 3.5 mi S Palm Desert, 1 ♀, Malaise Trap, VII-19/21-1969 (UCR).

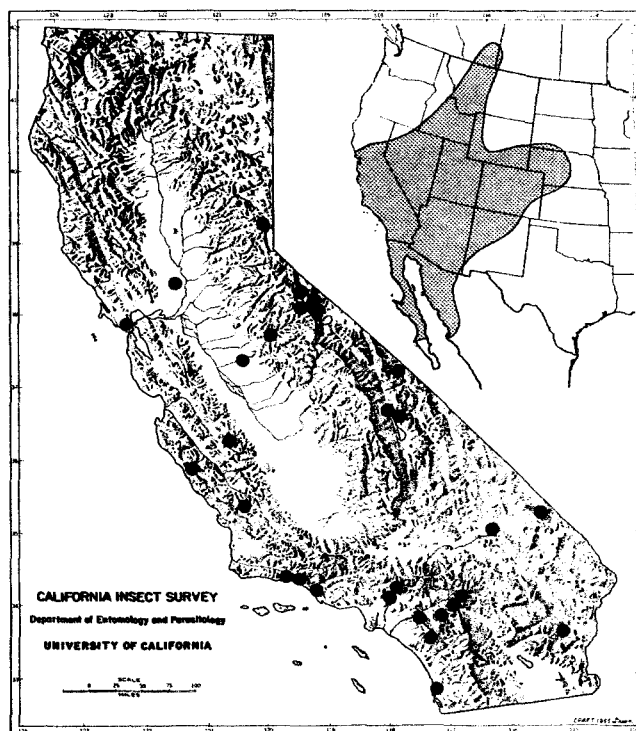
The specimen from Riverside County is the only one we have seen in addition to those recorded by Evans (1966).

This obviously uncommon species can be recognized in the female by the all black body, broad front (MID/TFD about 0.58), marginal cell of anterior wing removed from wing tip by at most 1.5 times its own length, and narrow, transverse postnotum. In these characters, it is similar to *jacintoensis*, but it differs in the weak pulvillar comb, the propodeum with the declivity not as pronounced and without erect hair. The males are similar to those of *orophilus* in having the metasoma entirely black, three submarginal cells in the anterior wing, a pale stripe on the posterior margin of the pronotum and the third antennal segment about two or more times as long as wide. From *orophilus* it differs in the broad, apically tapering subgenital plate (cf. figs. 146, 151) and the ocelli about equidistant from each other and from the eyes.

Pompilus (Hesperopompilus) orophilus Evans
(Figs. 137, 151, 171; map 49)

Pompilus orophilus Evans, 1947:14. Holotype female, New Mexico: Raton (MCZ).

Geographic range (map 49). — Western North America from California east to central Nebraska and from southern Alberta south to the Mexican states of Baja California and western Sonora.



Map 49. California distribution of *Pompilus (Hesperopompilus) orophilus* Evans. Inset: overall distribution.

California distribution (map 49). — Although an uncommonly encountered species, *Pompilus orophilus* has been found in a wide diversity of habitats from the Colorado and Mojave deserts to over 2,130 m in the Sierra Nevada. It is absent from the northernmost portion of the state. California records are as follows. Inyo Co.: Antelope Spr., 1 ♂, VI-22-1960 (H.K. Court, UCD); Deep Springs, 1 ♂, Malaise Trap, V-25-1974 (M. Wasbauer, MSW); Deep Springs Valley, 2 ♀♀, 2 ♂♂, pit trap in dunes, II-21 to IX-28-1978 (D. Giuliani, MSW, CDFA); 5 mi. S Deep Springs College, 1 ♂, VII-11-1967 (S. and S. Frommer, UCR); 5 mi. N.W. Independence, 1 ♀, Malaise Trap, VIII-28/29-1979 (M. Wasbauer, P. Adams, MSW); 5.2 mi. E. Independence, 1 ♂, VIII-31-1969 (UCR). Los Angeles Co.: Crystal Lake, 1 ♀, VI-29 (CIS); Monrovia, 1 ♀, VIII-15 (MCZ). Marin Co.: 1 mi. N. Alpine Lake, 1 ♀, IX-1961 (E.P. Catts, CIS); Mill Valley, 24 ♂♂, Flight Trap, VII-3 to X-8-1965 (P.H. Arnaud, CAS). Merced Co.: Delhi, 1 ♀, V-27-1961 (Weedin, CDFA). Mono Co.: 11 mi. N. Bridgeport, 1 ♂, VII-7-1961 (R.M. Bohart, UCD); Leavitt Meadow, 1 ♂, Flight Trap, VIII-14-1963 (H.B. Leech, CAS); Mill Cr. Cyn., 7 mi. S. Jct. Hwy. 395, 1 ♂, Malaise Trap, VIII-25/26-1979 (M. Wasbauer, P. Adams, CDFA). Monterey Co.: Cone Mt., 3,000', 1 ♀, 1 ♂, VIII-10-1962 (E.I. Schlinger, UCR). Riverside Co.: Desert Center, 1 ♀, *Asclepias erosa*, VI-2-1976 (L.G. Bezark, SJS); Elsinore, 1 ♀, VIII-24-1962 (H.E. Evans, MCZ); Riverside, 1 ♂, V-11-1969 (J.C. Hall, UCR); San Timoteo Cyn., 15 ♂♂, Malaise Trap, 1 ♂ at honeydew from galls *Disholcaspis eldoradensis* on *Quercus lobata*, IX-14-1972 (M. Wasbauer, A.R. Hardy, MSW, CDFA). San Bernardino Co.: 12 mi. S. Ivanpah, 1 ♂, V-1-1956 (P.D. Hurd, Jr., CIS); Thurman Flats Picnic Area, 1 ♀, X-22-1965 (P.H. Arnaud, CAS); Wildwood Cyn., 3 mi. E. Yucaipa, 1 ♂, VI-15-1976 (T. Griswold, TG); Zzyzx Spr., 9 mi. S. Baker, 1 ♀, IV-20-1977 (J.A. Powell, CIS). San Diego Co.: La Jolla, 1 ♀, 1 ♂, Malaise Trap, VI-18/19-1979 (K. Corwin, P. Adams, CDFA). San Luis Obispo Co.: Creston, 1 ♂, VII-31-1977 (Guenther, UCD). Santa Barbara Co.: Carpinteria, 1 ♂, McPhail Trap, IX-19-1963 (B. Osuna, CDFA); Santa

Barbara, 1 ♀, McPhail Trap, VIII-15-1964 (B. Osuna, MSW). Tuolumne Co.: Oakland Camp, 1 ♀, X-2-1954 (C.D. MacNeill, MSW). Ventura Co.: Ventura, 1 ♂, McPhail Trap, VIII-17-1961 (B. Osuna, CDFA).

Seasonal occurrence. — Of the 12 females and 57 males we have examined, there are a few records from April, May, June and October, but the majority have been July, August and September, indicating a single late summer generation in most areas.

In the female of *orophilus*, which is all black, the frons is narrow ($MID/TFD = 0.50-0.54$); the marginal cell of the anterior wing is short, about half as long as the distance from its tip to the tip of the wing; the postnotum is well developed and is nearly as long as the metanotum. In the male, the ocelli are much nearer the eyes than each other; the posterior margin of the pronotum has a yellow stripe and the subgenital plate is very slender (fig. 151).

Biology. — Adults are known to feed on various substances. Females have been taken on flowers of *Asclepias erosa*, and although males have not been collected at flowers, they visit sugary materials, having been taken visiting honeydew exuding from the galls of *Disholcaspis eldoradensis* on *Quercus lobata* and captured in McPhail Traps. These traps were used for fruit fly detection and were baited with a mixture of brown sugar, torula yeast and water.

Pompilus (Hesperopompilus) rufopictus Evans
(Fig. 156; map 50)

Pompilus (Hesperopompilus) rufopictus Evans, 1948:144. Holotype female, California: Riverside County. Dos Palmas CAS).

Pompilus (Hesperopompilus) boharti Evans, 1951a:216. Holotype male, California: San Diego County. Borrego (CAS).

Geographic range (map 50). — This species has a rather narrow range in southern California, southern Arizona and Baja California. Although there are no records, it undoubtedly also occurs in northern Sonora.

California distribution (map 50). — Fresno Co.: Kerman, 7 mi. W., 1 ♀, antifreeze pit trap, VIII-17 to XII-21-1979 (A.J. Gilbert, CDFA). Imperial Co.: Chocolate Mts., Ogilby Rd., 3 mi. S. Jct. Hwy. 78, 1 ♀, 1 ♂, Malaise Trap, X-16/22-1977 (M.S. Wasbauer, MSW); Fish Cr. Mts., 1 ♂, IV-20-1955 (W.R. Richards, CNC). Inyo Co.: 8 mi. S.E. Panamint Spr., 1 ♂, V-15-1969 (P.A. Opler, P. Rude, CIS). Riverside Co.: Deep Canyon, 1 ♀, 2 ♂♂, IX-24- to X-15-1963 (M.E. Irwin, UCR); Desert Res. Center, 3.5 mi. S. Palm Desert, 2 ♀♀, 9 ♂♂, Malaise Trap, V-VIII-1969 (Frommer, Worley, UCR); 1 ♂, IX-5/9-1969 (Frommer, Turner, UCR); 1 ♂, V-15/23-1970 (S. Frommer, UCR). San Bernardino Co.: Colton Hills, 3300', S 15, TION, R15E, 1 ♂, *Eriogonum fasciculatum polifolium*, VI-8-1980 (T. Griswold, TG); Kelso, 6 mi. N.E., 1 ♀, 1 ♂, *Asclepias erosa*, VI-16-1980 (T. Griswold, TG). San Diego Co.: Borrego Valley, Palm Cyn., 1 ♀, IV-19-1957 (E.I. Schlinger, UCD). Stanislaus Co.: Del Puerto



Map 50. California distribution of *Pompilus (Hesperopompilus) rufopictus* Evans. Inset: overall distribution.

Cyn., 1 ♂, IX-24-1978 (P.H. Arnaud, CAS); 1 ♂, VIII-6-1979 (L. French, UCD).

Pompilus rufopictus is one of two California species in the subgenus *Hesperopompilus* with bicolored females in which the head and mesosoma are black and the metasoma red. From the other red and black species, *serrano* Evans, females of *rufopictus* are distinguished by having three submarginal cells in the anterior wing and lacking white markings on the collar and posterior margin of the pronotum. Males of *rufopictus* are entirely black, have three submarginal cells in the anterior wing, lack a pale stripe on the posterior margin of the pronotum, have brown and silver rather than blue pubescence and lack erect hair on the propodeum.

There are flower visitation records for males at *Eriogonum fasciculatum polifolium* and *Chilopsis* sp. Both sexes have been collected on *Asclepias erosa*.

Pompilus (Hesperopompilus) serrano Evans
(Fig. 176)

Pompilus (Hesperopompilus) serrano Evans, 1966:369. Holotype female, Mexico: Baja California, Km. 220 S. Tijuana (CAS).

Geographic range. — Southern California and northern Baja California.

California distribution. — Imperial Co.: Chocolate Mts., Ogilby Rd., 3 mi. S. Jct. Hwy. 78, 1 ♂, Malaise Trap, X-16/22-1977

(M. Wasbauer, MSW). Inyo Co.: Surprise Cyn., 1 ♀, V-5-1961 (P.M. Marsh, UCD). Riverside Co.: 8 mi. N. jct. Deep Cr. and Horsethief Cr., 1 ♀, VI-29 to VII-6-1973 (Tabel, UCR); Riverside, 1 ♂, V-21-1969 (J.C. Hall, UCR); San Timoteo Cyn., 1 ♂, Malaise Trap, IX-14-1972 (M.S. Wasbauer, A.R. Hardy, MSW); 1 ♂, Malaise Trap, IX-9-1974 (M.S. Wasbauer, R. McMaster, CDFA). San Bernardino Co.: Helendale, 1 ♂ (allotype), V-27-1955 (W.R.M. Mason, CNC). Stanislaus Co.: Del Puerto Cyn., 1 ♂, IX-24-1978 (P.H. Arnaud, CAS).

This small, seldom-collected species is unique

among *Hesperopompilus* in that the body is bicolored in both sexes (the male with the second metasomal segment and adjoining portions of the first and third, orange) and there are two submarginal cells instead of the usual three. The pronotum of the female, as well as that of the male has white integumental markings on the posterior margin.

Subgenus *Perissopompilus* Evans

The two known species of *Perissopompilus* are western in distribution and seem to be restricted to arid or semi-arid situations. The subgenus has been recorded from central Mexico to Baja California, California, Nevada, Utah and Texas. Both species are known from the more xeric areas of California.

The species are quite distinctive with short antennae in both sexes and the body patterned with striking silvery pubescence in one or both sexes. The females have the head very broad with large compound eyes, and the frons is convex with a median linear impression running from the

anterior ocellus to the level of the antennal sockets. The anterior basitarsus is short with two well developed comb spines, and the ultimate segment is either without spines ventrally or with two or three small spines toward the base. In the males, the apical margin of the clypeus is truncate, the sixth sternum has a pair of longitudinal carinae, the subgenital plate lacks basal appendages, and the basal hooklets of the genitalia are double.

Nothing is known about the biology of either species.

KEY TO KNOWN SPECIES OF THE SUBGENUS *PERISSOPOMPILUS*

Anterior wing with 3 SM cells; female: mesopleuron without silvery pubescence; anterior wing entirely infusate; male: pubescence of metasomal terga in large part dark with contrasting silvery apical bands; SGP with strong basal expansions (fig. 153); genitalia as in fig. 174. *phoenix* Evans

Anterior wing with 2 SM cells; female: mesopleuron with extensive silvery pubescence; anterior wing hyaline with the apex infusate beyond SM2; male: pubescence of metasomal terga entirely silvery; SGP not strongly expanded basally (fig. 155); genitalia as in fig. 173. *perfasciatus* Evans

Pompilus (Perissopompilus) phoenix Evans (Figs. 136, 153, 174; map 51)

Pompilus (Ammosphex) phoenix Evans, 1948a:123. Holotype female, Arizona: Phoenix (CAS).

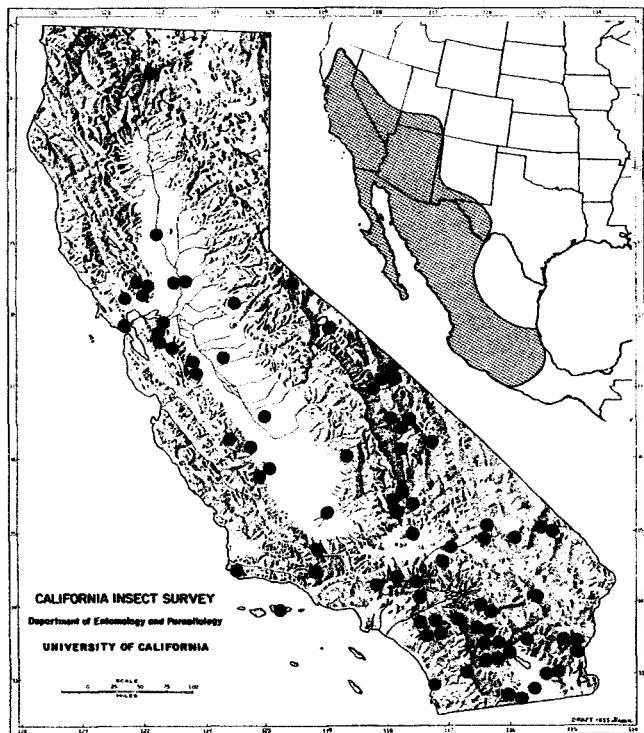
Geographic range (map 51). — California east to western Texas and south to the Mexican states of Puebla and Guerrero.

California distribution (map 51). — Widely distributed in the southern portion of the state in arid or semi-arid situations in the deserts, the southern California mountains, Great Basin, Central Valley and inner Coast Ranges. It is generally found at low elevations, but we have taken it near Monitor Pass, Alpine County at an elevation of 2,499 m. We have seen specimens from only three coastal localities, but there is a record for Santa Cruz Island (Canada del Medio, 1 ♀, IX-22-1968, R.O. Schuster, UCD).

Seasonal occurrence. — There are multiple capture records without strong peaks for March through November, although the number of males is significantly lower in July. This indicates at least two overlapping generations. Males may have a considerably shorter life span than females.

This is a velvety black species with three submarginal cells, the females with entirely dark anterior wings and the silvery pubescence normally limited to the lower face and outer eye orbits. The males are more extensively silver pubescent with coarse silver bands across the apical portion of the otherwise dark metasomal terga. The anterior wings of the male are hyaline with the apices dark.

Biology. — Females of *Pompilus phoenix* have been taken at flowers of *Euphorbia polycarpa*, *Eysenhardtia polystachya* and *Pectis papposa*. Males have been taken visiting honeydew of unspecified origin on *Chrysothamnus* sp. and honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata*. Both sexes have been collected from flowers of *Asclepias* sp.



Map 51. California distribution of *Pompilus (Perissopompilus) phoenix* Evans. Inset: overall distribution.

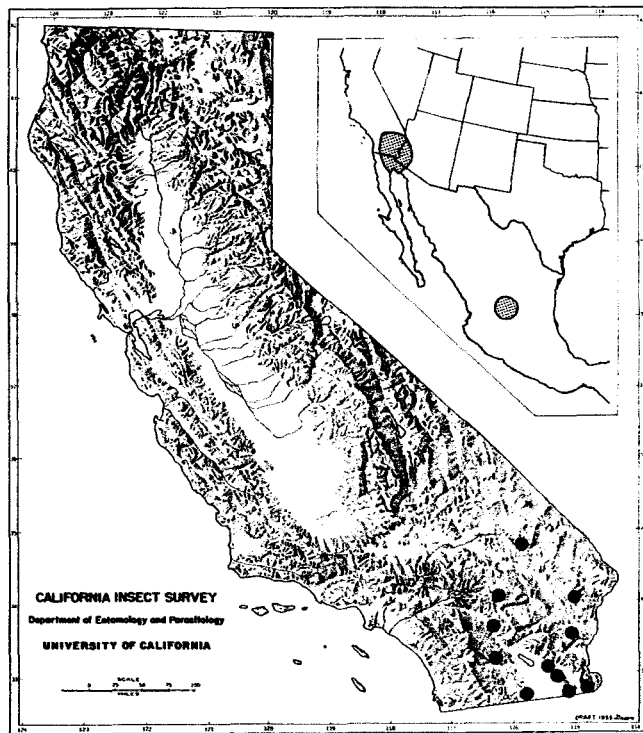
Prey has been recorded once for this species in March near Desert Center, Riverside County, California. The wasp was proceeding backward, dragging an immature *Filistata* sp. (Filistatidae) across sparsely vegetated soil (Evans, 1966a).

Pompilus (Perissopompilus) perfasciatus Evans
(Figs. 155, 173; map 52)

Pompilus (Perissopompilus) perfasciatus Evans, 1951a:225.
Holotype female, California: Riverside County, Whitewater (CAS).

Geographic range (map 52). — Most of the records of this species are clustered in the Colorado Desert of California and Arizona. The specimens we have seen from Baja California (66 mi. N. San Felipe, 1 ♀, IV-10-1968, M.E. Irwin, UCR) and Sonora (El Golfo, 1 ♀, Fluor. blacklight, IV-10-1973, M.S. Wasbauer, MSW) were collected in fairly close proximity at the north end of the Gulf of California. There is one isolated record from Zacatecas, Mexico.

California distribution (map 52). — Imperial Co.: Glamis, 1 ♀, on dunes, XI-23-1967 (M.S. Wasbauer, CDFA); 1 ♀, IV-8-1964 (F.D. Parker, UCD); 1 mi. W. Glamis, 1 ♀, Sand dune assoc., IV-19-1964 (E.I. Schlinger, UCR); 3.5 mi. N.W. Glamis, 3 ♀♀, IV-13-1968 (Tejada, UCR); 17 mi. N.W. Glamis, 1 ♀, III-31-1978 (J.A. Powell, CIS); 3 mi. W. Gordon's Well, 3 ♀♀, IV-16-1975 (E. Fisher, MSW); Pinto Wash, 1 ♀, IV-28-1958 (F.X. Williams, CAS); 2 mi. W. Winterhaven, 1 ♀, IV-14-1968 (E. Fisher, LACM). Riverside Co.: 15 mi. W. Blythe, 1 ♂, *Asclepias*, V-22-1964 (A.E. Michelbacher, CIS); 18 mi. W. Blythe, 2 ♀♀, 2 ♂♂, III-22-1967 (Kovacic, Schuster, UCD); 2 ♀♀, IV-2-1963 (R.M. Bohart, M.E. Irwin, UCD); Hopkins Well, 6 ♀♀, *Baileya*,



Map 52. California distribution of *Pompilus (Perissopompilus) perfasciatus* Evans. Inset: overall distribution.

IV-29-1952 (J.G. Rozen, CIS, MCZ); Thousand Palms, 1 ♂, IV-9-1964 (F.D. Parker, UCD); 1 ♂, IV-11-1970 (R.M. Bohart, UCD); Whitewater, 1 ♀ (holotype), VII-9-1950 (J.W. MacSwain, CAS). San Bernardino Co.: Kelso Dunes, 2180', S7, TION, R13E, VI-16-1980 (T. Griswold, TG); 2 mi. W. Rice, 1 ♀, X-12-1963 (R.R. Snelling, MSW); Twentynine Palms, 3 ♀♀, III-25-1968 (D.S. Horning, UCD); 2 mi. N. Twentynine Palms, 3 ♀♀, X-28-1970 (E. Fisher, LACM). San Diego Co.: Borrego, 1 ♀, 2 ♂♂, IV-29-1955 (F.X. Williams, CAS); Borrego Vy., 1 ♀, 3 ♂♂, IV-18-1957 (R.M. Bohart, H. Court, UCD, MCZ); 1 ♀, III-24-1967 (D.S. Horning, UCD).

Seasonal occurrence. — We have seen 58 females and 9 males of this uncommon species. Most specimens of both sexes have been taken in March and April with one record for each in May. A few females have been collected in October, November and December, but neither sex has been taken from June through September. It is possible that adults of this species, adapted to harsh desert conditions, estivate during the summer months.

Both sexes of this distinctive little species are extensively clothed with silvery pubescence. The anterior wings of the female, as well as the male are milky to hyaline with strongly contrasting dark tips and there are only two submarginal cells.

Pompilus perfasciatus is an inhabitant of open, sandy areas and is frequently found on dunes. The records we have indicate that both sexes occasionally visit flowers. Females have been collected on *Baileya* sp. and *Oenothera clavaeformis* var. *Peirsoni*. Males are recorded as visiting flowers of *Asclepias* sp.

Subgenus *Xerochares* Evans

Evans (1951a) proposed this subgenus to accommodate a single species, *expulsus* Schulz, which exhibits a number of traits found in the Old World subgenus *Pompilus* but also a number which are unique: the apical segment of the anterior tarsus in the female has one to three ventral spines near the base, the apical portion of the segment bare. Both anterior tarsal claws of the male are cleft. The subgenital plate does not have

basal appendages. The basal hooklets of the genitalia are single and well developed.

The distribution of *Xerochares* is New World, from the arid portions of the western U.S. south to Nicaragua (Evans, 1968). Its occurrence in Colombia has been reported recently by Day (1981).

The biology of the one species in this subgenus is unknown.

Pompilus (Xerochares) expulsus Schulz
(Map 53)

Pompilus connexus Fox, 1893a:23. Holotype female, Mexico.

Baja California: San Jose del Cabo (CAS). Preoccupied by *connexus* Cresson, 1869.

Pompilus expulsus Schulz, 1906:170. New name for *Pompilus connexus* Fox, 1893.

Psammochaeres arizonica Banks, 1910:115. Type female, Arizona: Parmerlee (MCZ).

Pompilus rubriventris Bradley, 1944a:9. New name for *Pompilus connexus* Fox, 1893.

Geographic range (map 53). — Extreme southeastern California, southern Arizona and southern New Mexico south into Mexico, Guatemala, El Salvador and Nicaragua.

California distribution. — Imperial Co.: Chocolate Mts., Ogilby Rd., 3 mi. S. jct. Hwy. 78, 2 ♂♂, Malaise Trap, III-20/22-1978 (M.S. Wasbauer, J.E. Slansky, P. Adams, MSW); 2 mi. W. Glamis, 1 ♂, XI-21-1967 (M.S. Wasbauer, CDFA).

This large, bicolored species is quite distinct from all other California Pompilidae. It is superficially similar to *Anoplius (Arachnophroctonus) a. apiculatus* (Smith) but is easily separable from that species, which also has appressed grey pubescence and a red metasoma, by the abundant, white erect hair on the head and mesosoma and the thin, lenticular head as well as by the generic characters.



Map 53. Overall distribution of *Pompilus (Xerochares) expulsus* Schulz.

Subgenus *Ammosphex* Wilcke

As defined by Wilcke (1943), *Ammosphex* is equivalent in its scope to the *Arachnospila* of recent European workers. Dreisbach (1950) and Evans (1951a, 1966) have restricted *Ammosphex* to include only those species with the apical cells of the anterior wing a considerable distance from the wing apex and the marginal cell somewhat shortened. As thus defined, the subgenus contains 12 New World species of which five are polytypic. Nine have been recorded from California.

The subgenus contains medium to small-sized wasps which are black or black and red or the

integument occasionally deep blue with the pubescence in some species reflecting blue tints. It is closely related to the two other Holarctic subgenera in our fauna, *Arachnospila* Kincaid and *Anoplochaeres* Banks, with which it shares the following traits: the posterior margin of the pronotum usually is angulate and in the female the apical segment of the anterior tarsus has a median row of ventral spines. The row extends beyond the middle of the segment, and the spines are about the same size as those on the preceding segments. In the male the apical segment of the anterior tarsus is

asymmetrical with the inner margin produced, and the basal hooklets of the genitalia are double. *Ammosphe* differs from the other subgenera in the much shorter marginal cell of the anterior wing in both sexes, the presence of small, sclerotized teeth on the sides of the male aedeagus, and in the male the shape of the apical segment of the anterior tarsus, which is widest at or very near the middle. The female possesses a tarsal comb but in general the spines are shorter than in *Arachnospila*.

Information on the biology of North American *Ammosphe* is fragmentary. Several of the species

seem to be inhabitants of wooded areas while at least two, *angularis* (Banks) and *anomalus* (Dreisbach), are often found in open, sandy situations. The adults of some of the species have been found at honeydew or on flowers. Errant spiders of several families are taken as prey.

Although details of the male genitalia and subgenital plate are diagnostic for species of this subgenus, the females are structurally uniform and difficult to identify, as reflected in the following key.

KEY TO CALIFORNIA SPECIES OF AMMOSPHE

1. Females 2
- Males 10
2. Propodeum without hairs or with only a few short, inconspicuous hairs on sides; apical margin of clypeus truncate or slightly concave 3
- Propodeum with some long, noticeable erect hairs; apical margin of clypeus somewhat emarginate 8
3. Length of third antennal segment 0.9-1.0 X UID; integument in part, blue; tarsal comb with spines longer than maximum width of tarsal segments 4
- Length of third antennal segment 0.6-0.9 X UID; integument black, pubescence sometimes reflecting blue; tarsal comb with spines usually no longer than maximum width of tarsal segments 5
4. Pubescence entirely dark; spines of tarsal comb long, apical comb spine of basitarsus at least 0.72 X length of second tarsal segment *solonus solonus* (Banks)
- Pubescence silvery on lower front, at least adjacent to compound eyes; spines of tarsal comb shorter, apical comb spine of basitarsus usually at most 0.71 X length of second tarsal segment *silvivagus* Evans
5. Anterior wing with MC removed from wing apex by 2.2 or less X its length; SM2 considerably narrower than SM3 *wasbaueri* Evans
- Anterior wing with MC removed from wing apex by 2.5-3.0 X its length; SM2 usually not narrower than SM3 6
6. MID 0.55-0.61 X TFD (average 0.58); length of third antennal segment usually slightly less than combined lengths of first and second *angularis angularis* (Banks)
- MID 0.53-0.57 X TFD (average 0.55); length of third antennal segment equal to or slightly greater than combined lengths of first and second 7
7. Pubescence entirely dark; wings with strong violaceous reflections; length of third antennal segment 0.6-0.8 X UID *anomalus anomalus* (Dreisbach)
- Pubescence usually silvery on frons above clypeus; wings variable, often not or only slightly violaceous; length of third antennal segment 0.75-0.9 X UID *parvulus* (Banks)
8. Either tarsal comb with spines distinctly longer than maximum width of tarsus; or clypeus distinctly emarginate (figs. 129, 130) 9
- Tarsal comb with spines not or only slightly longer than maximum width of tarsus; clypeus scarcely emarginate (fig. 131) *imbecillus imbecillus* (Banks)
9. Posterior tibia with longer spur two-thirds or less length of posterior basitarsus; emargination of clypeus deep (fig. 129); integument black *luctuosus luctuosus* (Cresson)
- Posterior tibia with longer spur more than two-thirds length of posterior basitarsus; emargination of clypeus shallow (fig. 130); integument with vague blue reflections *occidentalis* (Dreisbach)
10. SGP without median preapical erect hairs (figs. 141, 142); aedeagus constricted near its middle with an expanded dorsal flange (figs. 161, 162) 11
- SGP with a median series or preapical tuft of erect hairs (figs. 147, 149, 150); aedeagus not constricted near its middle, without flange (figs. 167, 177) 13
11. SGP with sides not emarginate, narrowing gradually to apex (fig. 141); apex of gonostylus with long, closely set hairs (fig. 161) *angularis angularis* (Banks)
- SGP with sides emarginate, narrowing more suddenly before apex (figs. 142, 154); apex of gonostylus with short hairs (fig. 162) 12
12. SGP with lateral groups of long hairs near base, apex slender, narrowly rounded (fig. 142); gonostylus with the hairs erect, bristling, especially toward base (fig. 162) .. *anomalus anomalus* (Dreisbach)
- SGP without lateral groups of long hairs near base, apex broad; gonostylus with hairs decumbent (fig. 154) *parvulus* (Banks)
13. SGP with median linear series of long, erect hairs (figs. 149, 160) 14
- SGP without median linear series of erect hairs, with median preapical tuft of hairs (figs. 147, 159) 15
14. SGP flat, median series of hairs often preceeding tuft or compact series of stronger hairs (fig. 149); gonostylus slender with lateral fringe of long hairs (fig. 167) *luctuosus luctuosus* Cresson
- SGP strongly elevated medially, median series of hairs not preceding tuft or compact series of stronger hairs (fig. 160); gonostylus stout with longer hairs only at apex (fig. 179) *wasbaueri* Evans
15. SGP with erect hairs at apex short, in loose tuft or short series (figs. 158, 159) 16
- SGP with erect hairs at apex long (figs. 147, 150) 17
16. SGP only narrowly elevated along midline (fig. 158); genitalia with gonostyli broad and strongly setose (fig. 177) *silvivagus* Evans
- SGP with entire disk elevated (fig. 159); genitalia with gonostyli narrower and not as strongly setose (fig. 178) *solonus solonus* (Banks)
17. SGP nearly flat; erect hairs at apex in compact, pencil-like tuft (fig. 150) *occidentalis* (Dreisbach)
- SGP strongly elevated, erect hairs at apex in loose tuft (fig. 147) *imbecillus imbecillus* (Banks)

Pompilus (AmmospheX) angularis
angularis (Banks)
 (Figs. 141, 161; map 54; graph 24)

Psammochares angularis Banks, 1910:115. Type female, California: Claremont (MCZ).

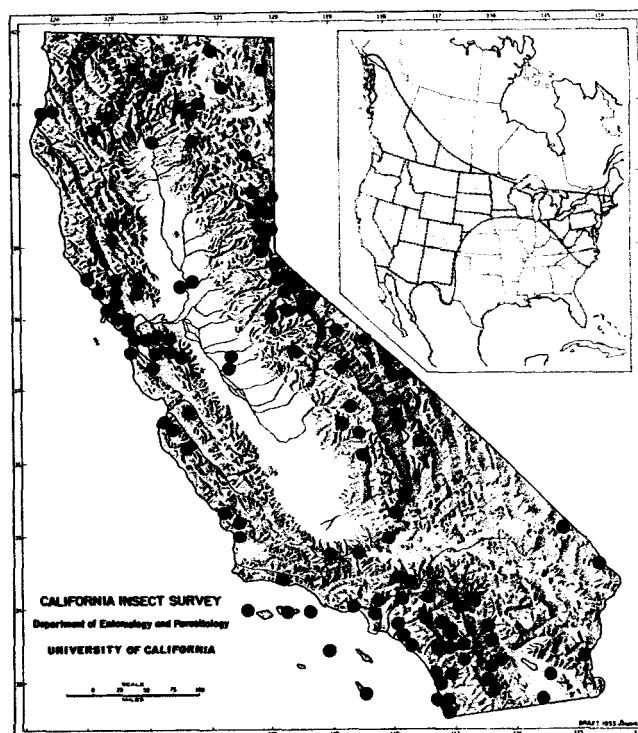
Geographic range (map 54). — Transcontinental from Yukon south to northern Mexico. Within this range, it is more common and widespread in the western than in the eastern U.S. It is replaced to the south by another subspecies, *volcanicus* Evans, in the mountains of central and southern Mexico.

California distribution (map 54). — A widespread and fairly common element in the California fauna, *Pompilus a. angularis* is found in the southern California mountains, Transverse Ranges, Coast Ranges, Sierra Nevada at elevations to 3,300 m, Siskiyou Mountains and in the Great Basin. It is not commonly collected in the Central Valley or in the true desert but has been taken on five of the Channel Islands: San Clemente (China Camp — Cluster Pt., China Pt., Eel Pt., N. end (airport), Pyramid head, Sand dune area, West Cove dunes, West shore at 32° 56' N-118° 33' W, Whale Pt.); San Miguel (2 ♀♀, 2 ♂♂, VIII-16/17-1970, J. Donahue, LACM); San Nicolas (1 ♀, IV-24-1940, C. Henne, LACM); Santa Barbara (Plateau above ranger's hut, 2 ♂♂, VIII-1-1968, C. Remington, L. Matlovsky, PM; 1 ♀, VI-11-1978, J. Trager, SBM; Northwestern terrace — Sta. 3, 1 ♀, IV-4-1979, S. Miller, SBM); Santa Cruz (Christi Beach, 1 ♀, IX-23-1968, R.W. Thorp, UCD).

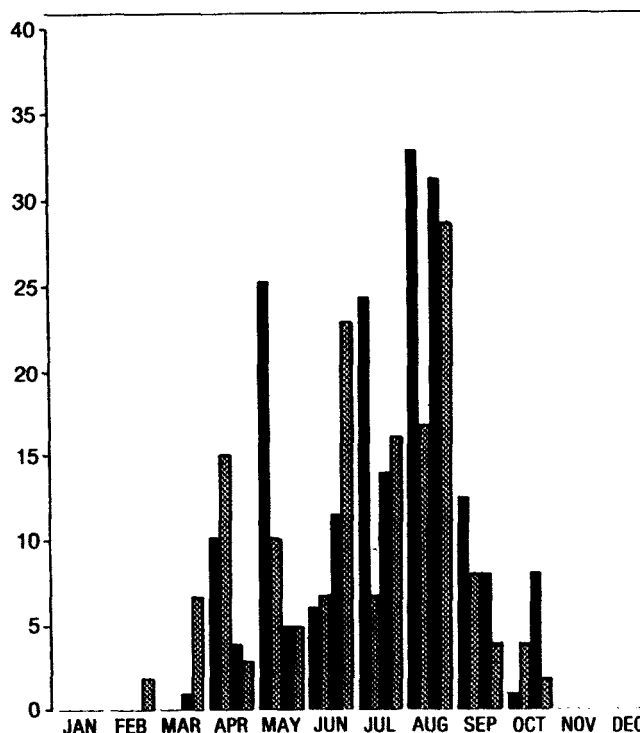
Seasonal occurrence (graph 24). — Both sexes of this species are most commonly taken April to August although females have been taken from March to October and males from February to October. We examined 257 females and 186 males.

Pompilus angularis is part of a complex of three closely related species, including *Pompilus anomalus* (Dreischach) and *Pompilus parvulus* (Banks). In this group, the wing veins are a considerable distance from the apex of the wing, the marginal cell of the anterior wing at least 2.5 times its length from the apex. There is no erect hair on the propodeum, and the apex of the female clypeus is truncate or only slightly concave. The aedeagus of the male is constricted near its middle with a broad dorsal flange overlying the constricted area (figs. 161, 162, 172), and the subgenital plate is without tufts or series of erect hairs on its midline.

External features are difficult to use in separating these three species, but the genitalia of the males show some constant differences. In the female of *angularis* the frons is slightly wider than in the other two species, the middle interocular distance averaging about 0.58 the transfacial distance, and the length of the third antennal segment is generally slightly less than the combined lengths of the first and second. The subgenital plate of the male tapers uniformly to a narrow apex (fig. 141). This feature usually cannot be seen without removal of the plate. Perhaps the most distinctive character in the male is in the genitalia (fig. 161). The apices of the gonostyli are set with long, inwardly directed hairs and are often visible without dissection.



Map 54. California distribution of *Pompilus (AmmospheX) angularis angularis* (Banks). Inset: overall distribution.



Graph 24. Seasonal occurrence of *Pompilus (AmmospheX) angularis angularis* (Banks). Black columns represent females; gray columns are males.

Biology. — In California, this species seems to show a preference for dry, fairly open areas. We have taken it on coastal and desert sand dunes but also in moderately high elevation conifer forests in

the Sierra Nevada. Adult feeding at nectar sources is uncommon, although Evans (1951a) reported it visiting honeydew and flowers of *Cleome*. We have seen females collected at flowers of *Eriogonum fasciculatum* and both sexes at flowers of *Hemizonia fasciculata*.

Hunting behavior has not been reported, but brief observations on the prey or nesting behavior have been made by Alcock (1973), Evans (1959a, 1963, 1970), Kurczewski and Kurczewski (1973) and Wasbauer and Powell (1962).

Females transport their prey in the usual manner of Pompilini, grasping the base of one of the legs in their mandibles and walking backwards. The spider is left, presumably near some landmark, while the wasp constructs its nest consisting (in the one example known) of a simple, diagonal burrow with a terminal cell. The egg is placed vertically on the side of the spider's abdomen near the base.

The range of prey spiders appears broad, and the following species have been reported: *Callilepis altitudinis* Chamberlin, *C. imbecilla* (Keyserling) (Gnaphosidae), *Pellenes* sp. (Salticidae), *Xysticus* sp. (Thomisidae) and an unidentified crab spider (Thomisidae).

Pompilus (Ammosphex) anomalus
anomalus Dreisbach
(Figs. 142, 162; map 55; graph 25)

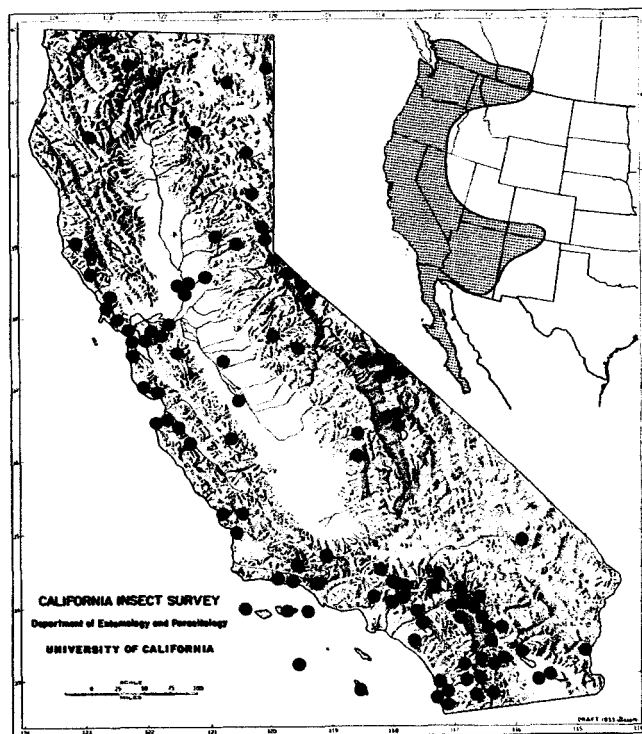
Anopompilinus anomalus Dreisbach, 1949:725. Holotype male, Colorado: Mt. Home Lake, Ft. Garland (MCZ).

Anopompilinus arnaudi Dreisbach, 1952a:153. Holotype male, California. Tuolumne County: Pinecrest (MCZ).

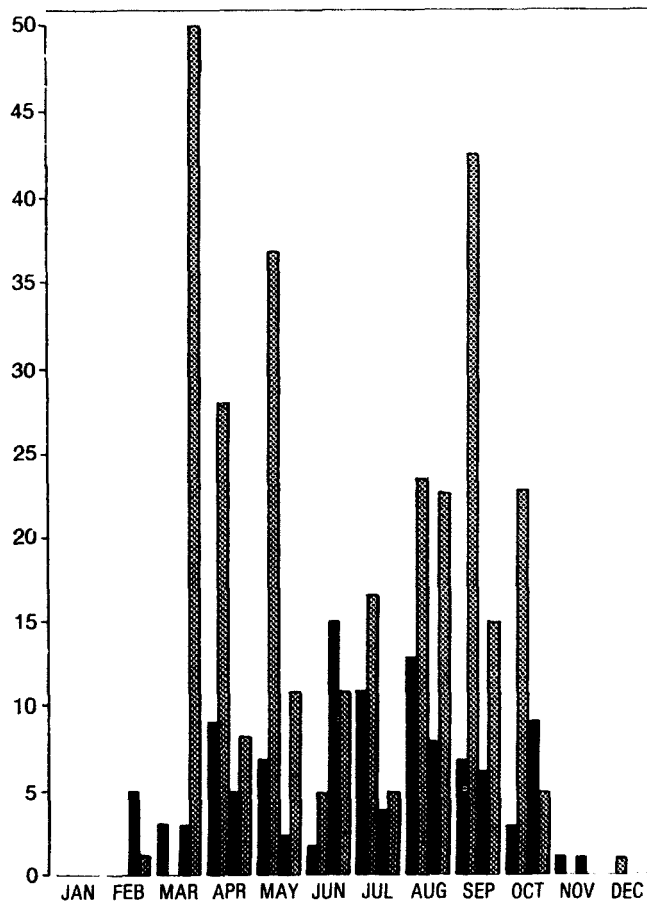
Geographic range (map 55). — Western United States from California east to Colorado and southern British Columbia and Alberta south to the tip of Baja California. There are no records from mainland Mexico, but the species no doubt occurs in northern Sonora. Another subspecies, *P. anomalus durangoanus* Evans, occurs in the mountains of central Mexico.

California distribution (map 55). — Occurring from sea level to over 3,000 m, this species is widespread and fairly abundant throughout the state and has been collected in the southern California mountains, Coast Ranges, Sierra Nevada, Siskiyou Mountains and Great Basin. Records are mostly from riparian situations in the Central Valley. There are records from four of the Channel Islands. San Clemente: China Pt., 1 ♂, VI-16-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); West Cove, 1 ♂, dunes, VI-11/14-1971 (J. Pinto, UCR). San Miguel: Cuyler Harbor, 1 ♂, VII-11-1970 (A.A. Grigarick, R.O. Schuster, UCD). San Nicolas: 20 ♂♂, V-5/7-1978, *Eriogonum* on dunes (J.A. Powell, M. Buegler, R. Coville, CIS). Santa Cruz: Canada del Medio, 1 ♀, IX-22-1968 (R.W. Thorp, UCD); 1 ♂, V-6-1968 (R.L. Brumley, UCD); Central Valley HQ, 1 ♂, IX-27/28-1978 (R. Coville, CIS); Christi Beach, 1 ♀, IV-23/26-1976 (Rato, UCR); Prisoner's Harbor, 1 ♂, IX-29-1978 (R. Coville, CIS).

Seasonal occurrence (graph 25). — There are multiple collection records for both sexes from March to October. Females have been taken in every month except December and January. The



Map 55. California distribution of *Pompilus (Ammosphex) anomalus anomalus* Dreisbach. Inset: overall distribution.



Graph 25. Seasonal occurrence of *Pompilus (Ammosphex) anomalus anomalus* (Dreisbach). Black columns represent females; gray columns are males.

species undoubtedly has several overlapping generations. We have examined 133 females and 316 males, the majority from California.

This species forms a closely knit complex with *Pompilus angularis* (Banks) and *P. parvulus* (Banks), separable primarily on characters of the male terminalia. The subgenital plate is rather abruptly narrowed to a slender apex and has paired groups of longer hairs toward the base (fig. 142). The hairs at the apex of the gonostylus are short, and those on the sides are erect and bristling (fig. 162).

The characters given in the key for separating the females from those of *angularis* and *parvulus* are not altogether satisfactory and are best used in conjunction with associated males.

Biology. — Like the preceding, this species seems to inhabit open situations such as coastal and interior dunes and open places in forested regions. There are records of adult feeding at nectar sources. Females have been collected on flowers of *Asclepias* sp. and *Foeniculum vulgare*, males on extra-floral nectaries of *Helianthus annuus* and flowers of *Agave (delicata?)*, *Croton californicus* and *Eriogonum Wrightii subscaposum*. Both sexes have been taken visiting honeydew.

There is one prey record, an immature of *Xysticus cunctator* (Thomisidae) given by Wasbauer and Powell (1962).

Pompilus (Ammosphex) parvulus (Banks)
(Figs. 154, 172; map 56)

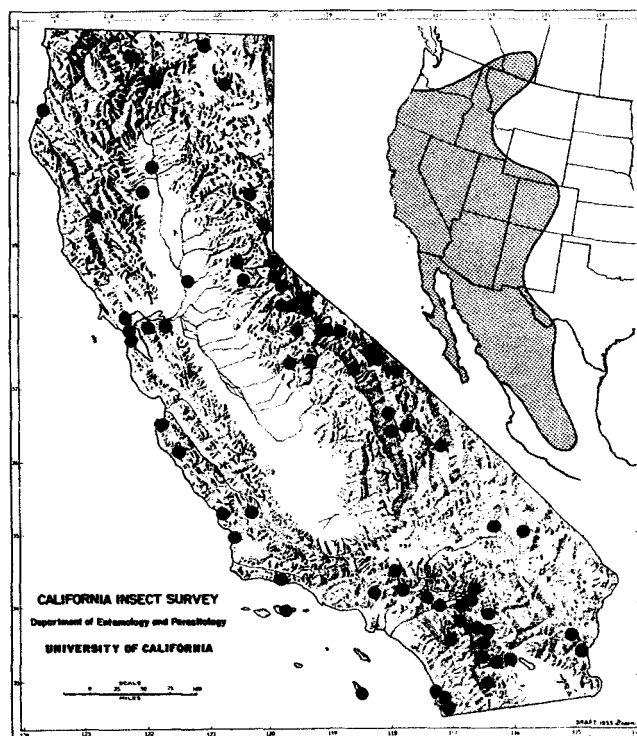
Pompiloides parvulus Banks, 1911 (1912):227. Holotype female, Colorado: Boulder (USNM).

Pompilus (Ammosphex) parvulus tepahuanus Evans, 1953:542. Holotype male, Mexico. Durango: El Salto (CAS).

Geographic range (map 56). — This species is similar in its distribution to *Pompilus anomalus*, occurring in the western United States from California east to Colorado and New Mexico and from southern Alberta south to Toluca in the mountains of Central Mexico.

California distribution (map 56). — Widespread in the state but with few records from the deserts and the Central Valley. Only females have been recorded from the Channel Islands, and although the records are shown on the map, confirmation from males is needed before the occurrence of *parvulus* on these islands can be accepted without reservation. Channel Islands records are San Clemente: West Cove and China Pt., dunes, 3 ♀♀, VI-11 to 14-1971 (J. Pinto, UCR); 20.5 mi. S.E. Wilson Cove, 1 ♀, VI-12-1971 (J. Doyen, CIS). Santa Cruz: Christi Beach, 1 ♀, IX-27-1978 (R. Coville, CIS).

Seasonal occurrence. — We have examined 132 females and 42 males. Females have been taken from February to November and males from April to September. The apparent disparity in flight period is probably a reflection of the small number of records for males. The greatest number of records is for August. Presumably there are two to three overlapping generations.



Map 56. California distribution of *Pompilus (Ammosphex) parvulus* (Banks). Inset: overall distribution.

Females usually have some silvery pubescence on the frons above the clypeus, and the third antennal segment is slightly longer than it is in *anomalus*, but there is a considerable amount of variation in these characters. For example, the ratio of the length of the third antennal segment to the upper interocular distance is 0.6-0.8 in *anomalus* and 0.75-0.9 in *parvulus*. Characters of the male genitalia are much more reliable in separating this species from *angularis* and *anomalus*. The subgenital plate is similar to that of *anomalus* but not usually as narrowly attenuate as in the latter. Likewise, the gonostyli of the two species are quite similar but the hairs on the sides are decumbent rather than bristly.

Biology. — Adult feeding is not common in this species. Females have been taken on flowers of *Asclepias* sp. and males at *Eriogonum Wrightii* and *Cryptantha muricata*. Nothing is recorded on the nesting behavior.

Pompilus (Ammosphex) solonus solonus (Banks)
(Figs. 159, 178; map 57)

Pompiloides solonus Banks, 1914:303. Holotype female, Arizona: Garces (MCZ).

Geographic range (map 57). — California, Utah, Arizona and southwestern New Mexico. We have been unable to locate any Nevada records, but the species undoubtedly occurs there. The only Mexican records are from the Sierra San Pedro Martir in

the state of Baja California. Another subspecies, *teotihuacanus* Evans, has been described from the mountains of central Mexico.



Map 57. California distribution of *Pompilus (Ammosphex) solonus solonus* (Banks). Inset: overall distribution.

California distribution (map 57). – Upper Sonoran and Transition Zones at elevations to 2,600 m mostly in the foothills and lower mountains throughout the state. This species is absent in the deserts and the Central Valley. There is one record from Santa Cruz Island: Canada del Medio, 1 ♂, IV-20-1967 (D.R. Miller, UCD).

Seasonal occurrence. – From the few available records, *solonus* seems to be most abundant in August, although there are records for females from March to October and for males from April to October. We have seen 43 females and 26 males of this species.

Pompilus solonus is one of three closely related species which Evans (1966:390) has called the *solonus* species group. Two of these, *solonus* and *silvivagus*, occur in the western United States and the third, *zapotecus* (Cameron), is found in the Mexican states of Durango, Guerrero and Morelos. These species share a tendency toward a bluish caste in the integument and possess a few short hairs on the propodeum. The male subgenital plate has a very short, inconspicuous tuft of hairs at the apex. The aedeagus is simple, and the gonostyli are relatively long. The characters used to separate the females of *solonus* and *silvivagus* involve presence or absence of silvery appressed pubescence on the face and the relative lengths of the comb spines. We are not convinced that these characters will separate females in all cases. Males may be distin-

guished by the form of the subgenital plate. In *solonus* a broad median area of the disc of the plate is elevated toward the base. In *silvivagus* the plate is elevated only along the midline (figs. 158, 159).

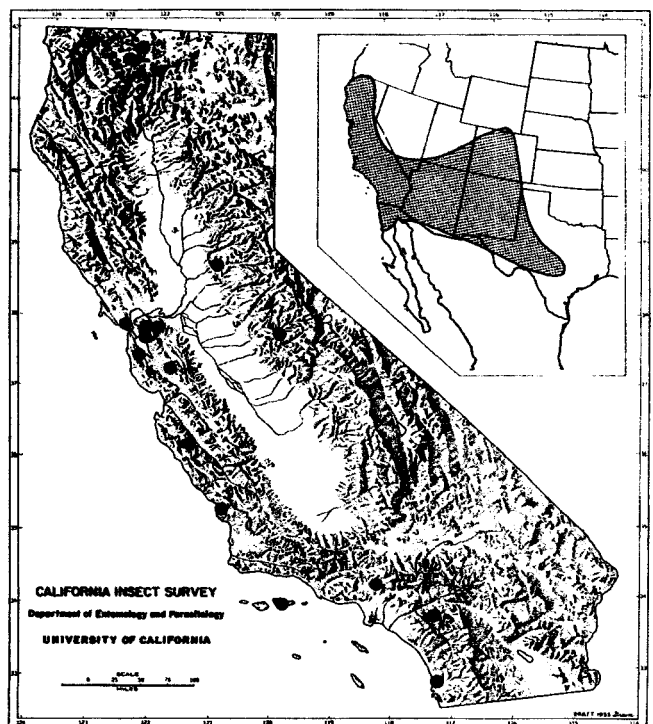
Biology. – Adults are frequently found in open spots in wooded or brushy situations. They occasionally visit flowers, females having been taken at blooms of *Yucca Whipplei* and *Cryptantha muricata*. Both sexes are recorded visiting flowers of *Euphorbia serpyllifolia*. Evans (1951a) took a female in the Chiricahua Mountains, Arizona, dragging an immature wolf spider of the genus *Lycosa*.

Pompilus (Ammosphex) silvivagus Evans
(Figs. 158, 177; map 58)

Pompilus (Ammosphex) solonus silvivagus Evans, 1951a:241.
Holotype male, New Mexico. Otero Co.: Cloudcroft (ANSP).

Geographic range (map 58). – California, Arizona, Colorado, New Mexico and Texas. This species has been taken near the tip of Baja California and probably occurs in the northern mainland of Mexico, although we have not seen specimens from that area.

California distribution (map 58). – From sea level to 1,828 m on coastal beaches, foothills and mountains throughout the State in the Upper Sonoran and Transition Zones. Like the preceding species, *Pompilus silvivagus* has not been found in the deserts or the Central Valley. There is a single record for Santa Cruz Island: Ridge N. of Laguna Cyn., 1 ♂, IV-28-1966 (R.L. Langston, CIS).



Map 58. California distribution of *Pompilus (Ammosphex) silvivagus* Evans. Inset: overall distribution.

Seasonal occurrence. – Females have been collected from March to October and males from April to October. The majority of records for both sexes are for August.

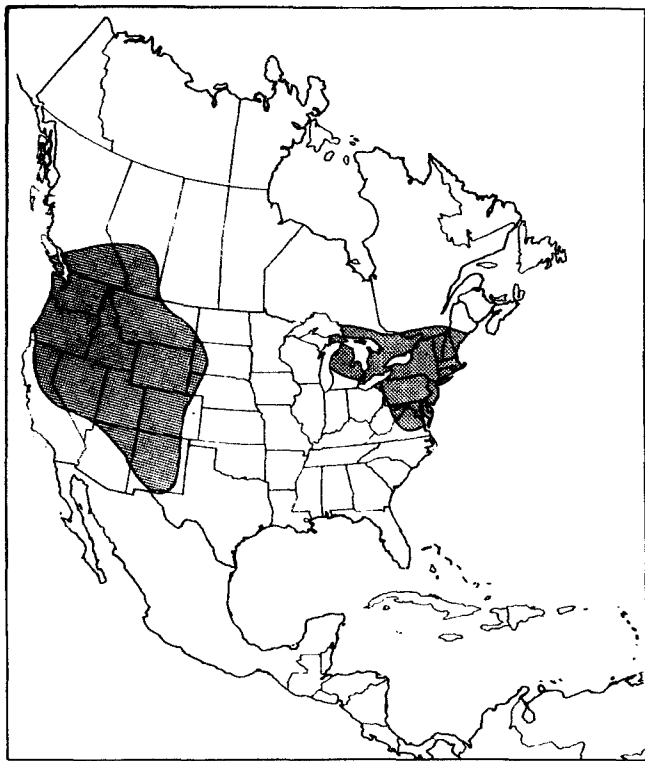
This species shows a preference for wooded areas, although we have taken both sexes flying with *P. solonus solonus* at the base of bushes and on open trails in coastal dunes near Morro Bay, San Luis Obispo County. It apparently does not visit flowers. Other aspects of the biology are unknown.

Pompilus (AmmospheX) imbecillus
imbecillus (Banks)
(Figs. 131, 147; map 59)

Anopliella imbecilla Banks, 1939:227. Holotype female, Connecticut: Colebrook (MCZ).

Anopompilinus coloradensis Dreisbach, 1949:724. Holotype male, Colorado: Florissant (MCZ).

Anopompilinus banksi Dreisbach, 1949:728. Holotype male, Michigan: Luce County (MCZ).



Map 59. Overall distribution of *Pompilus (AmmospheX) imbecillus imbecillus* (Banks).

Geographic range (map 59). – Probably transcontinental in southern Canada and the United States as far south as New Mexico and Arizona, but we have seen no record of its occurrence between Michigan and South Dakota. Although it was not previously recorded from any of the Pacific states, we have records of it from Washington, Oregon and California as well as Nevada. There is a subspecies, *ojibwae* Evans occurring north of the nominate form.

California distribution (map 59). – Transition Zone in the Siskiyou Mountains and Sierra Nevada at elevations from 1,525 to 2,438 m as far south as Madera County. California records are as follows. Alpine Co.: 1 mi. S. Monitor Pass, 8,200', 1 ♀, Malaise

Trap, 9A-5P, VIII-22/23-1979 (M.S. Wasbauer, P.A. Adams, CDFA). Madera Co.: Rd. to Mark Mine, S.E. slope Green Mtn., 7,600', 1 ♂, VIII-20-1971 (H.B. Leech, CAS); Chiquito Cr., below Upper Chiq. Cpgd., 6,820', 1 ♂, VIII-11-1971 (H.B. Leech, CAS). Modoc Co.: Adin Pass, 14 ♀♀, 21 ♂♂, VIII-6-1979 (T.R. Haig, CDFA, MSW); Cedar Pass Cpgd., 1,800 m, 10 ♂♂, VIII-10/11-1979 (P.H. Arnaud, CAS). Mono Co.: Mill Cr. Cyn., 7 mi. S. Jct. Hwy. 395, 8 ♀♀, 7 ♂♂, VIII-25/26-1979 (M.S. Wasbauer, P.E. Adams, CDFA, MSW). Nevada Co.: Sagehen, nr. Hobart Mills, 2 ♀♀, VII-4/9-1954 (J.A. Powell, CIS); 1 ♂, VII-19-1978 (L.S. Kimsey, UCD); 1 ♂, VII-25-1978 (collector?, UCD). Siskiyou Co.: 4 mi. N.E. Bray, 1 ♂, IX-14-1979 (T.R. Haig, CDFA); Dock Well, 1 ♀, IX-20-1979 (T.R. Haig, CDFA); McBride Springs, 1524 m, 2 ♀♀, 1 ♂, VIII-8-1967 (P.H. Arnaud, CAS); 1 ♀, VI-10/14-1974 (D.S. Green, CIS).

Seasonal occurrence. – The 29 females and 43 males we have seen from California were taken from June to September, the majority of records in August.

This species and the three which follow form a homogeneous group which Evans (1951a) termed the *luctuosus* group. It is characterized by the venation of the anterior wing extending close to the apex, the marginal cell usually less than twice its length from the apex, the presence usually of erect hair on the propodeum of the female, the male genitalia with the aedeagus simple, without a constriction or dorsal flange and the subgenital plate with a series of erect hairs on the midline or a tuft or pencil of setae near the apex.

Females of *P. i. imbecillus* are recognized by the short spines of the tarsal comb, presence of a few erect hairs on the body and the apical margin of the clypeus scarcely emarginate (fig. 131). The subgenital plate of the male is distinctive in being somewhat tectate and having the erect setae in a compact series or loose tuft near the apex (fig. 147).

This species appears characteristic of woodland situations. We have taken it in clearings and open areas in pine forests. Evans (1951a) reported collecting it at honeydew and at flowers of *Ceanothus americanus*.

Pompilus (AmmospheX) luctuosus
luctuosus Cresson
(Figs. 129, 140, 149, 167; map 60)

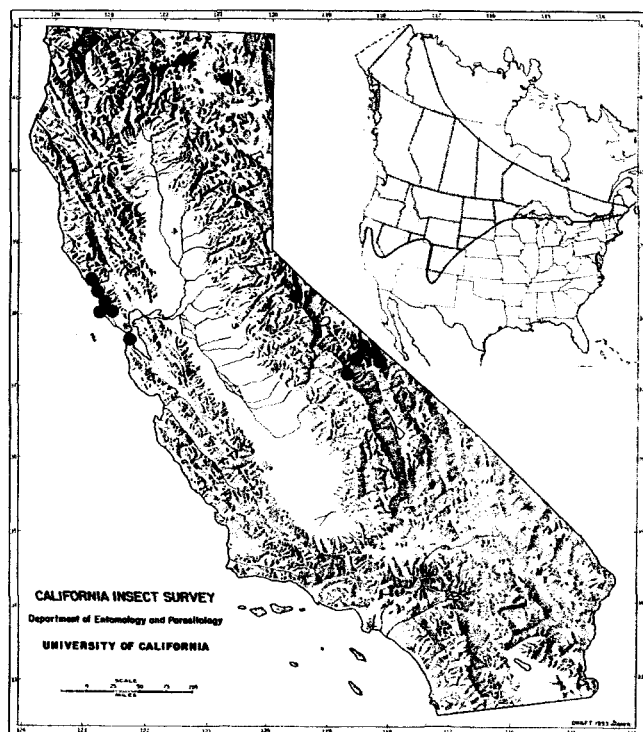
Pompilus luctuosus Cresson, 1865a:452. Lectotype female, Colorado (no further data) (ANSP).

Anopompilinus mainensis Dreisbach, 1949:733. Holotype male, Maine: Bangor (MCZ).

Anopompilinus hirsutus Dreisbach, 1949:733. Holotype male, Colorado: Estes Park (MCZ).

Geographic range (map 60). – Transcontinental in Canada and the northern U.S. It is probably more widespread in the eastern states than shown on the inset map, but we have seen no records for that region other than those given by Evans (1951a). Other subspecies occur in Europe.

California distribution (map 60). – Central Coast Ranges, Great Basin Ranges, Sierra Nevada and White Mountains. It



Map 60. California distribution of *Pompilus (Ammosphex) luctuosus luctuosus* (Cresson). Inset: overall distribution.

occurs near sea level in the Upper Sonoran Zone along the Marin and Sonoma County coast and at relatively high elevations in the Transition to Canadian Zones in the Sierras and White Mountains. California records are as follows. Inyo Co.: Mono Pass, 12,000', 2 ♂♂, VIII-13/15-1957 (D.D. Linsdale, C.D. MacNeill, CIS, CAS); Ruby Lake, 11,500', 2 ♀♀, VIII-13-1957 (J.A. Powell, CIS). Marin Co.: Dillon Beach, 1 ♀, IV-19-1947 (Welch, CIS); 1 ♀, V-18-1963 (J.W. MacSwain, CIS); 6 mi. W. Inverness, 4 ♀♀, 1 ♂, VII-28-1962 (M.E. Irwin, L.A. Stange, UCD); McClure's Beach, 1 mi. S., 1 ♀, VII-29-1964 (C.A. Toschi, CIS); Point Reyes, 1 ♀, IV-20-1958 (D.J. Burdick, MSW); 1 ♀, V-24-1956 (J.A. Powell, MSW); Point Reyes Nat. Seashore, N. Beach, 2 ♀♀, carrying spiders, VI-2-1979 (L. Vincent, CIS); 1 ♀, 2 ♂♂, dunes, VIII-20-1975 (W.W. Middlekauff, CIS); 1 ♀, IV-30-1967 (W.J. Turner, CIS); 2 ♂♂, VI-4-1977 (Powell, Nawalinski, CIS). Modoc Co.: Adin Pass, 1 ♀, VIII-6-1979 (T.R. Haig, CDF). Mono Co.: Big McGee Lake, 10,500', 1 ♂, VII-2-1974 (T. Griswold, TG); Blanco's Corral, White Mts., 10,000', 1 ♀, 1 ♂, VI-24-1953; 1 ♂, VII-21-1953 (G.A. McLellan, UCD); 1 ♂, VIII-10-1960 (A.S. Menke, UCD); 1 ♂, VI-15-1954 (D.J. Burdick, CIS); Crooked Cr. Lab, White Mts., 10,150', 1 ♀, VI-21-1961 (J.A. Powell, CIS); Mt. Barcroft Lab, 12,500', 1 ♀, VII-5-1961 (J.A. Powell, CIS); Sonora Pass, 1 ♂, VIII-10-1960 (A.S. Menke, UCD); White Mt., 14,000', 1 ♀, VII-21-1953 (G.A. McLellan, UCD). San Francisco Co.: San Francisco, 1 ♂, V-12-1915 (E.P. Van Duzee, CAS). Siskiyou Co.: Dock Well, 4 ♀♀, IX-20-1979 (T.R. Haig, CDF). Sonoma Co.: Bodega Bay, 1 ♀, VII-29-1964 (D.Q. Cavagnero, UCD); 1 mi. W. Bodega Bay, sand dunes, 1 ♀, IV-28-1962 (J. Doyen, CIS); Goat Rock Beach St. Pk., 1 ♀, VIII-22-1968 (M.E. Irwin, UCR). Tuolumne Co.: Sonora Pass, 9,626', 1 ♀, VII-27-1964 (R.R. Snelling, LACM); 1 ♀, VIII-6-1956 (C.D. MacNeill, MSW); 1 ♂, VIII-10-1960 (A.S. Menke, UCD); 1 ♀, VIII-16-1959 (G.I. Stage, MSW); Near Sonora Pass, 11,000', 1 ♀, VII-14-1957 (C.D. MacNeill, CAS); Sonora Peak, 11,400', 2 ♀♀, VII-10-1957 (J.A. Powell, CIS).

Seasonal occurrence. — In coastal localities from April to

August and in the mountains from June to September. We examined 34 females and 14 males from California.

In the female of *P. l. luctuosus*, the integument is dull black without blue tints, the apical margin of the clypeus is distinctly arcuately emarginate (fig. 129) and the longer spur of the posterior tibia is less than two-thirds the length of the basitarsus. In addition to the distinctive, nearly flat subgenital plate with its median series of long, erect setae (fig. 149), the male can be recognized by the flattened posterior basitarsus. The genitalia are as in fig. 167.

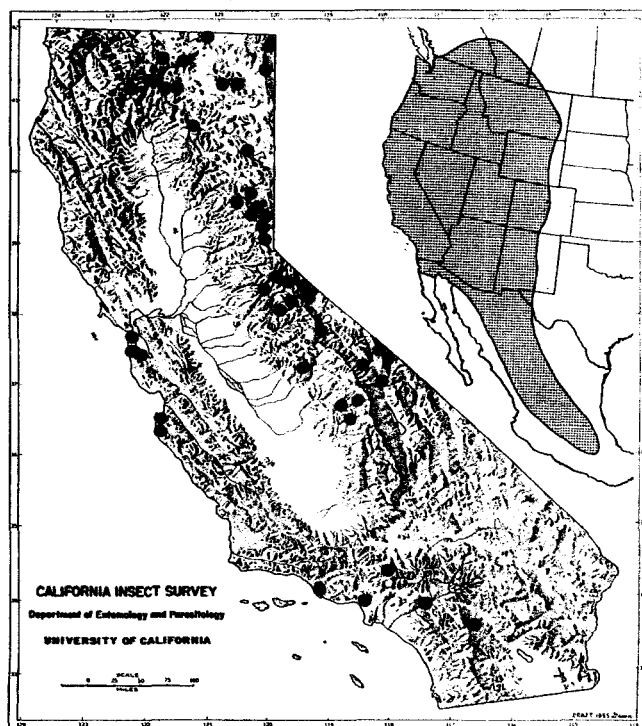
Biology. — Along the California coast, this species frequents vegetation in sand dune areas and is sometimes taken on the open sand of the dunes. In mountainous areas, it is generally found around low vegetation in clearings. Adults apparently do not visit flowers, other nectar sources or honeydew.

Wasbauer (1983) reported as prey of this species females of *Anypaena pacifica* (Banks) (Anyphaenidae).

Pompilus (Ammosphex) occidentalis (Dreischach)
(Figs. 130, 133, 150; map 61; graph 26)

Anopompilinus occidentalis Dreischach, 1949:726. Holotype male, California. Tuolumne County: Pinecrest (MCZ).

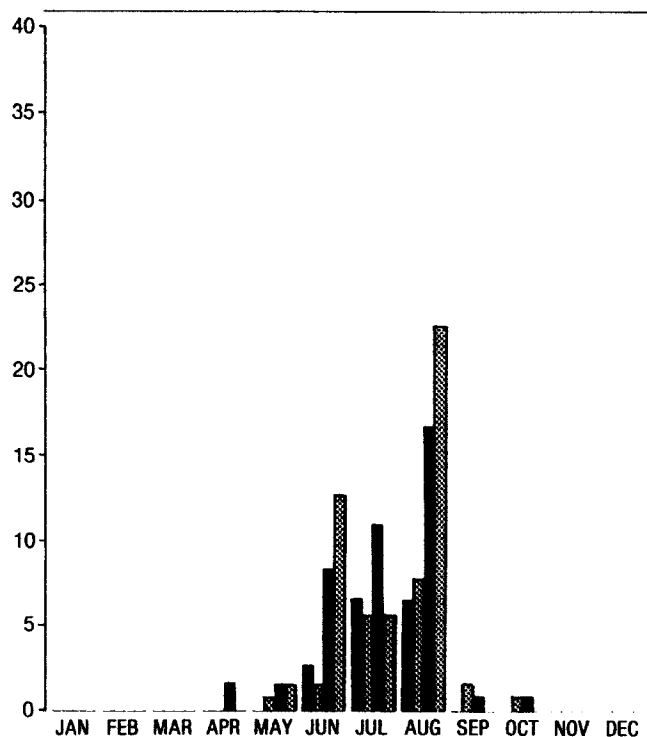
Geographic range (map 61). — Western United States and Canada from California east to Montana, Colorado and New Mexico and from British Columbia and Alberta south to the highlands of the state of Mexico, Mexico.



Map 61. California distribution of *Pompilus (Ammosphex) occidentalis* (Dreischach). Inset: overall distribution.

California distribution (map 61). — Sea level to 3,350 m in the Upper Sonoran to Canadian zones, southern California mountains, central and south Coast Ranges, Sierra Nevada, Siskiyou Mountains and Great Basin montane. This species is similar in its distribution in California to *P. l. luctuosus* but is more widespread in the Sierra Nevada.

Seasonal occurrence (graph 26). — Females have been taken from April to October and males from May to October, with peaks for both sexes in June, July and August, indicating a single midsummer generation. We have seen 83 females and 101 males, the majority from California.



Graph 26. Seasonal occurrence of *Pompilus (Ammosphex) occidentalis* (Dreisbach). Black columns represent females; gray columns are males.

The integument of this species often exhibits blue highlights, especially noticeable on the frons. Females are otherwise similar to *luctuosus* except somewhat more hairy, with the clypeus (fig. 130) not as strongly emarginate apically and the longer spur of the posterior tibia more than two-thirds the length of the posterior basitarsus. Males are best distinguished by the subgenital plate (fig. 150), which is nearly flat and bears a subapical, compact pencil of long, usually somewhat curved setae.

Biology. — A characteristic inhabitant of open mountain forests and woodland clearings, it has also been taken on coastal dune vegetation and occasionally on open dunes. Adults are occasionally attracted to flowers. Females have been taken at blossoms of *Chrysothamnus* sp. and males at flowers of *Lomatium triternatum*. We have taken both sexes in numbers in a clearing next to a stand of poplars at Mill Creek Canyon, Mono County.

They were visiting honeydew of *Chaitophorus populicola* on *Populus trichocarpa*.

Powell (1957) provided observations on the prey transport and nest construction activities of a single female of this species near Big Meadows, Calaveras County. The prey was *Pardosa* sp. Prey transport was carried out in the usual manner of *Pompilus*. The spider was placed on a tuft of grass while the wasp constructed its burrow, which was 20 mm long and slanting. The white, elongate 2 mm egg of the wasp was placed diagonally on the lower lateral portion of the middle of the spider's abdomen. Evans (1963) reported a female of *Pardosa uintana* Gertsch used as prey in Wyoming.

Pompilus (Ammosphex) wasbaueri Evans (Fig. 160)

Pompilus (Ammosphex) wasbaueri Evans, 1966:396. Holotype male, California. Contra Costa County: Orinda Cross Road (CAS).

Geographic range. — Widespread but uncommon in California, *Pompilus wasbaueri* has not been found in other states; however, it probably occurs in southern Oregon.

California distribution. — Alameda Co.: Patterson Reserve, Del Valle Lk., 1 ♂, VII-20-1973 (J.A. Powell, CIS). Contra Costa Co.: Orinda Cross Rd., 1 ♂ (holotype), VIII-25-1953 (M.S. Wasbauer, CAS). Marin Co.: Sausalito, 1 ♂, no date or collector (OSU); Mill Valley, Blithedale Ridge, 3 ♀♀, 17 ♂♂, flight trap, various dates, VII-1 to IX-16-1965 (P.H. Arnaud, CAS). Napa Co.: Biter Creek, nr. Calistoga, 1 ♂, IX-2-1978 (P.H. Arnaud, CAS). San Diego Co.: La Jolla, 1 ♂, Malaise Trap, VII-18/19-1979 (P.A. Adams, K. Corwin, CDFA). Siskiyou Co.: McBride Springs, 1 ♂, VIII-7-1968 (P.H. Arnaud, CAS); Ft. Jones, 1 ♂, Malaise Trap, VIII-6-1979 (F.D. Horn, CDFA). Tuolumne Co.: Strawberry, 1 ♂, VIII-6-1960 (E. Jessen, CIS).

Seasonal occurrence. — At Mill Valley, Marin County, males of this species have been taken in a Malaise Trap from July to the middle of September. The three females from this locality were taken from the last week in July to an indeterminate date in August. The male from La Jolla was taken near the middle of July. The remainder of specimens, all males from various localities, were taken in August to early September. We have seen 3 females and 23 males.

The recently described female of this species (Kimsey, 1983), if correctly associated, does not fit characters of the *luctuosus* group well. The propodeum is without erect hairs and the venation of the anterior wing does not extend apically as far as in females of *imbecillus*, *luctuosus* and *occidentalis*. Thus in the key it comes out with *angularis*, *anomalous* and *parvulus* and is separated principally by the slightly longer marginal and small second submarginal cell of the anterior wing. In all the males we have examined, the second submarginal cell is narrower than the third. It varies from 0.12 to 0.68 the width of the third, measured along the cubitus. The subgenital plate of the male is distinctive. It tapers to a narrow

apex, is elevated medially and provided with a linear series of long setae at about the middle (fig. 160).

Our impression is that this species normally

confines itself to rather dense, low vegetation and is not often found on open ground. The majority of specimens have been taken in flight traps.

Subgenus *Arachnospila* Kincaid

When used in the restricted sense of Evans (1951a), the name *Arachnospila* applies to a small, relatively homogeneous group of spider wasps occurring principally in the Holarctic Region. Two species are found in Europe, and also occur in the United States and Canada. A third species is restricted to the Nearctic Region. All three species have been taken at higher elevations in Mexico but not farther south and are represented in California. Interestingly, several additional species, some of them strikingly colored, have been recorded from the Andean area of South America.

The species found in the United States are all somber-colored wasps, completely black or rendered somewhat blue-black by the pubescence. One subspecies has the base of the metasoma marked with red. It does not occur in California, and although we have included it in the key it is not treated further. Structurally, the species are similar to those in the subgenus *Anoplochares* Banks, but both sexes are more strongly hairy and have the

labrum scarcely exerted beyond the clypeus. The females possess a strong tarsal comb, which is lacking in the latter subgenus, and the males have characteristic genitalia with the digiti excavated mesally and short in relation to the gonostyli. In *Anoplochares*, the digiti are not excavated mesally and are nearly as long as the gonostyli.

Biological information is available on all three species and has been summarized by Evans and Yoshimoto (1962).

Females are most often found in open country or open areas in woods. They frequent areas of sand or soft, friable soil. One species is commonly taken on flowers and is also known to feed at the leg bases of captured spiders. As far as known, the burrow is oblique and usually straight, terminating in an enlarged cell. Errant spiders of several families have been recorded as prey. After the cell has been provisioned and the burrow filled, the wasp uses its abdomen to tamp the soil down over the burrow entrance.

KEY TO NEARCTIC SPECIES OF THE SUBGENUS *ARACHNOSPILA*

- | | | | |
|--|--|--|--|
| 1. Females | 2 | Metasoma entirely black; pubescence dark violaceous | |
| Males | 5 | <i>fumipennis eureka</i> (Banks) | |
| 2. Antenna with scape devoid of hair; clypeus with apical margin distinctly concave | <i>arctus</i> Cresson | 5. SGP convexly raised with a pair of basal teeth or elevations (fig. 144); genitalia with gonostylus slender (fig. 3) | |
| Antenna with scape bearing at least a few long hairs; clypeus with apical margin truncate or only slightly concave | 3 | <i>arctus</i> Cresson | |
| 3. Ocellar triangle with front angle right or obtuse; OOL much greater than POL; anterior basitarsus usually with 4 (sometimes only 3) comb spines; pubescence often strongly blue | <i>scelestus</i> Cresson | SGP tectate, median line keeled (fig. 145); genitalia with gonostylus expanded toward apex (fig. 164) | 6 |
| Ocellar triangle with front angle acute; OOL equal to or only slightly greater than POL; anterior basitarsus with 3 comb spines; pubescence brown or obscurely violaceous | 4 | 6. SGP, in lateral view, with keel straight or somewhat convex; genitalia with digitus strongly expanded (fig. 175) | <i>scelestus</i> Cresson |
| 4. Metasoma with first 2 segments red; pubescence mostly brown | <i>fumipennis fumipennis</i> Zetterstedt | SGP, in lateral view, with keel distinctly concave (fig. 145); genitalia with digitus smaller, less strongly expanded (fig. 164) | 7 |
| | | 7. Metasoma with first 2 segments red; pubescence mostly brown | <i>fumipennis fumipennis</i> Zetterstedt |
| | | Metasoma entirely black; pubescence entirely dark violaceous | <i>fumipennis eureka</i> (Banks) |

Pompilus (Arachnospila) arctus Cresson
(Figs. 1, 3, 132, 135, 144; map 62; graph 27)

Pompilus arctus Cresson, 1865a:453. Holotype male, Colorado (ANSP).

Psammochares anoplinus Banks, 1919:231. Holotype female, Canada. Alberta: Medicine Lake to Jasper (CU).

Pycnopompilus siouxensis Dreisbach, 1950:592. Holotype male, Nebraska. Sioux County: Glen (UN).

Pycnopompilus sculleni Dreisbach, 1950:587. Holotype male, Oregon: Cornucopia (MCZ).

Pycnopompilus parvus Dreisbach, 1952a:152. Holotype male, Utah: Kelton (USNM).

Geographic range (map 62). — Transcontinental in the Hudsonian, Canadian and Transition zones and from Yukon and Labrador south to the mountains of south-central Mexico.

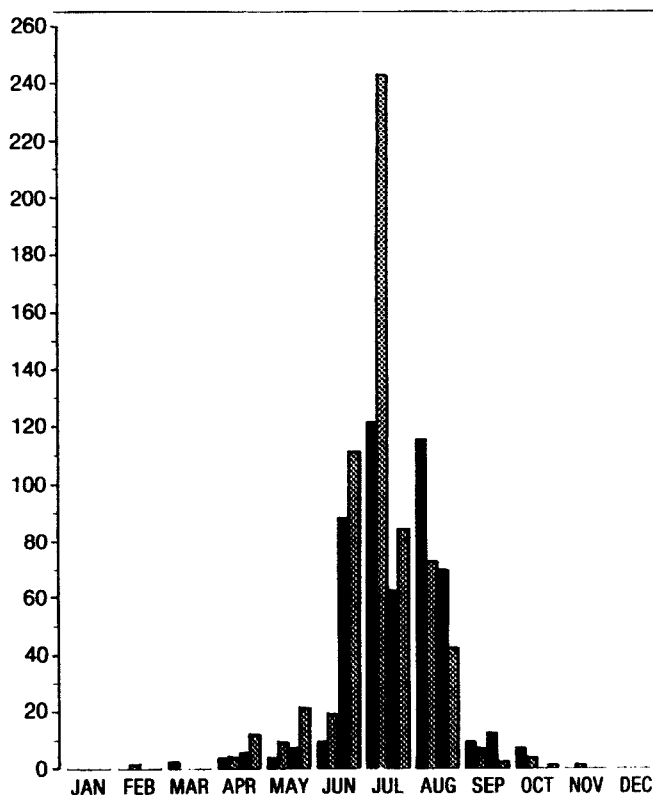


Map 62. California distribution of *Pompilus (Arachnospila) arctus* Cresson. Inset: overall distribution.

California distribution (map 62). — This is the most commonly collected species of *Pompilus* in California. It is widespread and abundant over most of the state in the Upper Sonoran, Transition and Canadian zones at elevations to 3,357 m. It has been recorded from riparian situations in several Central Valley localities and from Santa Cruz Island: South Ridge, 1 ♀, VI-19-1967 (D.S. Horning, UCD); La Cascada, 1 ♀, VI-20-1967 (R.L. Brumley, UCD).

Seasonal occurrence (graph 27). — February to November. The majority of records from California are for June, July and August, with peaks for both sexes in July, indicating a single midsummer generation. We have examined 531 females and 693 males from California.

All three species of the subgenus *Arachnospila* occurring in California are characterized by an abundance of erect hair on the head and body. A convenient feature for separating females of *arctus*



Graph 27. Seasonal occurrence of *Pompilus (Arachnospila) arctus* Cresson. Black columns represent females; gray columns are males.

from those of *scelestus* and *fumipennis eureka* is that in the former long erect hairs are absent from the antennal scapes, while in the latter two they are present. In addition, the apical margin of the clypeus is arcuately concave; in the others, truncate or only slightly concave. The subgenital plate is the most diagnostic feature of the male. In *arctus* it is convexly raised medially to a pair of sometimes acute but often ill defined swellings toward the base of the exposed portion. In *scelestus* and *fumipennis* it is distinctly keeled.

Biology. — Adults are most frequently encountered in open areas such as roads and clearings in wooded regions. They are not often attracted to flowers or other nectar sources, but females have been collected at flowers of *Senecio* sp. and males at flowers of *Asclepias* sp., *Chrysothamnus nauseosus consimilis* and *Layia platyglossa*. Both sexes have been taken from flowers of *Eriogonum Wrightii*, at extra-floral nectaries of *Helianthus annuus* and at honeydew of *Chaitophorus populicola* on *Populus trichocarpa*.

Only sketchy information is available on other aspects of the biology (Evans, 1951a; Evans and Yoshimoto, 1962; Kurczewski and Kurczewski, 1968a; Wasbauer, 1983). Prey thus far reported belong to five spider families: *Orodorassus coloradensis* Emerton and *Gnaphosa muscorum*

(L. Koch) (Gnaphosidae); *Amaurobius ferox* (Walckenaer) and *A. bennetti* (Blackwall) (Amaurobiidae); *Clubiona* sp. (Clubionidae); *Cybaeus* sp. (Agelenidae); *Arctosa* sp., *Schizocosa saltatrix* (Hentz) and *Trochosa avara* Keyserling (Lycosidae).

Pompilus (Arachnospila) scelestus Cresson
(Figs. 157, 175; map 63; graph 28)

Pompilus scelestus Cresson, 1865a:451. Lectotype female, Colorado (ANSP).

Pompilus pulchrinellus Cameron, 1893:194. Holotype female, Mexico. Sonora: Northern part (BMNH).

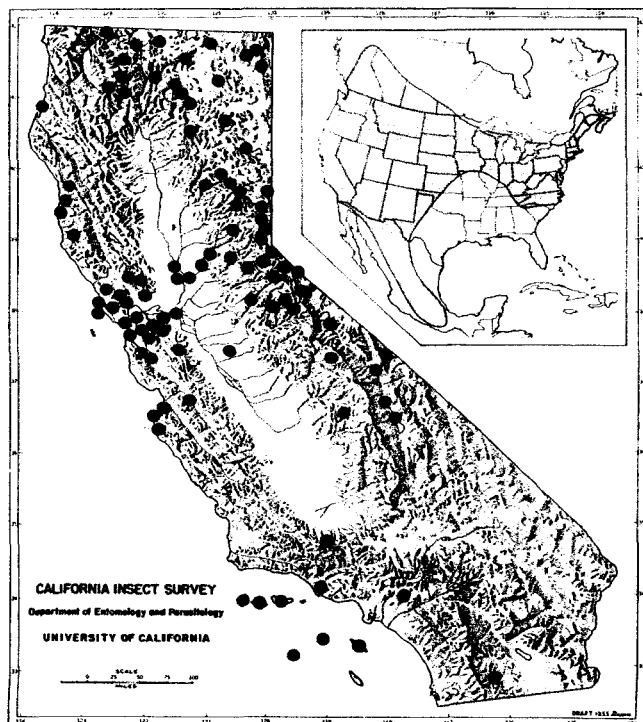
Pompilus omiltemensis Cameron, 1893:197. Holotype male, Mexico. Guerrero: Omilteme (BMNH).

Psammochares astur Banks 1911 (1912):225. Holotype female, Maryland: Great Falls (MCZ).

Psammochares sublaevis Banks, 1921:20. Holotype female, Indiana: Marion County (MCZ).

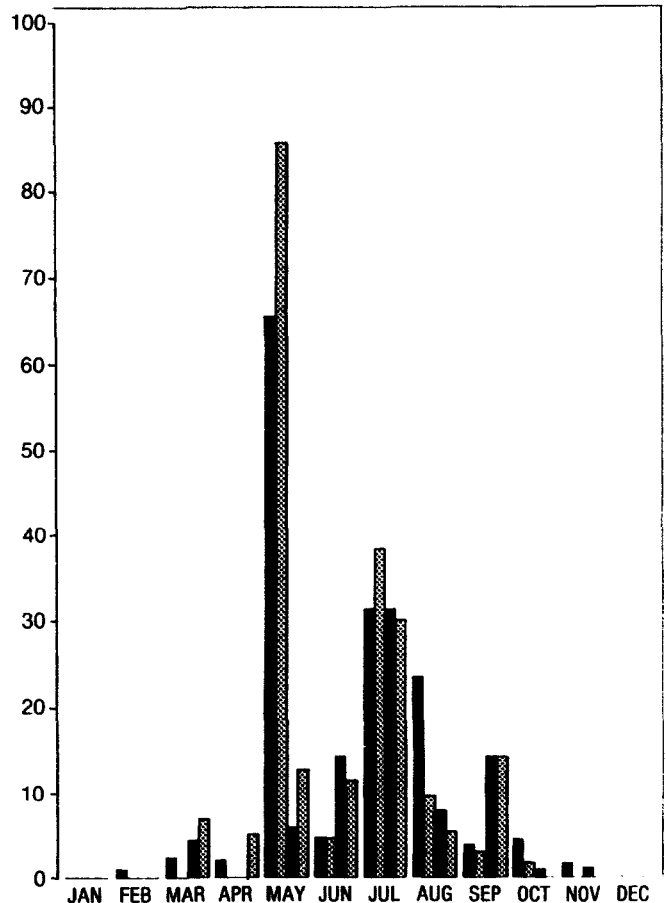
Geographic range (map 63). – Transcontinental in southern Canada and the U.S. from British Columbia south to the state of Oaxaca, Mexico.

California distribution (map 63). – Widespread in the Upper Sonoran and Transition zones primarily in the northern portion of the state at elevations from sea level to 3,200 m. This species occurs in the Central Valley along watercourses and, despite the scarcity of records from southern California, it has been taken at the following Channel Islands localities: San Miguel (Cuyler Harbor, Green Mt., Simonton Cove, Willow Cyn.); San Nicolas (Beach area from sand spit to cyn. below sewage ponds, Celery Cyn., Dutch Harbor, N. end dunes and NE NAS HQ, 1.5 mi. E. Seal Beach water tank, Thousand Sprs., Twin Rivers – E. fork,



Map 63. California distribution of *Pompilus (Arachnospila) scelestus* Cresson. Inset: overall distribution.

Vizcaino Pt.); Santa Barbara (Plateau above ranger's hut); Santa Catalina (Bull Rush Cyn.); Santa Cruz (Canada Cervada, Canada del Medio, 2 mi. E. mouth Canada Sauces Oeste, La Cascada, Christi Beach, Coches Prietos, Prisoner's Harbor, cyn. 2 mi. W. Sandstone Pt., S. Ridge, 6 mi. W. Stanton Rch. HQ, Upper Central Vy.); Santa Rosa (Beechers Bay area, Canada Lobos, China Camp – Cluster Pt. area, Torrey Pine area, Water Cyn., Windmill Cyn. to Black Mt., Windmill Cyn. – N. Fork, Upper Wreck Cyn.).



Graph 28. Seasonal occurrence of *Pompilus (Arachnospila) scelestus* Cresson. Black columns represent females; gray columns are males.

Seasonal occurrence (graph 28). – Females have been collected from February to November and males from March to October. Most of the records for both sexes are in the midsummer months. We have examined 339 females and 323 males.

This is a highly variable species in size, color and various structural features. The length of the females varies by a factor of over three (6-20 mm). In the majority of specimens the pubescence reflects blue, but in others it is obscurely violaceous or brownish. The usual number of comb spines on the anterior basitarsus is four, but there may be three or even five. The ratio of OOL to POL varies to some extent also. None of these features, used alone, would be sufficient to distinguish females of *Pompilus scelestus*, but in combination they form a reliable means for separating this species from

P. fumipennis. Males of both *scelestus* and *fumipennis* have a keel on the midline of the subgenital plate, but in *scelestus* the keel is convex or nearly straight in profile and in *fumipennis* it is emarginately concave (fig. 145).

Biology. — Adults of this species frequent open, sandy areas and are often collected on coastal dunes as well as in wooded areas. Females have been taken on flowers of *Cleome serrulata*, at honeydew of *Chaitophorus populicola* on *Populus trichocarpa* and at honeydew on oak. Males have been collected at flowers of *Chrysothamnus nauseosus* and both sexes at flowers of *Astragalus* sp., *Eriogonum* sp. and *Lupinus bicolor*, as well as at extra-floral nectaries of *Helianthus annuus*. Additional floral visitation records listed by Evans (1951a) are *Daucus carota*, *Petalostemum*, *Sphaeralcea* and *Solidago*.

The Peckhams (1898) and Raus (1918) have provided information on the nesting behavior of *P. scelestus* which has been summarized by Evans and Yoshimoto (1962). Additional information is provided by Evans (1951a, 1970). Gwynne (1979) observed this species attacking burrowing wolf spiders of the genus *Geolycosa*. Kurczewski and Kurczewski (1968, 1968a, 1973) and Wasbauer (1983) have published data on prey.

The sequence of prey capture and nest construction is variable. In some cases the wasp captures a spider before preparing a nest cell, while in others the nest is completed before hunting takes place. Burrows are short, vertical to oblique and constructed in sand or light soil. Transport of prey is normally accomplished by the wasp walking backward grasping the spider by the base of one of the posterior legs. It is pulled into the burrow by the spinnerets. Paralysis generally seems to be temporary. The egg is placed transversely on the spider's abdominal venter. The provisioned burrow is filled and the soil tamped down with the tip of the abdomen. The following prey have been reported: *Lycosa frondicola* Emerton, *L. gulosa* Walckenaer, *Schizocosa pacifica* (Banks), *Trochosa avara* Keyserling (Lycosidae); *Dolomedes* sp. (Pisauridae); *Phidippus* sp. (Salticidae). Known parasites are *Ceropales* sp. and *Evagetus parvus* (Cresson) (both Pompilidae).

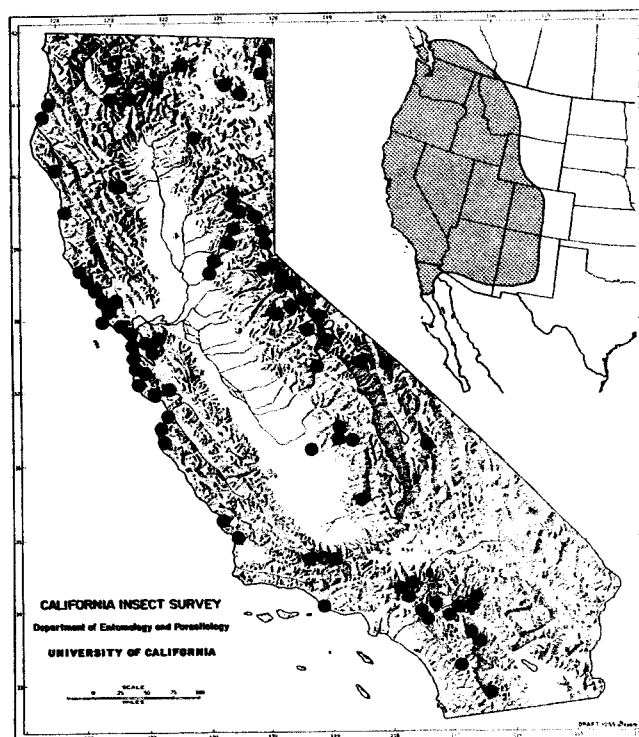
Pompilus (Arachnospila) fumipennis eureka (Banks)

(Figs. 138, 145, 164; map 64; graph 29)

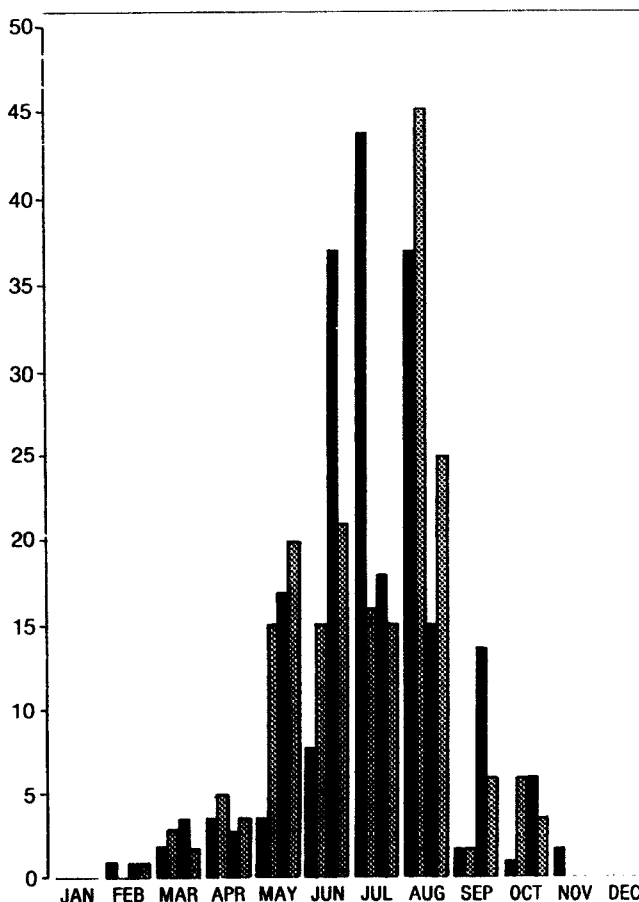
Psammochares eureka Banks, 1919:231. Holotype female, California: Ingleside (MCZ).

Psammochares catalinae Banks, 1933:7. Holotype female, Arizona: Mt. Lemmon, Santa Catalina Mts. (MCZ).

Geographic range (map 64). — Western United States from California east to Montana, Wyoming, Colorado and New



Map 64. California distribution of *Pompilus (Arachnospila) fumipennis eureka* (Banks). Inset: overall distribution.



Graph 29. Seasonal occurrence of *Pompilus (Arachnospila) fumipennis eureka* (Banks). Black columns represent females; gray columns are males.

Mexico and from southern British Columbia south to northern Baja California. The nominate subspecies is Holarctic and occurs north of the range of *eureka*.

California distribution (map 64). — Widespread primarily in the Upper Sonoran and Transition zones throughout the state at elevations from sea level to 3,100 m. This species is absent from the floor of the Central Valley and occurs only marginally in the deserts.

Seasonal occurrence (graph 29). — Females have been taken from February to November and males from February to October. Both sexes are most abundant in June, July and August.

Pompilus fumipennis eureka does not exhibit the wide variation in size, color of pubescence and structural features characteristic of *scelestus*. The pubescence is brownish or at most obscurely violaceous. The anterior basitarsus of the female always bears three comb spines. The male sub-

genital plate, in profile, has a median ridge which is arcuately concave from a high crest. Other recognition features are as given in the key.

Biology. — Adults are occasional visitors of flowers. Males have been taken at blossoms of *Baccharis pilularis* and females at *Eriogonum fasciculatum* and *Rhamnus* sp. Both sexes have been collected at honeydew of *Chaitophorus populicola* on *Populus trichocarpa* at the edge of a forest clearing.

Evans (1951a) found this species constructing a burrow in tumulus excavated by a small mammal in an alpine meadow at 2,743 m. The prey was an immature specimen of *Lycosa* sp. Other recorded prey are also Lycosidae: *Alopecosa kochi* (Keyserling), female; *Lycosa* sp., immature; *Trochosa pratensis* Emerton, male (Evans, 1959a; Wasbauer and Powell, 1962; Wasbauer, 1983).

Subgenus *Anoplochaeres* Banks

Anoplochaeres is a Holarctic group with few species. The Nearctic element comprises two species; one, *similaris* (Banks), is restricted to the Alleghanian and part of the Carolinian fauna of the eastern United States from Ontario south to Georgia. The other species, *apicatus* Provancher, is widespread and in the United States is found transcontinentally in the Transition Zone.

This very distinctive subgenus should pose no problems in identification. Both males and females

have the labrum partially exerted. The females lack a tarsal comb and the male aedeagus is broadly expanded before the apex.

There is no biological information available on the Nearctic species, but the European *spissus* Schiodte has been found searching in the burrows of lycosid spiders. It attacks and oviposits on the spider in its burrow, which it then closes with debris (Adlerz, 1910).

Pompilus (Anoplochaeres) apicatus Provancher (Figs. 2, 4, 134, 143, 163; map 65)

Pompilus apicatus Provancher, 1882:35. Holotype female, Canada. Quebec: St. Hyacinthe (UL).

Pompilus rectus Banks, 1914:303. Holotype male, Virginia: Great Falls (MCZ).

Pompiloides elsinore Banks, 1919:235. Holotype female, Canada. British Columbia: Carbonate, Columbia River (CU).

Geographic range (map 65). — Transcontinental in the United States and southern Canada. Although it has not been recorded from Mexico, *Pompilus apicatus* has been taken in the United States as far south as Brownsville, Texas.

California distribution (map 65). — Common in the mountains of northern California at elevations to 2,316 m. There are only three records south of Fresno County and one from the Central Valley: Stanislaus Co.: Turlock, 1 ♀, V-3-1952 (R.R. Snelling, CAS).

Seasonal occurrence. — Although there are scattered records from February to October, this species is commonly taken only in June and July, indicating a single midsummer generation. We have examined 102 females and 221 males, of which 54 females and 27 males were from California localities.



Map 65. California distribution of *Pompilus (Anoplochaeres) apicatus* Provancher. Inset: overall distribution.

In size and venational features, *Pompilus apicatus* resembles species in the subgenus *Arachnospila*. The lack of a tarsal comb on the anterior legs of the female is perhaps the most obvious distinguishing feature. The body lacks abundant erect hair, the clypeus is short and the labrum is partially exerted in both sexes. The

subgenital plate of the male is relatively narrow and tectate and the aedeagus is expanded and narrowed again before the apex (fig. 163).

We have seen no records of adult feeding for this species, but Evans (1951a) reported that it has been taken on flowers of wild carrot and parsnip, poison hemlock, goldenrod, *Bifora* and *Angelica*.

Genus *Aporinellus* Banks

Aporinellus is a nearly cosmopolitan genus, characteristic of warmer temperate and subtropical areas in all major zoogeographical regions except the Australian. There are seven Nearctic species, all of which enter at least the northern portions of Central America. Banks (1947) recorded another species from northern South America and we have seen still another, probably undescribed, from Argentina. All the North American species are found in California.

The species of *Aporinellus* present a distinctive facies and the genus is thus easily recognized. They are all medium to small-sized black (occasionally partly red) wasps, frequently banded conspicuously with gray. All have the propodeum produced into conical teeth posterolaterally and the postnotum absent dorsally.

Females of one of the species, *taeniatus* (Kohl), exhibits a wide degree of variability in color and degree of banding. This variability is the basis used by Evans (1951) for recognition of several subspecies.

The information available on the biology of species of *Aporinellus* is due primarily to the work of the Peckhams (1898) in the United States and Ferton (1897, 1901, 1908, 1911) in Europe. This information has been summarized by Evans and Yoshimoto (1962).

Sandy soil appears to be favored for nesting. Burrows are short and have not been reported over 6 cm in depth. Prey consists mostly of salticid and thomisid spiders. Adult wasps are known to visit flowers and honeydew secretions.

KEY TO NEARCTIC SPECIES OF *APORINELLUS*

1. Females 2
Males 8
2. Ultimate segment of tarsus with a few minute spines ventrally (fig. 180); anterior wing with SM2 less than twice as wide as long (fig. 184) *taeniatus* (Kohl)
Ultimate segment of tarsus without spines ventrally; anterior wing with SM2 more than twice as wide as long (fig. 183) 3
3. Ocelli in a compact triangle, front angle equal to or less than a right angle; 2 or 3 SM cells present, width of SM2 or SM2 + SM3, 2.0-2.5 times the length 4
Ocelli in a broad triangle, front angle greater than a right angle; 2 SM cells present, width of SM2 usually greater than 2.5 times the length 7
4. Head (fig. 188) with vertex evenly arched above tops of eyes, widest near the middle, TFD/FD 1.10-1.16
medianus Banks
Head (figs. 186, 187) with vertex nearly straight across or weakly arched between tops of eyes, widest somewhat above middle, TFD/FD 1.13-1.20 5
5. Head (fig. 187) with vertex nearly straight between tops of eyes; clypeus about 3.0 times as wide as long; anterior basitarsus with apical comb spine about as long as second tarsal segment *completus* Banks
Head (fig. 186) with vertex weakly arched; clypeus 2.5-2.7 X as wide as long; anterior basitarsus with apical comb spine often much longer than second tarsal segment 6
6. Posterior ocelli close to compound eyes, OOL/POL about 0.5; deserts of California, Nevada, Arizona
borregoensis Evans
Posterior ocelli farther from compound eyes, OOL/POL 0.65-0.80 (fig. 186); widespread in western United States *basalis* Banks
7. Antenna long and slender, third segment 4 to 5 times as long as thick, 0.64-0.80 X UID; tenth segment 2.5-3.5 times as long as thick *fasciatus* (Smith)
Antenna short, compact, third segment 3.2 to 4 times as long as thick, 0.45-0.68 X UID; tenth segment 1.6-2.3 times as long as thick *yucatanensis* Cameron
8. SGP broad, nearly flat, apex broadly rounded or subtruncate (figs. 189, 191) 9
SGP tectiform, apex narrowly rounded or subacute (figs. 190, 192) 10
9. SGP (fig. 191) with weak median elevation; genitalia with setae of digitus clubbed (fig. 196) *medianus* Banks
SGP (fig. 189) with sharp, discontinuous median basal carina; genitalia with setae of digitus simple (fig. 193) *basalis* Banks
10. Anterior wing with 2 SM cells, width of SM2 less than 2 times length (fig. 184); gonostyli with ventral surface uniformly setose (fig. 197) *taeniatus* (Kohl)
Anterior wing with 2 or 3 SM cells, width of SM2 or SM2 + SM3 greater than 2 times length (fig. 183); gonostyli with ventral surface setose mostly on apical third 11

11. Anterior wing with 2 or 3 SM cells; width of SM2 or SM2 + SM3 2.0-2.5 times the length; ocellar triangle with front angle equal to or less than a right angle.....12
 Anterior wing with 2 SM cells; width of SM2 usually greater than 2.5 times the length; ocellar triangle broad, front angle greater than a right angle.....13
 12. Metasoma with apical tergum dark, not silvery pubescent; SGP narrow, subangulate at apex (fig. 190); genitalia with digitus clothed with minute setae apically (fig. 194).....*completus* Banks
 Metasoma with apical tergum bearing white integumental

spot and silvery pubescence; SGP broader, more rounded apically (as in fig. 192); genitalia with digitus bearing long setae apically (as in fig. 195).....

borregoensis Evans

13. Antenna with third segment 1.3-1.6 times as long as wide, much shorter than fourth segment; digitus with hairs straight (fig. 195).....*fasciatus* (Smith)

Antenna with third segment 1.6-1.8 times as long as wide, not or only slightly shorter than fourth segment; digitus with hairs long, sinuate (fig. 198).....*yucatanensis* (Cameron)

Aporinellus taeniatus (Kohl)

(Figs. 180, 182, 184, 185, 192, 197; map 66; graph 30)

Pompilus taeniatus Kohl, 1886:315. Holotype female, Mexico, Veracruz: Orizaba (VM).

Pompilus taeniolatus Dalla Torre, 1897:326. New name for *taeniatus* Kohl, thought to be preoccupied.

Aporus ferrugineipes Viereck, 1906:203. Holotype female, Kansas: Clark County (UK).

Aporinellus rufus Banks, 1911 (1912):230. Holotype female, Colorado. Boulder (USNM). NEW SYNONYMY.

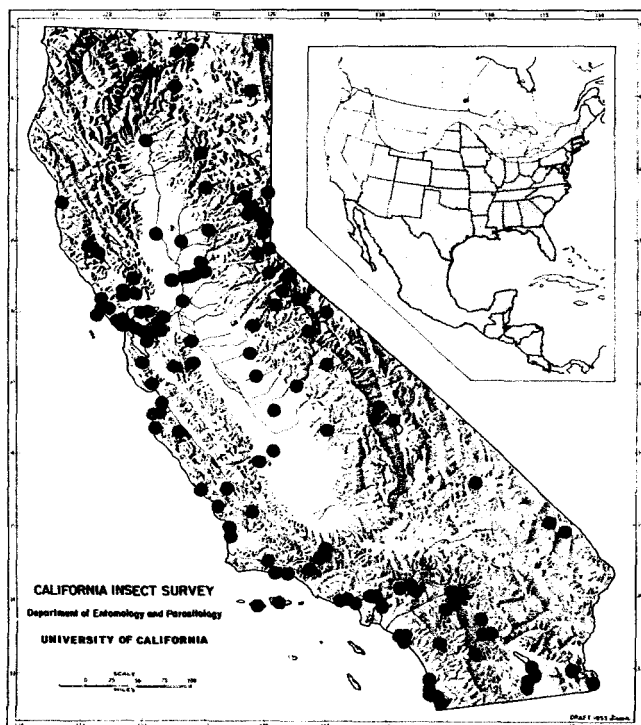
Aporinellus californicus Rohwer, 1917:240. Holotype female, California: Alameda County (USNM).

Aporinellus banksi Bequaert, 1919:118. Holotype female, Texas: Lee County (MCZ).

Aporinellus semirufus Banks, 11929:326. Holotype female, South Dakota: Martin (MCZ).

Aporinellus bequaerti Banks, 1933:3. Holotype female, Texas: El Paso (MCZ).

Geographic range (map 66). — Transcontinental in the United States and from southern British Columbia south to southern Costa Rica.

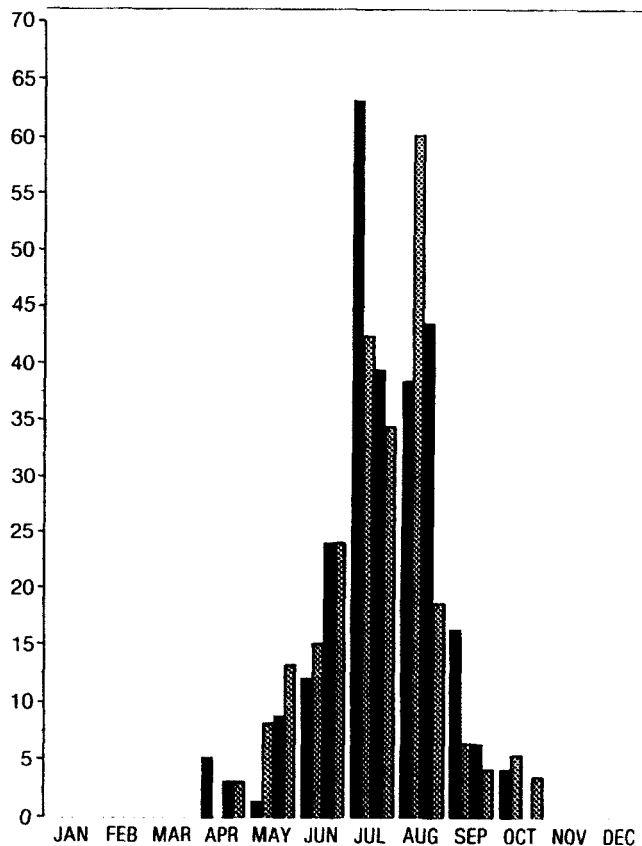


Map 66. California distribution of *Aporinellus taeniatus* (Kohl). Inset: overall distribution.

California distribution (map 66). — Widely distributed and abundant over most of the state in coastal, montane, valley and desert habitats and at elevations from sea level to 2,500 m. This species has been taken on two of the Channel Islands. Santa Cruz: Central Vy., U.C. Field Sta. HQ, 1 ♀, IX-27/28-1978 (R. Coville, CIS); Christi Beach, 1 ♀, IX-27-1978 (J.A. Powell, CIS). Santa Rosa: China Camp — Cluster Pt. area, 1 ♀, VI-8-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); Windmill Cyn. to Black Mt., 100'-1000', 2 ♂♂, VI-9-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); Windmill Cyn., N. Fork, 50'-250', 1 ♂, VI-7-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).

Seasonal occurrence (graph 30). — Recorded in at least small numbers from April through October, reaching peaks in July and August. We have studied 397 females and 317 males of this species.

Aporinellus taeniatus is a highly variable species, in both the color and extent of the patterns



Graph 30. Seasonal occurrence of *Aporinellus taeniatus* (Kohl). Black columns represent females; gray columns are males.

of appressed pubescence and also in integumental color. Females vary from entirely black to extensively banded with whitish or silvery pubescence, and the integumental color may be entirely black or partly to entirely red. Males are always black and are conspicuously banded. Differences in color and pubescence have been the basis for several species and subspecies in the past. We have not seen specimens of *A. taeniatus wheeleri* Bequaert, and this may well fit subspecies criteria, but others appear to us more like random variants or perhaps environmentally selected color forms of a restricted, local nature. For example, the form with a nearly completely red body (*rufus* Banks) has been treated as a subspecies of *taeniatus*, but it has been found in Colorado and Minnesota and is known from two desert localities in California: San Bernardino Co.: 11.2 mi. N. Goffs, 1 ♀, VI-3-1971 (M.E. Irwin, UCR). San Diego Co.: Borrego State Park, Clark Dry Lake, 1 ♀, IV-1-1977 (J. Slansky, M. Wasbauer, MSW). Therefore we have placed the name *rufus* Banks in synonymy. Evans (1966:409) relegated the form with black mesosoma and red legs and metasoma (*semirufus* Banks) to synonymy. This form is known from the northern Great Plains, eastern Texas and the states of Sinaloa, Nayarit and Zacatecas, Mexico. It has also been taken in California: Mono Co.: Mono Lake sand dunes, 6 ♀♀, antifreeze pit trap, VIII-17/XI-21-1979 and VI-17/IX-1-1980 (D. Giuliani, CDFA, MSW); Trench Canyon sand dunes, 2 ♀♀, antifreeze pit trap, VI-7/IX-1-1980 (D. Giuliani, CDFA, MSW). San Bernardino Co.: New York Mountains, T14N-R16E Sec. 30, 1 ♀, VI-5-1976 (T. Griswold, TG).

We have not seen material of *taeniatus baboquivari* Evans, described from Arizona. Since this form is intermediate in extent of reddish integumental color between *semirufus* and *rufus* and since it is known from a single published record, it is likely to be merely another local color form not worthy of formal recognition.

Two additional forms from California should be mentioned. One is similar to *semirufus* but with all legs black except the posterior femur and tibia red. This form is from San Bernardino Co.: San Bernardino Mts., 2 km E. Sugarloaf P.O., 2,100 m, 1 ♀, IX-5-1976 (E. Fisher, CDFA). The other is an all black form uniformly covered with dense golden brown pubescence. It has been taken in San Diego Co.: Warner Springs, Agua Caliente Creek, 3,100 feet, 2 ♀♀, Malaise Trap, 8A-5P, VIII-26/28-1980 (M. Wasbauer, P. Adams, CDFA).

Structural features which will distinguish *taeniatus* from other species of *Aporinellus* are the presence of two submarginal cells in the anterior wing, the second always less than twice as broad

as high, the presence of one to three minute spines on the ventral surface of the ultimate tarsal segment of the female and the ventral surface of the male gonostyli uniformly covered with small setae.

Biology. — Evans (1951a) stated that adults of this species visit honeydew occasionally. We have taken both sexes at honeydew of *Chaitophorus populicola* on *Populus trichocarpa* in Mono County and females at honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata* in Riverside County. Females have also been taken at extrafloral nectaries on the stems of *Gossypium hirsutum* and are known to visit flowers of the following: *Eriogonum* spp., *Euphorbia* sp., *Melilotus albus* and *Prosopis juliflora*. Males have been collected on flowers of *Calochortus luteus*, *Euphorbia albomarginata* and *E. serpyllifolia*. Both sexes have been taken at flowers of *Atriplex semibaccata*, *Foeniculum vulgare* and *Karwinskia Humboldtiana*.

Kurczewski and Kurczewski (1973) describe the burrow of *taeniatus* as constructed in sand at about a 50° angle to the surface, 3 mm in diameter and 5.5 cm long, terminating in an oval cell. They provide the following prey records: *Pellenes agilis* (Banks), immature, *P. borealis* (Banks), immature and *P. viridipes* (Hentz) (Salticidae). Another salticid, *Habronattus calcaratus* (Banks), is reported as prey by Evans (1951a).

Aporinellus medianus Banks

(Figs. 181, 188, 191, 196; map 67; graph 31)

Aporinellus medianus Banks, 1917:97. Holotype female, California: El Cajon (MCZ).

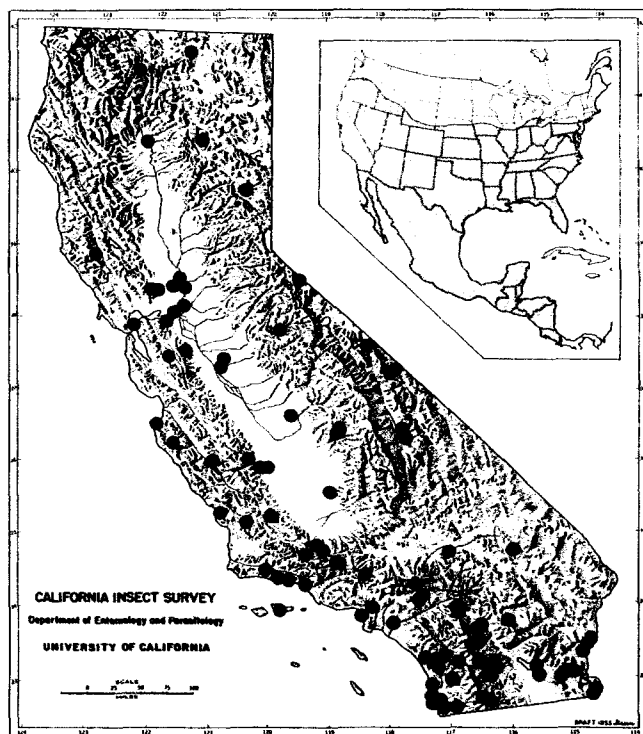
Aporinellus intermedius Banks, 1919:240. Holotype female, California: Claremont (CU).

Geographic range (map 67). — Oregon, Nebraska, Michigan and New York south to southern Costa Rica.

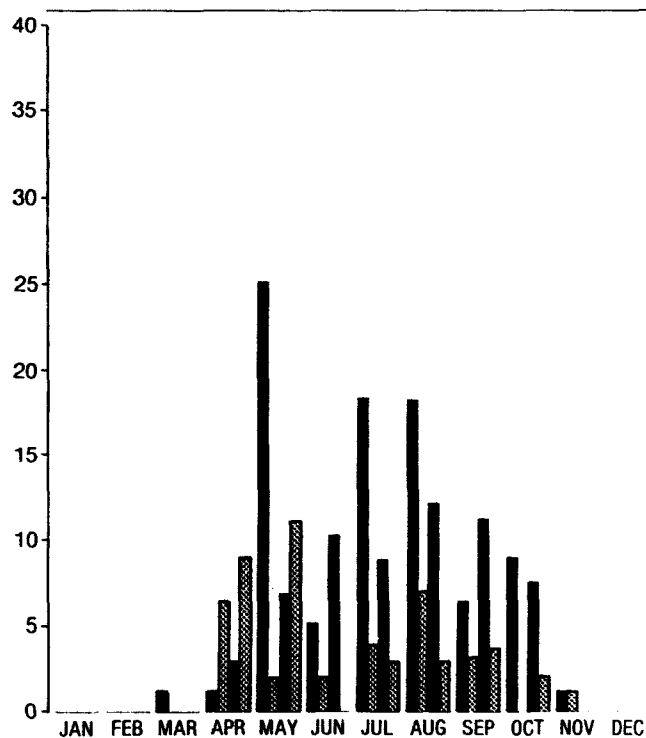
California distribution (map 67). — Most of the state at elevations from sea level to 1,828 m in the Lower Sonoran to Transition zones. This species is common on Santa Cruz Island: Canada del Medio, 16 ♀♀, V-3/12-1968 (R.L. Brumley, D.S. Horning, D.R. Miller, R.O. Schuster, UCD); Christi Beach, 1 ♀, IX-27-1978 (R. Coville, CIS). We have examined 258 females and 130 males.

Seasonal occurrence (graph 31). — Over the entire range there are records from throughout the year, but most of the California records are in May to August. There is a peak for males in May. Thus there may be at least two generations a year in some localities.

Aporinellus medianus is one of a group of species (including *completus*, *borregoensis* and *basalis*) having a narrow ocellar triangle, the front angle of which is 90° or less, and either two or three submarginal cells. The second, or second plus third



Map 67. California distribution of *Aporinellus medianus* Banks. Inset: overall distribution.



Graph 31. Seasonal occurrence of *Aporinellus medianus* Banks. Black columns represent females; gray columns are males.

when three are present, is usually less than 2.5 times as wide as long. In females of *medianus*, the head is more nearly circular, widest about the middle, with the vertex evenly arched above the tops of the eyes. In the other three species, the head is somewhat more transverse, the vertex not as strongly arched above the eyes. Males are readily separated from those of the other North American species by the broad, nearly flat subgenital plate which lacks a well defined, discontinuous median carina.

California females of *medianus* exhibit considerable variation in the extent of the white pubescent markings. The form with greatly reduced markings appears sporadically but seems to be more common in the central and southern coastal regions of the state.

Until fairly recently, this species was widely misidentified as *Aporinellus fasciatus* (Smith). Evans (1966) has discussed the application of the names *medianus* and *fasciatus*.

Biology. — Like most California species of *Aporinellus*, *medianus* is most frequently found in open, sandy situations. Both sexes are often attracted to flowers and sometimes visit honeydew secretions. Evans (1951a) recorded this species taken at flowers of Queen Anne's lace, cotton, thistle, *Rudbeckia* and *Eriogonum*. Floral visitation records we have seen for females include *Haplopappus pinifolius* and *tenuisectus*, *Asclepias*

sp., *Baileya multiradiata*, *Chilopsis* sp., *Eriogonum Thomasii*, *Solidago* sp., and *Stanleya pinnata*. Males have been taken at flowers of *Cleomella* sp., *Euphorbia* sp. and *Oenothera* sp. Females visit honeydew from galls of *Disholcaspis eldoradensis* on *Quercus dumosa* and honeydew on *Chrysothamnus* sp. Both sexes have been taken at extrafloral nectaries of *Gossypium hirsutum*.

Evans and Yoshimoto (1962) summarized published information on nesting behavior and prey of this species. Kurczewski and Kurczewski (1968) provided information on hunting behavior and nests. Females hunt over vegetation near their sandy nesting sites, then construct a short (3 to 6 cm) burrow, often leaving their paralyzed spiders on low plants while excavating the nest. Paralysis of the prey is generally of short duration. The spider is transported by dragging over the ground, the wasp walking backwards and grasping the spider by the mouth-parts. The prey is pulled into the burrow by the spinnerets. Females sometimes try to rob other females transporting their spiders. Burrows under construction are sometimes abandoned, the wasp filling an uncompleted burrow before starting a new one. Prey thus far reported for this species are Oxyopidae: *Oxyopes salticus* Hentz; Salticidae: *Maevia vittata* Hentz, *Phidippus whitmani* Peckham (?), *Phidippus* sp., *Salticus* sp., *Tibellus duttoni* (Hentz); Thomisidae: *Xysticus* sp. near *gulosus* Keyserling.

Aporinellus basalis Banks
(Figs. 12, 186, 189, 193; map 68; graph 32)

Aporinellus basalis Banks, 1933:3. Holotype female, Arizona: Tempe (MCZ).

Aporinellus bridwelli Evans, 1951a:291. Holotype male, Kansas: Clay County (MCZ).

Geographic range (map 68). — California and Oregon east to southern Manitoba, Kansas and Texas, south to southern Costa Rica.



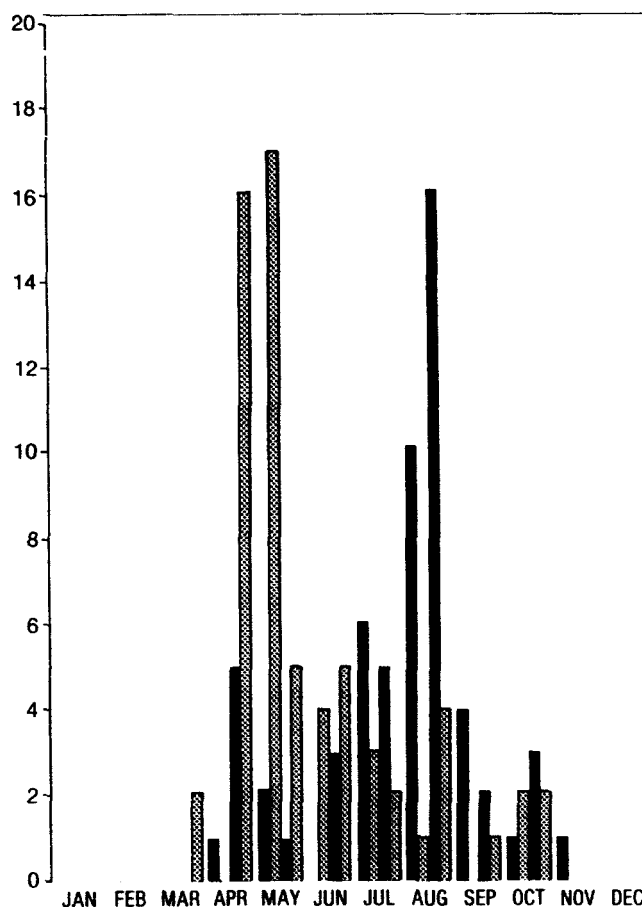
Map 68. California distribution of *Aporinellus basalis* Banks. Inset: overall distribution.

California distribution (map 68). — Sea level to 2,400 m mainly in the Upper and Lower Sonoran zones over most of the state but apparently absent from the north coast. There are records from Santa Cruz Island: Canada del Medio, 5 ♂♂, VI-3/12-1968 (R.L. Brumley, D.S. Horning, R.O. Schuster, UCD).

Seasonal occurrence (graph 32). — Females have been collected from April to November and males from March to October, with peak occurrence of females in August and males in April and May.

Females are quite similar to those of *borregoensis* Evans, but the ocelli are in a more compact triangle and OOL/POL is 0.65-0.80 while in *borregoensis* it is about 0.50.

There is considerable variation in extent of grey pubescent markings in California specimens of *basalis*. Examples from some northern and central California populations can be extensively patterned with grey, with examples from nearby populations almost without any grey pubescence. The amount of reduction seems to be generally greater in the southern portion of the state.



Graph 32. Seasonal occurrence of *Aporinellus basalis* Banks. Black columns represent females; gray columns are males.

Biology. — As in other species of *Aporinellus*, adults of *basalis* frequently visit flowers and other nectar sources. Females have been taken at extrafloral nectaries of *Helianthus* and *Gossypium* and flowers of *Atriplex semibaccata* and *Psoralea* sp. Males have been collected at flowers of *Asclepias* sp., *Croton californicus*, *Eriogonum inflatum*, *Euphorbia polycarpa* and *Larrea* sp.

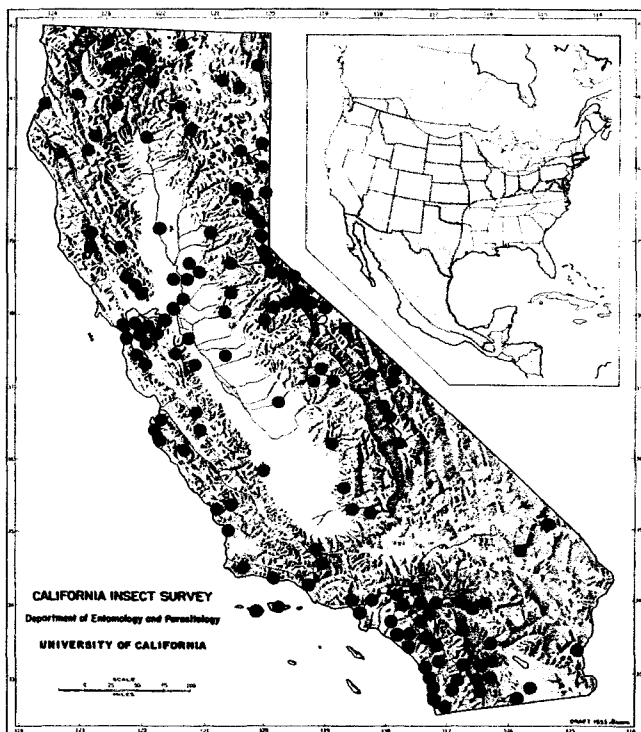
Evans (1959a) provided the only information available on the nesting biology of *basalis*: In June 1956, he collected a female near Riviera, Texas, with a female *Oxyopes helius* Chamberlin (Oxyopidae). The wasp was carrying the spider backward up a sand bank, grasping it near the petiole.

Aporinellus completus Banks
(Figs. 187, 190, 194; map 69; graph 33)

Aporinellus completus Banks, 1917:97. Holotype female, Washington: Lone Tree, Yakima River (MCZ).

Geographic range (map 69). — Transcontinental in the United States and from southern British Columbia and Alberta south to Guatemala. We have not seen material from the southeastern U.S.

California distribution (map 69). — Widespread and abundant over the entire state from sea level to 2,500 m although not commonly encountered in the deserts. This species has been collected on two of the Channel Islands. Santa Cruz: Canada del Medio, 1 ♀, 2 ♂♂, VI-19-1967 (R.L. Brumley, UCD); Christi Beach, 1 ♀, IV-30-1966 (J.A. Powell, CIS); 3 ♀♀, 2 ♂♂, V-5/12-1968 (R.L. Brumley, UCD, M.E. Irwin, UCR); 2 ♀♀, IX-21/22-1968 (D.S. Horning, R.L. Brumley, UCD). Santa Rosa: Beechers Bay area, 1 ♀, 1 ♂, VI-5/6-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); Torrey Pine area, 1 ♀, VI-6-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM); Windmill Cyn., N. Fork, 1 ♂, VI-11-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).



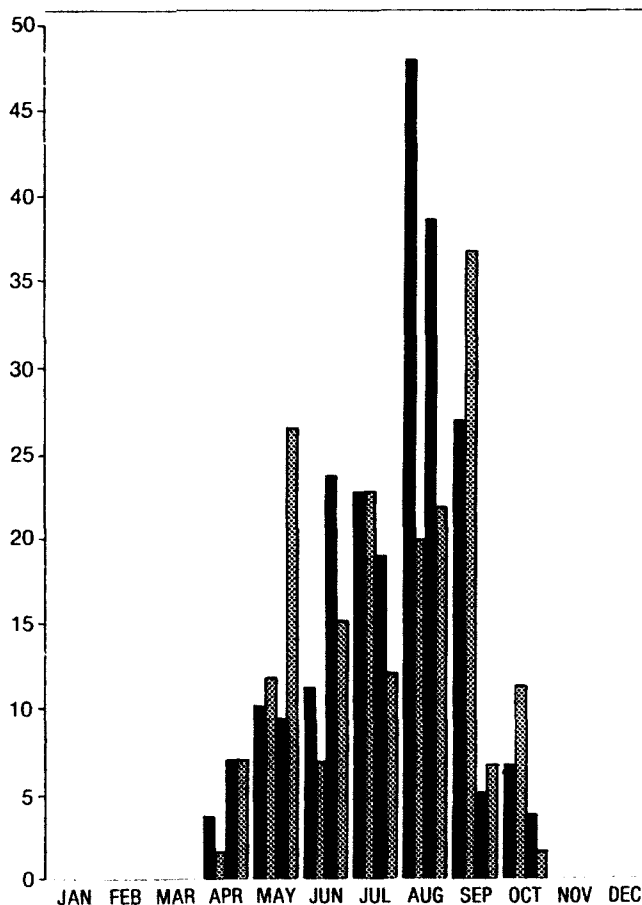
Map 69. California distribution of *Aporinellus completus* Banks. Inset: overall distribution.

Seasonal occurrence (graph 33). — April to October. The majority of specimens of both sexes have been collected in the months of August and September. We have examined 343 females and 305 males.

Females of *Aporinellus completus* are separable from those of *borregoensis* and *basalis* principally by the short, wide clypeus which is about three times as wide as long and by the apical basitarsal comb spine which is about as long as the second tarsal segment. In *borregoensis* and *basalis*, the clypeus is not over 2.7 times as wide as long, and the comb spine at the apex of the anterior basitarsus usually is longer than the second tarsal segment. Males of *completus* have the apical tergum entirely dark, and the subgenital plate is quite narrow and subangulate at the apex. The apical tergum of *borregoensis* males is silvery pubescent and has a distinct white integumental spot. The subgenital plate is broad and more rounded apically.

There is considerable variation in pattern of the grey pubescence in females of this species. Some

specimens are entirely grey, others possess only narrow bands on the metasomal terga and have grey pubescence reduced to a narrow band on the pronotum or absent from the mesosoma entirely. This variation does not appear to have a geographic basis in California, but specimens from Baja California seem to show a greater reduction in the amount of grey pubescence.



Graph 33. Seasonal occurrence of *Aporinellus completus* Banks. Black columns represent females; gray columns are males.

Biology. — Evans (1951a) stated that this species is a frequent visitor to honeydew and has been collected on sunflower and wild carrot. We have seen records of females taken at extra-floral nectaries of *Helianthus annuus* and at flowers of *Acacia Greggii*, *Adenostoma fasciculatum*, *Eriogonum inflatum*, *Euphorbia albomarginata*, *Foeniculum vulgare*, *Hemizonia Lobbii*, *Opuntia* sp. and *Polygonum californicum*. Males have been collected at honeydew of *Disholcaspis eldoradensis* galls on *Quercus lobata* and *Q. dumosa*, at extra-floral nectaries on *Gossypium hirsutum* and on flowers of *Asclepias* sp. Both sexes are recorded visiting honeydew of *Chaitophorus populicola* on *Populus trichocarpa* and flowers of *Baccharis glutinosa*, *Chrysothamnus* sp., *Eriogonum fasciculatum* and *Euphorbia serpyllifolia*.

Krombein (1961) witnessed a female of *completus* filling its nest, located 3 mm beneath the surface of the soil. The wasp egg, 1.1 mm long and 0.5 mm wide, was attached to the abdomen of the spider, an immature *Phidippus clarus* Keyserling. Evans (1951a), Kurczewski and Kurczewski (1968a) and Wasbauer (1983) have provided additional prey records, all Salticidae, as follows: *Evarcha hoyi* (Peckham), *Habrocestum pulex* (Hentz), *Maevia vittata* (Hentz), *Pellenes borealis* (Banks), *Pellenes viridipes* (Hentz), *Pellenes* sp. and *Sitticum palustris* (Peckham).

Aporinellus borregoensis Evans
(Map 70)

Aporinellus borregoensis Evans, 1957:184. Holotype male, California. San Diego County: Borrego (CAS).

Geographic range (map 70). – Desert areas of southern California, Nevada, Utah, Arizona and New Mexico. There is little question that this species occurs in northern Sonora and Baja California although we have seen no Mexican records.

California distribution (map 70). – Deserts from Inyo County south to San Diego County. We have examined 28 females and 33 males of this uncommonly encountered species, taken from March 23 at Borrego, San Diego County to August 17 at Palm Desert, Riverside County.

Females of this little species are similar in many respects to *basalis* Banks, but the posterior ocelli are twice as far from each other as from the eyes (OOL/POL 0.5). In *basalis* the posterior ocelli are

more removed from the eyes (OOL/POL 0.65-0.80). The males resemble *completus* Banks, but the apical metasomal tergum usually is silvery pubescent and has a white integumental spot. In *completus*, the apical tergum is entirely dark.

Nothing is known of the biology except that adults are sometimes attracted to flowers. Both sexes in the type series from Borrego were collected at flowers of *Croton californicus*. In addition females have been collected from flowers of *Cleome serrulata* and *Pluchea sericea*. We have taken males at flowers of *Eriogonum fasciculatum*.

Aporinellus fasciatus (Smith)
(Figs. 183, 195; map 71; graph 34)

Aporus fasciatus Smith, 1855:175. Holotype male, South Carolina: Warm Springs (BMNH).

Pompilus unionis Dalla Torre, 1897:330. New name for *fasciatus* Smith, preoccupied in *Pompilus*.

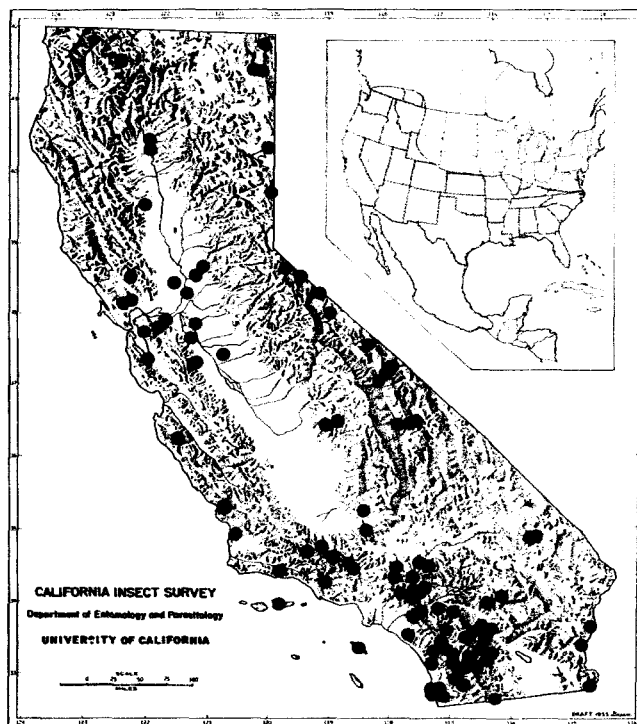
Aporus apicatus Banks, 1910:126. Holotype male, California: Claremont (MCZ).

Geographic range (map 71). – Southern half of the United States south to Chiapas, Mexico. In the west, this species occurs as far north as southern British Columbia and Alberta.

California distribution (map 71). – Widespread over most of the state in the Lower Sonoran to Transition zones at elevations from sea level to 1,737 m. It appears to be absent from the north coast but has been taken on Santa Cruz Island: Canada del Medio, 3 ♀♀, 7 ♂♂, V-6/12-1968 (R.L. Brumley, R.O. Schuster, R. Thorp, UCD); 3 ♀♀, IX-22-1968 (R.O. Schuster, R. Thorp, UCD); Christi Beach, 1 ♂, IX-21-1968 (D.S. Horning, UCD);



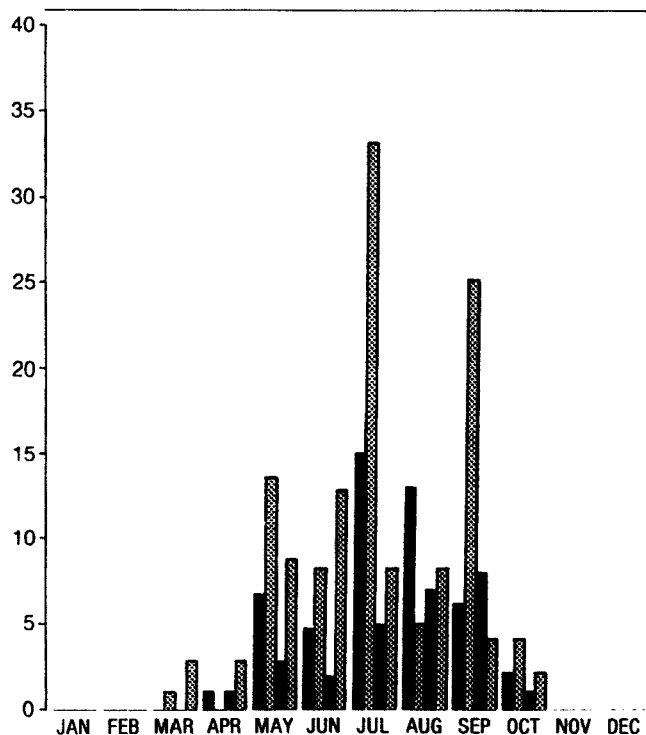
Map 70. California distribution of *Aporinellus borregoensis* Evans. Inset: overall distribution.



Map 71. California distribution of *Aporinellus fasciatus* (Smith). Inset: overall distribution.

La Cascada, 1 ♂, V-4-1968 (D.R. Miller, UCD); Upper Central Valley, 1 ♂, VI-8-1966 (J.A. Powell, CIS). There is one record for Santa Catalina Island: Cape Cyn., 850', 3 ♂♂, VII-3-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).

Seasonal occurrence (graph 34). — Both sexes have been collected from April to October and are most abundant in July. There are a few Mexican records for January and February, indicating that there are continuous, overlapping generations in the southern portion of the range. We have examined 132 females and 218 males.



Graph 34. Seasonal occurrence of *Aporinellus fasciatus* (Smith). Black columns represent females; gray columns are males.

Aporinellus fasciatus shares with *A. yucatanensis* (Cameron) several features indicative of close relationship. The anterior wing always has only two submarginal cells, the second usually at least 2.5 times as wide as long, and the ocelli form a broad triangle, the front angle of which is greater than a right angle. Individuals of both species average a little larger than those of other North American *Aporinellus*.

Females of the two species are separable by the relative lengths of the antennal segments. In *fasciatus* the third segment is 4.5 times as long as wide and 0.64-0.80 the upper interocular distance. The tenth segment is 2.5-3.5 times as long as wide. In *yucatanensis* the antennae are shorter, the third segment 3.2-4 times as long as wide and 0.45-0.68 the upper interocular distance. The tenth segment is 1.6-2.3 times as long as wide. Males of *fasciatus* have the third antennal segment 1.3-1.6 times as long as wide and much shorter than the fourth segment. In *yucatanensis* the antenna of the male

has the third segment 1.6-1.8 times as long as wide and only slightly shorter than the fourth. The male genitalia of the two species are very similar, but in *fasciatus* the hairs on the digitus are only moderately long and straight while in *yucatanensis* they are very long and sinuate (figs. 195, 198).

Females of *fasciatus* from California often have the grey pubescence reduced, and specimens from the southern end of the state frequently are nearly entirely dark with narrow grey bands only on the first two or three metasomal terga. Occasional females have four rather than the usual three basitarsal comb spines.

Adults are often seen running or flying over vegetation and are attracted to flowers and honeydew secretions. Evans (1951a) recorded a female (the allotype of *sinuatus*) visiting honeydew under an oak tree. We have seen the following floral visitation records. Females: *Baccharis viminea*, *Hemizonia pungens*, *Chrysothamnus* sp., *Eriogonum Thomasii*, *Heliotropium curassavicum*, *Melilotus albus* and *Ribes aureum*. Males: *Encelia* sp., *Eriogonum fasciculatum*, *Penstemon* sp. and *Salix* sp. Both sexes are recorded visiting flowers of *Asclepias erosa*, extra-floral nectaries of *Helianthus annuus* and honeydew both on *Chrysothamnus* and on leaves of *Populus trichocarpa*. Males have been taken at honeydew from galls of *Disholcaspis eldoradensis* on *Quercus lobata* and *Q. dumosa*.

Nothing is known of the nesting biology.

Aporinellus yucatanensis (Cameron) (Fig. 198; map 72; graph 35)

Pompilus (*Aporus*) *yucatanensis* Cameron, 1893:189. Holotype female, Mexico. Yucatan: northern part (BMNH).

Aporinellus laticeps Banks, 1911 (1912):230. Holotype female, Colorado: Boulder (USNM).

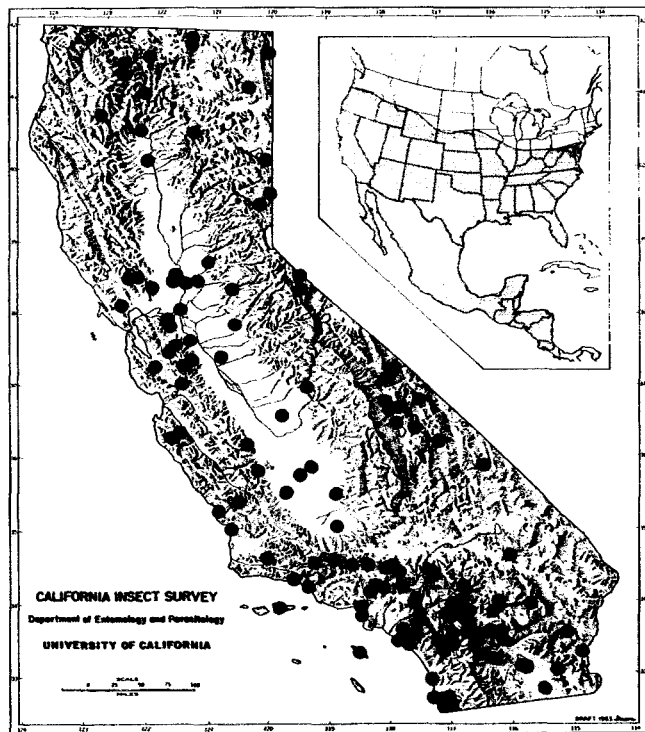
Aporinellus sinuatus Evans, 1951a:298. Holotype male, Texas: Limpia Canyon, Davis Mts. (ANSP).

Geographic range (map 72). — Transcontinental in the United States south to central Costa Rica.

California distribution (map 72). — Abundant and widespread in the state; most frequently encountered in lowland situations to elevations of 1,676 m. There are many records from the southern California montane, the Colorado Desert, south Coast Ranges, Central Valley and Great Basin Ranges. This species is absent from the humid North Coast and from higher elevations in the Sierra Nevada. It has been taken on Santa Cruz Island: Canada del Medio, 5 ♀♀, 3 ♂♂, V-6/12-1968 (R.L. Brumley, D.R. Miller, R.O. Schuster, UCD); 2 ♀♀, VI-16-1967 (D.R. Miller, UCD); 9 ♀♀, 8 ♂♂, IX-21/22-1968 (R.L. Brumley, R.O. Schuster, R.W. Thorp, UCD); Central Valley, 1 ♀, IX-26-1978 (J.A. Powell, CIS); Christi Beach, 1 ♀, V-5-1968 (D.S. Horning, UCD); 2 ♀♀, IX-21-1968 (D.S. Horning, UCD); La Cascada, 1 ♀, IV-8-1968 (R.O. Schuster, UCD); 1 ♀, V-6-1968 (D.R. Miller, UCD); Prisoner's Harbor, 1 ♀, IX-25-1978 (R. Coville, CIS); 2 mi. W. Sandstone Pt., 1 ♀,

VIII-1-1970 (L. Matlovsky, PM). There is one record from Santa Catalina Island: Middle Cyn., 10'-200', 2 ♀♀, VI-29-1978 (A.S. Menke, D.R. Miller, R. Rust, USNM).

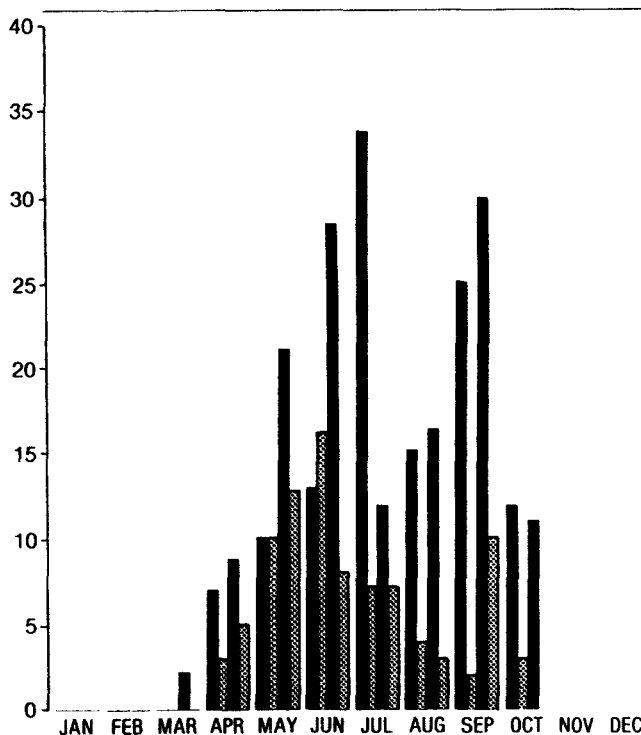
Seasonal occurrence (graph 35). — Females of this species make their appearance in March and occur in numbers through the warmer months and at least at low population levels until October. Males appear in small numbers in April, reach a peak in June and disappear in October. There appear to be several overlapping generations. We have studied 368 females and 176 males.



Map 72. California distribution of *Aporinellus yucatanensis* (Cameron). Inset: overall distribution.

This species is quite similar to *Aporinellus fasciatus*. The characteristics distinguishing *yucatanensis* from *fasciatus* are discussed under the latter species heading.

Biology. Adults are frequent visitors of flowers and honeydew secretions. Evans (1951a) listed as flower visitation records *Heterotheca*, *Helianthus*, *Ratibida*, *Sphaeralcea*, *Gossypium*, *Cleome*, *Eriogonum*, *Euphorbia* and *Tephrosia*. Our records indicate that females visit flowers of *Adenostoma fasciculatum*, *Baileya multiradiata*, *Chrysopsis villosa*, *Chrysothamnus nauseosus*, *Colubrina*



Graph 35. Seasonal occurrence of *Aporinellus yucatanensis* (Cameron). Black columns represent females; gray columns are males.

texensis, *Croton* sp., *Eriodictyon* sp., *Gutierrezia californica*, *Haplopappus venetus*, *Hyptis Emoryi*, *Melilotus albus*, *Senecio Douglasii*, *Sida hederacea*, *Trichostema* sp. and *Wislizenia refracta*. They have also been taken at honeydew of *Disholcaspis eldoradensis* galls on *Quercus lobata* and *Q. dumosa*. Males have been collected from flowers of *Condalia* sp., *Croton californicus*, *Encelia* sp., *Euphorbia* sp., *Lycium Andersonii*, *Tamarix* sp. and *Tetradymia comosa* and also at honeydew on *Chrysothamnus* sp. Both sexes have been taken on flowers of *Asclepias erosa*, *Atriplex semibaccata*, *Chilopsis* sp. and *Eriogonum* sp.

Krombein (1959) provided the only information available on prey and nests of this species: He found a worn female 7.5 mm long just completing a burrow on the barrens beneath a stunted live oak at 0845 in July. Her paralyzed prey, a young female thomisid, a species of *Xysticus*, 4 mm long, was lying on the sand several centimeters from the burrow entrance.

Genus *Allochaeres* Banks

A genus strictly of the southern Nearctic Region, *Allochaeres* is monotypic; the single species, *azureus* (Cresson), occurs from the states of Veracruz and Puebla in Mexico to the southern tier of the United States.

Evans (1951a) suggested an evolutionary relationship between *Allochaeres* and the highly specialized Old World genus *Homonotus*, and although the modifications in *Allochaeres* are not as extreme, the shape of the head and propodeum seems to indicate such a relationship. It is unfortunate that nothing has been reported on the habits of *Allochaeres*, as a knowledge of the biology might shed some light on its position in relation to the Old World homonotine genera.

Recognition of the genus poses no problem. The shape of the head and the very characteristic excavated propodeum, emphasized by the backwardly projecting conical teeth, in addition to the lack of a tarsal comb in the female are characteristic features. The integument is black but exhibits blue or green highlights due to the pubescence. The preceding genus, *Aporinellus*, also is characterized by propodeal teeth but is immediately separable by the nonexcavated propodeum, lack of distinct blue or green highlights, usual presence of light gray pubescence on the body and the shape of the head.

Allochaeres azureus (Cresson)
(Fig. 22; map 73)

Pompilus (*Agenia*) *azureus* Cresson, 1867:131. Holotype female, Mexico: Veracruz (ANSP).

Pompilus sinaloae Cameron, 1893:192. Holotype female, Mexico: Mazatlan (BMNH).

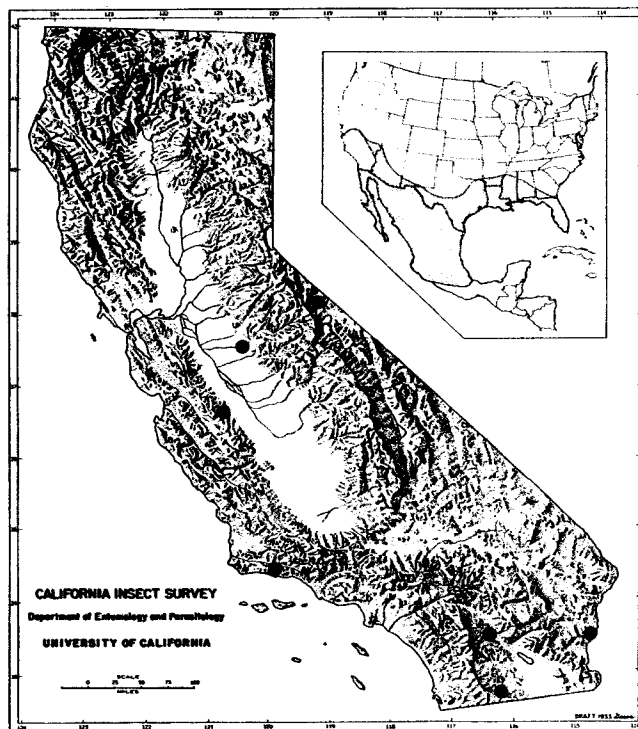
Allochaeres bruesi Banks, 1917:98. Holotype female, Texas: Austin (MCZ).

Geographic range (map 73). — Central Mexico north to the southern United States.

California distribution (map 73). — Fresno Co.: Panoche Creek Canyon, 1 ♂, VI-29-1960 (R.R. Snelling, CIS). Mono Co.: 11 mi. N. Bridgeport, 1 ♀, VII-7-1961 (R.M. Bohart, UCD). Riverside Co.: Blythe, 1 ♀, VIII-2-1946 (P.D. Hurd, CIS); Desert Res. Center, S. of Palm Desert, 1 ♂, V-18-1969, Malaise Trap (M.E. Irwin, UCR). San Diego Co.: Borrego Valley, Palm Canyon, 1 ♂, IV-19-1957 (J.C. Hall, UCD). Santa Barbara Co.: Santa Ynez Mts., 1 ♀, VI-24-1956 (R. Spore, UCD). Stanislaus Co.: La Grange, 1 ♀, VIII-4-1962 (R.P. Allen, CDF).

We have examined only 24 females and 17 males of this uncommon species, of which only four females and three males are from California.

Evans (1951a) reported adults visiting flowers of *Baccharis* and *Solidago*. We have seen females collected at flowers of *Acacia* sp., *Asclepias* sp., *Condalia* sp. and *Hyptis Emoryi* and have taken males at flowers of *Colubrina texensis* in Texas.



Map 73. California distribution of *Allochaeres azureus* (Cresson). Inset: overall distribution.

LITERATURE CITED

- Adlerz, G.
1910. Lefnadsforhallanden och instinkter inom familjerna Pompilidae och Sphegidae. III. Kungl. Svenska Vet.-Akad. Handl., 45:1-75.
- Alcock, J.
1973. Notes on a nesting aggregation of digger wasps in Seattle, Washington. Wasmann J. Biol., 31:323-336.
- Ashmead, W.H.
1902. Classification of the fossorial, predaceous and parasitic wasps or the superfamily Vespoidea. Can. Entomol., 34:79-88.
- Banks, N.
1910. New species of Psammocharidae. J. New York Entomol. Soc., 18:114-126.
1910a. A few new Psammocharidae. Psyche, 17:248-251.
1912 (1911). Psammocharidae: Classification and descriptions. J. New York Entomol. Soc., 19:219-237.
1911a. A tendency toward posterior erythrization in the Psammocharidae. Proc. Entomol. Soc. Wash., 13:238.
1914. New species of Psammocharidae. J. New York Entomol. Soc., 22:300-306.
1917. New fossorial Hymenoptera. Bull. Mus. Comp. Zool., 61:97-115.
1919. The Psammocharidae of western North America. Bull. Mus. Comp. Zool., 63:229-248.
1919a. New Psammocharidae and Philanthidae. Can. Entomol., 51:81-85.
1921. New Nearctic fossorial Hymenoptera. Ann. Entomol. Soc. Amer., 14:16-26.
1926. Several new species of Psammocharidae. Can. Entomol., 58:201-203.
1929. Four new species of Psammocharidae. Psyche, 36:326-327.
1933. New Psammocharidae from the United States. Psyche, 40:1-19.
1939. Notes and descriptions of native Psammocharidae. Can. Entomol., 71:225-231.
1941. A partition of our *Cryptochilus*, with some new Psammocharidae. Can. Entomol., 73:119-122.
1944. Psammocharidae, notes and descriptions. Bull. Mus. Comp. Zool., 94:167-187.
1944a. Psammocharidae taken at Kartabo and other localities in British Guiana. Zoologica, 29:97-112.
1945. Two new species of Psammocharidae. Psyche, 52:105-106.
1947. Studies of South American Psammocharidae. I. Bull. Mus. Comp. Zool., 99:371-488.
- Bequaert, J.
1919. The Nearctic Psammocharidae of the genus *Aporinellus* Banks. Psyche, 26:115-123.
- Bradley, J.C.
1944. A preliminary revision of the Pompilinae (exclusive of the tribe Pompilini) of the Americas. Trans. Amer. Entomol. Soc., 70:23-157.
1944a. The generic position of certain Mexican Pompilidae, with descriptions of a new genus. Notulae Nat. Acad. Nat. Sci., Philadelphia, 145:1-12.
- Brimley, C.S.
1936. The Psammocharidae or spider wasps of North Carolina. J. Elisha Mitchell Sci. Soc., 52:107-131.
- Cameron, P.
1893. Pompilides, Scoliides. In Godman, F.D. and Salvin, O. Biologia Centrali-Americana, Insecta, Hymenoptera, 2:177-256.
- Cresson, E.T.
1865. On the Hymenoptera of Cuba. Proc. Entomol. Soc. Philadelphia, 4:1-200.
1865a. Catalogue of Hymenoptera in the collection of the Entomological Society of Philadelphia, from Colorado Territory. Proc. Entomol. Soc. Philadelphia, 4:426-488.
1867. Notes on the Pompilidae of North America. Trans. Amer. Entomol. Soc., 1:85-150.
1869. Notes on Mexican Pompilidae with descriptions of new species. Proc. Boston Soc. Nat. Hist., 12:366-380.
- Dahlbom, A.G.
1843. Hymenoptera Europaea praecipue borealia; formis typicus nonnullis specierum generumve exoticorum aut extraneorum propter nexum systematicum associatis; per familias, genera, species et varietates disposita atque descripta. 172 pp. Lundbergiana, Lund.
1845. Same title. Supp. 1. Sphex in sensu Linnaeano. xlv + 528 pp. Lundbergiana, Lund.
- Dalla Torre, C.G. de
1897. Catalogus Hymenopterorum hucusque descriptorum systematicus et synonymus, 8:1-749. Leipzig.
- Davidson, A.
1905. An enemy of the trap door spider. Entomol. News, 16:233-234.
- Day, M.C.
1974. A contribution to the taxonomy of the genus *Anoplius* Dufour (Hymenoptera: Pompilidae) including a revision of the Palearctic subgenus *Orientalanoplius* Haupt. Bull. British Mus. (Nat. Hist.), Entomol. Ser., 30:375-404.
1977 (1976). Notes on some Pompilidae (Hymenoptera) of incorrectly reported type-locality. Entomol. Mon. Mag., 112:71-74.

1981. A revision of *Pompilus* Fabricius, with further nomenclatural and biological considerations. Bull. British Mus. (Nat. Hist.), Entomol. Ser., 42:1-42.
- Dreisbach, R.R.
1949. A new genus of the subfamily Psammocharinae with descriptions of eight new species and a key to the species. Amer. Midland Nat., 42:722-743.
- 1949a. Psammocharini of North America and the Antilles: Keys to genera; new species and key to males of *Pompilinus*. Entomol. Amer., 29:1-58.
1950. New species in the genera *Anoplius*, *Pycnopompilus* and *Streptosella*, n. gen. with keys and microphotographs of the genitalia of the males of these genera and *Agenioideus* for North America and the Antilles. Amer. Midland Nat., 43:570-599.
1952. A new species of the genus *Euplaniceps* from California with microphotographs of the genitalia of the two males of the genus. Entomol. News, 63:94-97.
- 1952a. Additional new species in the genera *Anopompilinus*, *Anoplius*, *Pompilinus* and *Pycnopompilus* and corrections of previous papers. Amer. Midland Nat., 48:145-160.
1954. Two new species and a new variety in the genus *Arachnophroctonus* with photomicrographs of the genitalia and subgenital plate for the genus and for several other species. Amer. Midland Nat., 52:437-442.
1957. A new species in the genus *Arachnophroctonus* with photomicrographs of the genitalia and subgenital plate. Entomol. News, 68:72-75.
1958. Two new species in the genus *Pompilinus* with photomicrographs of the genitalia and subgenital plate of the male. Entomol. News, 69:61-65.
- Eberhard, W.
1970. The predatory behavior of two wasps, *Agenioideus humilis* and *Sceliphron caementarium* on the orb weaving spider *Araneus cornutus*. Psyche, 77:243-251.
- Essig, E.O.
1926. Insects of Western North America. xi + 1035 pp. The Macmillan Co., New York.
- Evans, H.E.
1947. Two new spider wasps from southwestern United States. Entomol. News, 58:10-16.
1948. A new subgenus of *Pompilus*. Proc. Entomol. Soc. Wash., 50:141-149.
- 1948a. Two new southwestern spider wasps. Pan-Pac. Entomol., 24:123-130.
- 1948b. Biological notes on two species of *Anoplius*. Entomol. News, 59:180-184.
1949. The strange habits of *Anoplius depressipes* Banks: a mystery solved. Proc. Entomol. Soc. Wash., 51:206-208.
1950. A taxonomic study of the Nearctic spider wasps belonging to the tribe Pompilini. I. Trans. Amer. Entomol. Soc., 75:133-270.
- 1950a. The genus *Allaporus* Banks: notes and descriptions. Entomol. News, 61:1-5.
1951. A taxonomic study of the Nearctic spider wasps belonging to the tribe Pompilini. II. Genus *Anoplius* Dufour. Trans. Amer. Entomol. Soc., 76:207-361.
- 1951a. A taxonomic study of the Nearctic spider wasps belonging to the tribe Pompilini. III. Trans. Amer. Entomol. Soc., 77:203-342.
1953. The Mexican species of the genus *Pompilus*. Ann. Entomol. Soc. Amer., 46:529-543.
- 1953a. Comparative ethology and the systematics of spider wasps. Syst. Zool., 2:155-172.
1954. The genus *Psorthaspis* on the Mexican Central Plateau. Amer. Mus. Novitates, 1162:1-18.
1957. Three new California spider wasps. Pan-Pac. Entomol., 33:181-186.
1959. The larvae of Pompilidae. Ann. Entomol. Soc. Amer., 52:430-444.
- 1959a. Prey records for some midwestern and southwestern spider wasps. J. Kansas Entomol. Soc., 32:75-76.
1961. Notes on the distribution and biology of *Tastiotenia festiva*. Southwest. Nat., 6:51-52.
1963. Notes on the prey and nesting behavior of some solitary wasps at Jackson Hole, Wyoming. Entomol. News, 74:233-239.
1964. Notes on the prey and nesting behavior of some solitary wasps of Mexico and southwestern United States. J. Kansas Entomol. Soc., 37:302-307.
1965. Studies on Neotropical Pompilidae. I. The Genus *Agenioideus* Ashmead in South America. Breviora, 234:1-7.
1966. A revision of the Mexican and Central American spider wasps of the subfamily Pompilinae. Mem. Amer. Entomol. Soc., 20:1-439.
- 1966a. Some unusual prey records for Pompilidae. Proc. Entomol. Soc. Wash., 68:339.
1968. Mexican and Central American Pompilinae: supplementary notes, II. Entomol. News, 79:255-260.
1970. Ecological-behavior studies of the wasps of Jackson Hole, Wyoming. Bull. Mus. Comp. Zool., 140:451-511.
1973. Studies on Neotropical Pompilidae, VIII. The genus *Aporus* Spinola in South America. Studia Entomol., 16:353-370.
- Evans, H.E., K.V. Krombein and C.M. Yoshimoto
1955. An ethological study of *Anoplius* (*Pompilinus*) *fraternus* (Banks). Bull. Brooklyn Entomol. Soc., 50:77-84.
- Evans, H.E., C.S. Lin and C.M. Yoshimoto
1953. A biological study of *Anoplius apiculatus autumnalis* (Banks) and its parasite, *Evagetus mohave* (Banks). J. New York Entomol. Soc., 61:61-78.
- Evans, H.E. and C.M. Yoshimoto
1962. The ecology and nesting behavior of the Pompilidae of the northeastern United States. Misc. Publ. Entomol. Soc. Amer., 3:66-119.
- Fabricius, J.C.
1793. Entomologia systematica emendata et aucta, secundum classes, ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus. II. Char. gener. Hafniae, Proft et Storch. viii + 519 pp.
- Ferton, C.
1897. Nouvelles observations sur l'instinct des pompilides. Act. Soc. Linn. Bordeaux, 52:1-34.
1901. Notes détachées sur l'instinct des Hyménoptères mellifères et ravisseurs. Ann. Soc. Entomol. France, 70:83-148.
1908. Notes détachées sur l'instinct des Hyménoptères mellifères et ravisseurs. 4e. Ser. Ann. Soc. Entomol. France, 77:535-586.
1911. Notes détachées sur l'instinct des Hyménoptères mellifères et ravisseurs. 7e. Ser. Ann. Soc. Entomol. France, 80:351-412.
1921. Notes détachées sur l'instinct des Hyménoptères mellifères et ravisseurs. 9e. Ser. Ann. Soc. Entomol. France, 89:329-375.

- Fox, W.J.
 1891. On a collection of Hymenoptera made in Jamaica during April, 1891. Trans. Amer. Entomol. Soc., 18:337-348.
 1892. Description of four new species of fossorial Hymenoptera from California. Entomol. News, 3:170-172.
 1893. New species of fossorial Hymenoptera. Can. Entomol., 25:113-117.
 1893a. Report on some Mexican Hymenoptera, principally from Lower California. Proc. Calif. Acad. Sci., (2)4:1-25.
 1894. Second report on some Hymenoptera from Lower California, Mexico. Proc. Calif. Acad. Sci., (2)4:92-121.
 1897. Contributions to the knowledge of the Hymenoptera of Brazil, No. 2 - Pompilidae. Proc. Acad. Nat. Sci. Philadelphia, 49:229-283.
- Gwynne, D.T.
 1979. Nesting biology of the spider wasps (Hymenoptera: Pompilidae) which prey on burrowing wolf spiders (Araneae: Lycosidae, Geolycosa). J. Nat. Hist., 13:681-682.
- Haupt, H.
 1941. Resultate der Oxford Universitat Expedition nach Sarawak (Borneo). 1932. Beitrage zur kenntnis der psammochariden-fauna. Ann. Mag. Nat. Hist., (11)7:50-82.
- Howard, L.O.
 1901. The Insect Book. xxx + 429 pp. Doubleday, Page and Co., New York.
- Hurd, P.D., Jr.
 1947. Redescription of *Agenioideus humilis* (Cresson) with notes on its biology. Pan-Pac. Entomol., 23:132-134.
- Hurd, P.D. Jr., and M.S. Wasbauer
 1956. New host records for North American spider wasps (Hymenoptera: Pompilidae). J. Kansas Entomol. Soc., 29:168-169.
- Iwata, K.
 1976. Evolution of Instinct. Comparative ethology of Hymenoptera. x + 535 pp. Illus. Amerind Publ. Co. Pvt. Ltd., New Delhi.
- Jenks, G.E.
 1938. Marvels of metamorphosis. Nat. Geogr. Mag., 74:807-828.
- Kaston, B.J. and E. Kaston
 1953. How to know the spiders. First Ed. vi + 220 pp. W.C. Brown Co., Dubuque.
- Kimsey, L.S.
 1983 (1982). The female of *Pompilus (Ammosphex) wasbaueri* Evans. Pan-Pac. Entomol., 57:109-110.
- Kohl, F.F.
 1886. Neue pompiliden in den sammlungen des K.K. Naturhistorischen Hofsmuseums. Verh. Zool. Bot. Ges. Wien., 36:307-346.
- Krombein, K.V.
 1952. Biological and taxonomic observations on the wasps in a coastal area of North Carolina. Wasmann J. Biol., 10:257-341.
 1953. Kill Devil Hills wasps, 1952. Proc. Entomol. Soc. Wash., 53:113-135.
 1953a. A note on the nesting behavior and prey of *Agenioideus (Agenioideus) humilis* (Cresson). Bull. Brooklyn Entomol. Soc., 48:113-115.
 1958. Biological notes on some wasps from Kill Devil Hills, North Carolina and additions to the faunal list. Proc. Entomol. Soc. Wash., 60:97-110.
 1959. Biological notes on some ground-nesting wasps at Kill Devil Hills, North Carolina, 1958 and additions to the faunal list. Proc. Entomol. Soc. Wash., 61:193-199.
1961. Miscellaneous prey records of solitary wasps. IV. Bull. Brooklyn Entomol. Soc., 56:62-65.
- Kurczewski, F.E.
 1975. Host records for some species of Pompilidae from southwestern United States and Mexico. Pan-Pac. Entomol., 51:147-151.
 1981. Observations on the nesting behaviors of spider-wasps in southern Florida. Florida Entomol., 64:424-436.
- Kurczewski, F.E. and E.J. Kurczewski.
 1968. Host records for some North American Pompilidae (Hymenoptera) with a discussion of factors in prey selection. J. Kansas Entomol. Soc., 41:1-33.
 1968a. Host records for some North American Pompilidae (Hymenoptera). First Supplement. J. Kansas Entomol. Soc., 41:367-382.
 1973. Host records for some North American Pompilidae. Third Supplement. Tribe Pompilini. J. Kansas Entomol. Soc., 46:65-81.
- Malloch, J.R.
 1929. Three new species of the genus *Pedinaspis*. Proc. Entomol. Soc. Wash., 30:100-102.
- Michener, C.D.
 1944. Comparative external morphology, phylogeny and a classification of the bees. Bull. Amer. Mus. Nat. Hist., 82:157-326.
- Morawitz, F.
 1889. Insecta a Cl. G. N. Potanin in China et in Mongolia novissime lecta, IV. Hymenoptera Aculeata. Horae Soc. Ent. Ross., 23:112-168.
- Olberg, G.
 1959. Das verhalten der solitären wespen Mitteleuropas. xiii + 402 pp. Veb Deutscher Ver. Wis., Berlin.
- Pate, V.S.L.
 1946. The generic names of the spider wasps (Psammocharidae olim Pompilidae) and their type species. Trans. Amer. Entomol. Soc., 72:65-137.
- Patton, W.H.
 1879. List of a collection of aculeate Hymenoptera made by S.W. Williston in northwestern Kansas. Bull. U.S. Geol., Geogr. Surv. Terr., 5:349-370.
- Peckham, G.W. and E.G. Peckham
 1898. On the instincts and habits of solitary wasps. Wisconsin Geol. Nat. Hist. Surv. Bull. 2, Sci. Ser. 1, 245 pp.
 1905. Wasps social and solitary. 311 pp. Archibald Constable and Co. Ltd., Haymarket.
- Powell, J.A.
 1957. A note on the nesting habits of *Pompilus (Ammosphex) occidentalis* (Dreischbach). Pan-Pac. Entomol., 33:39-40.
 1958. Biological notes on the burrow and prey of *Anoplius ventralis tarsatus* (Banks). Pan-Pac. Entomol., 34:53-56.
- Priesner, H.
 1966. Studien zur taxonomie und faunistik der Pompiliden Österreichs I. Nat. Jahrb. Stadt Ling., 1966:187-208.
- Provancher, L.A.
 1882. Faune Canadienne. Nat. Can., 13:33-51.
 1887. Additions et corrections au volume II de la faune Entomologique du Canada traitant des Hyménoptères par l'Abbé L. Provancher. Published as supplements in Nat. Can., 165-272.
 1895. Les dernieres descriptions de l'Abbé. Nat. Can., 22:110-112.

- Rau, P.
1922. Ecological and behavior notes on Missouri insects. Trans. Acad. Sci. St. Louis, 24:1-41.
- Rau, P. and N. Rau
1918. Wasp studies afield. 372 pp. Princeton Univ. Press, Princeton.
- Ricards, D.
1969. Observations on predation by the wasp *Anoplius ithaca* on the wolf spider *Pardosa groenlandica*. Entomol. News, 80:149-157.
- Richards, O.W. and A.H. Hamm
1939. The biology of the British Pompilidae. Trans. Soc. British Entomol., 6:51-114.
- Rohwer, S.A.
1917. A report on a collection of Hymenoptera (mostly from California) made by W.M. Giffard. Proc. U.S. Nat. Mus., 53:233-249.
- Say, T.
1837. Descriptions of new species of North American Hymenoptera and observations on some already described. Boston J. Nat. Hist., 1:361-416.
- Schulz, W.A.
1906. Spolia Hymenopterologica. Insel Creta. 355 pp. Paderborn.
- Scopoli, J.A.
1763. Entomologia Carniolica, exhibens Insecta Carnioliae indigena methodo Linnaeana distributa. xxxiv + 420 pp. J.T. Trattner, Vindobonae.
- Smith, F.
1855. Catalog of hymenopterous insects in the collection of the British Museum, Part III. London. 206 pp.
1860 (1861). Description of new genera and species of exotic Hymenoptera. J. Entomol., 1:65-84.
1862. Descriptions of new species of Mexican Pompilidae belonging to the genera *Pompilus*, *Agenia*, *Priocnemis*, *Notocyphus* and *Ferreola*. J. Entomol. Descrip. Geog., 1:395-399.
1864. Descriptions of new species of Brazilian Pompilidae. J. Entomol., 2:263-271.
1879. Descriptions of new species of Hymenoptera in the collection of the British Museum. London, 240 pp.
- Strand, E.
1911. Hymenoptera aus Peru und Ecuador. Arch. Natg. Berlin, 1 (Suppl. 2), 77:141-157.
- Taschenberg, E.
1869. Die Pompiliden des Museums der Universität Halle. Zeit. Ges. Nat. Sachs. Thuring., 34:27-75.
- Tischbein, O.
1850. Verzeichniss der bei Herrstein im Fürstenthum Birkenfeld aufgefundenen Mordwespen (*Sphex* in sensu Linnaeano). Stett. Entomol. Zeitg., 11:5-10.
- Tournier, H.
1889. Etude de quelques Pompilides d'Europe et contrées limitrophes. L'Entomol. Genev., 1:154-178.
- Verhoeff, C.
1892. Ueber einige neue und seltene fossorien. Entomol. Nachr., 18:65-72.
- Viereck, H.L.
1902 (1903). Hymenoptera from southern California and New Mexico with descriptions of new species. Proc. Acad. Nat. Sci., Philadelphia, 54:728-743.
1906. Notes and descriptions of Hymenoptera from the western United States. Trans. Amer. Entomol. Soc., 32:173-247.
- Wahis, R.
1970. Nouvelle contribution à la connaissance des Hyménoptères Pompilides de la Yougoslavie. Bull. Rech. Agron. Gembloux, 5:709-744.
- Wasbauer, M.S.
1955. Observations on the biology of *Anoplius fulgidus* (Cresson). Pan-Pac. Entomol., 31:90-92.
1957. A biological study of *Anoplius* (*Anoplius*) *imbellis* Banks. Wasmann J. Biol., 15:81-97.
1960. Taxonomic and distributional notes on some western spider wasps. Pan-Pac. Entomol., 36:171-177.
1983 (1982). Prey records for some North American spider wasps. Pan-Pac. Entomol., 58:223-230.
- Wasbauer, M.S. and J.A. Powell
1962. Host records for some North American spider wasps, with notes on prey selection. J. Kansas Entomol. Soc., 35:393-401.
- Wilcke, J.
1943. Die Nederlandse Pompilidae. Med. Land. Wageningen, 47:1-88.
- Williams, F.X.
1928. Studies in tropical wasps - their hosts and associates (with descriptions of new species). Hawaiian Sug. Planters' Assoc. Exper. Sta. Bull. (Entomol. Ser.), 19:1-179.
- Wolf, H.
1963. Die nord- und mitteleuropäischen arten der gattung *Anoplius* Dufour, 1834. Opusc. Entomol., 28:129-144.
1967. Wegwespen Finnlands. Acta Entomol. Fennica, 23:1-46.

PLATE 1. The first plate in the series, showing a landscape with a large building and a body of water.

PLATE 2. The second plate in the series, showing a landscape with a large building and a body of water.

PLATES

PLATE I

Figs. 1-4. Labeled diagrams of Pompilini.

Fig. 1. Lateral view of female.

Fig. 2. Frontal view of face.

Fig. 3. Male genital capsule. Left side, ventral; right side, dorsal.

Fig. 4. Mesosomal dorsum.

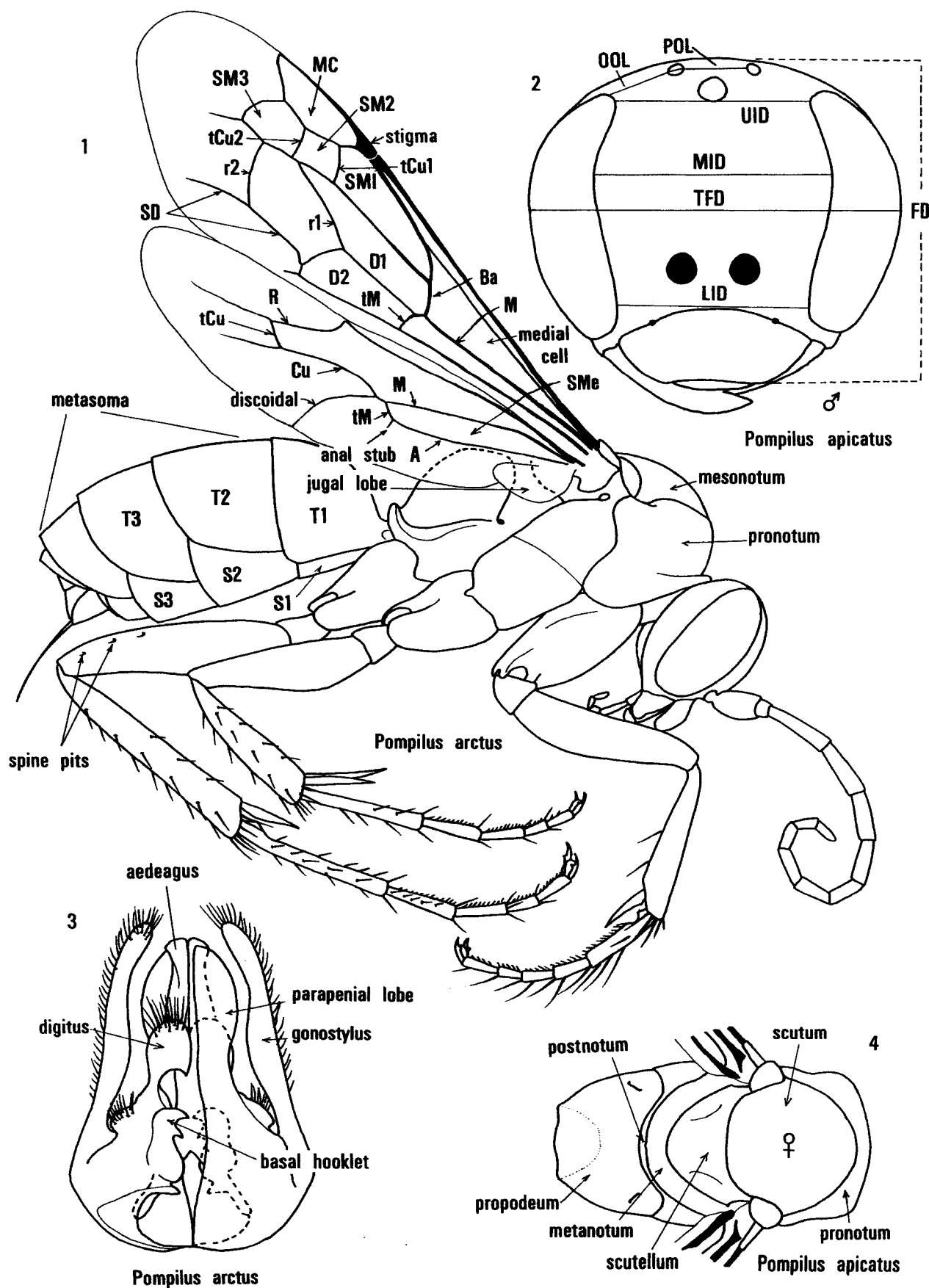


PLATE II

Figs. 5-8, 10-17. Females.

Fig. 9. Male.

Figs. 5-9. Frontal view of face.

Fig. 5. *Ceropales maculata fraterna*.

Fig. 6. *Psorthaspis planata*.

Fig. 7. *Pepsis pallidolimbata*.

Fig. 8. *Allaporus pulchellus*.

Fig. 9. *Tachypompilus ferrugineus torridus*.

Figs. 10-12. Mesosomal dorsum.

Fig. 10. *Sericopompilus neotropicalis*.

Fig. 11. *Tachypompilus ferrugineus torridus*.

Fig. 12. *Aporinellus basalis*.

Figs. 13-14. Apex of metasoma.

Fig. 13. *Pompilus fumipennis eureka*.

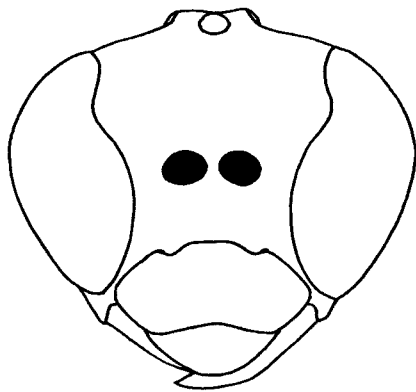
Fig. 14. *Anoplius cleora*.

Figs. 15-17. Apical segment of anterior tarsus, ventral view.

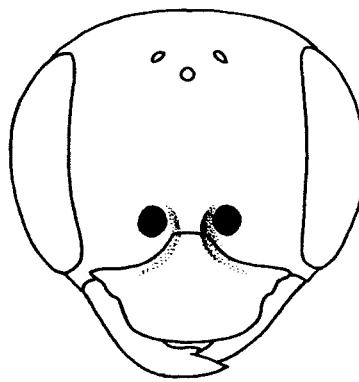
Fig. 15. *Sericopompilus neotropicalis*.

Fig. 16. *Episyrus biguttatus californicus*.

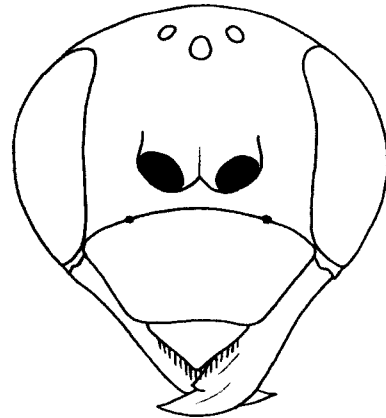
Fig. 17. *Chalcochaes hirsutifemur*.



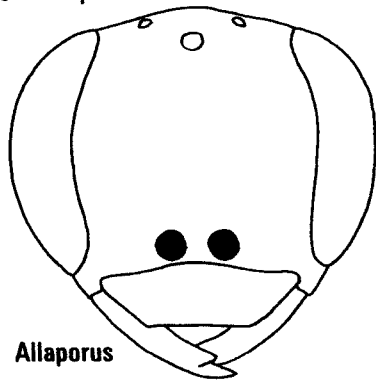
5 Ceropales



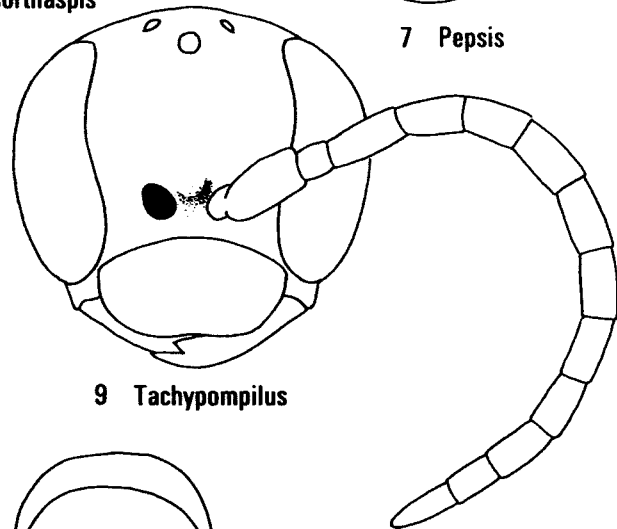
6 Psorthaspis



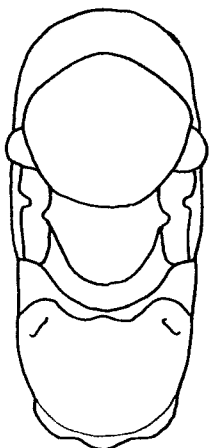
7 Pepsis



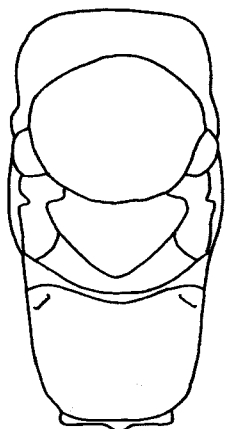
8 Allaporus



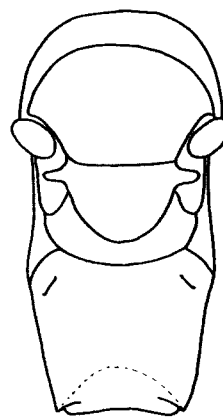
9 Tachypompilus



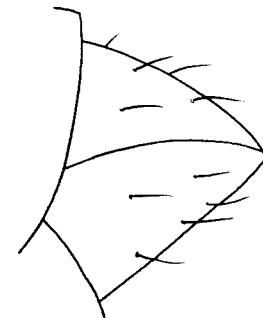
10 Sericopompilus



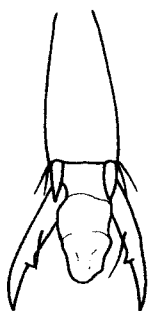
11 Tachypompilus



12 Aporinellus



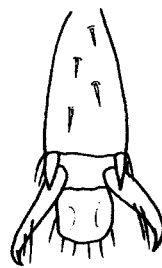
13 Pompilus



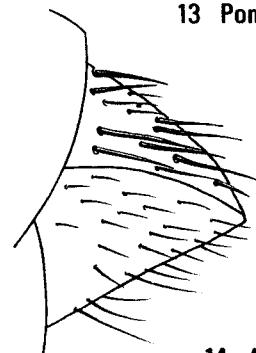
15 Sericopompilus



16 Episyron



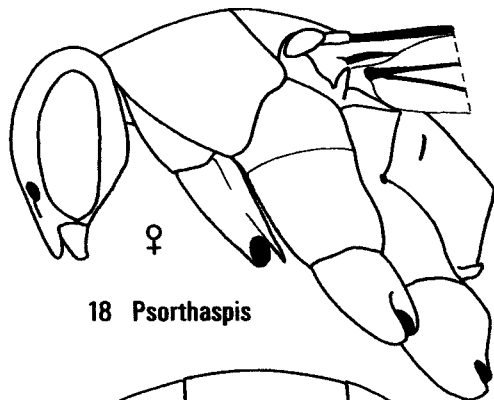
17 Chalcochaes



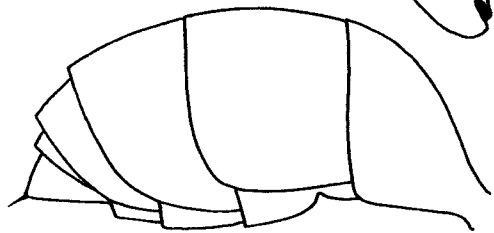
14 Anoplius

PLATE III

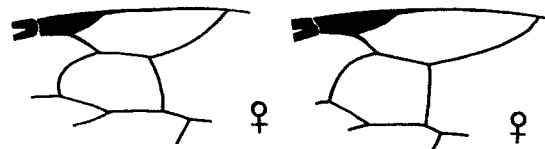
- Fig. 18. *Psorthaspis planata*. Lateral view of head and mesosoma.
Fig. 19. *Ageniella blaisdelli*. Lateral view of metasoma.
Figs. 20-21. Anterior wing, marginal and submarginal cells.
Fig. 20. *Aporus concolor*.
Fig. 21. *Aporus luxus*.
Fig. 22. *Allochaes azureus*. Anterior tarsus.
Figs. 23-24. Posterior tibia.
Fig. 23. *Priocnemis oregona*.
Fig. 24. *Ceropales maculata fraterna*.
Fig. 25. *Ageniella blaisdelli*. Anterior wing.
Figs. 26-28. Anterior and posterior wings.
Fig. 26. *Chalcochaes hirsutifemur*.
Fig. 27. *Tastiotenia festiva*.
Fig. 28. *Allaporus pulchellus*.
Figs. 29-30. *Ceropales maculata fraterna*. Apical metasomal segments.
Fig. 29. Lateral view.
Fig. 30. Ventral view.



18 *Psorthaspis*

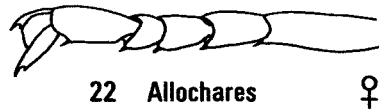


19 *Ageniella* ♀

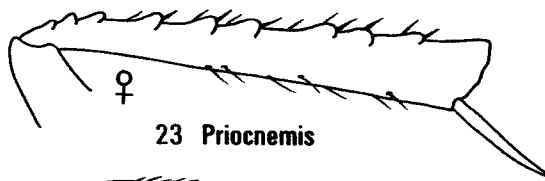


20 *Aporus*

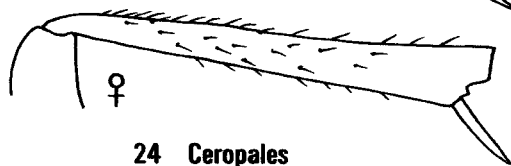
21 *Aporus*



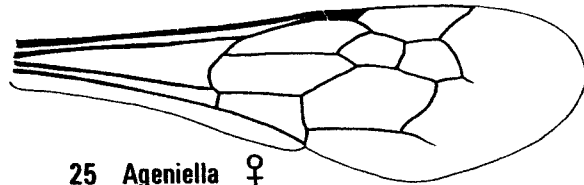
22 *Allochaes* ♀



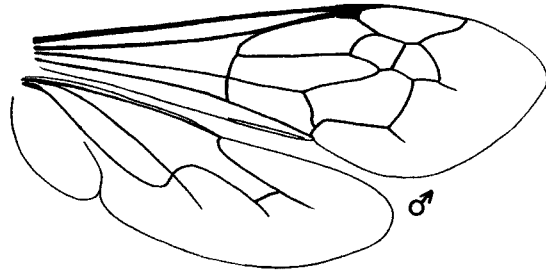
23 *Priocnemis*



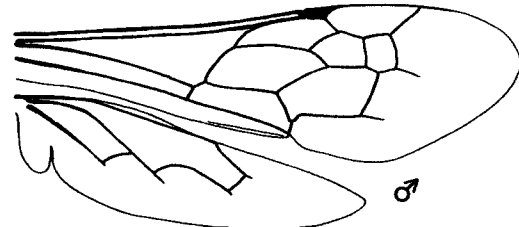
24 *Ceropales*



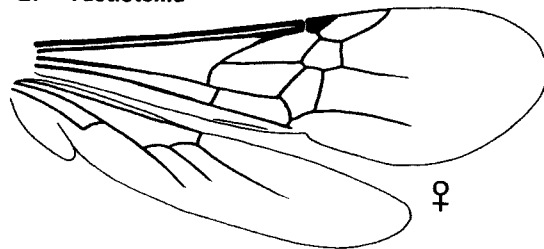
25 *Ageniella* ♀



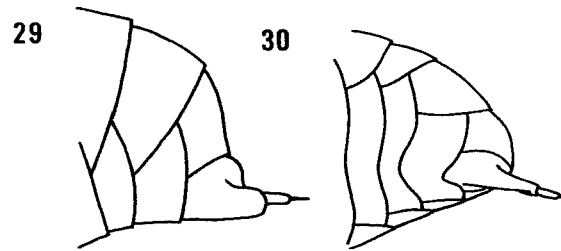
26 *Chalcochaes*



27 *Tastiolenia*



28 *Allaporus*



Ceropales ♀

PLATE IV

Figs. 31-44. *Aporus*.

Figs. 31-33. Face, frontal view.

Figs. 34-35. Anterior tarsus, lateral view.

Figs. 36-37. Posterior wing.

Fig. 38. Lower right portion of face and mandible.

Figs. 39-40. Male genital capsule.

Figs. 41-44. Male subgenital plate.

Figs. 41-42. Ventral view.

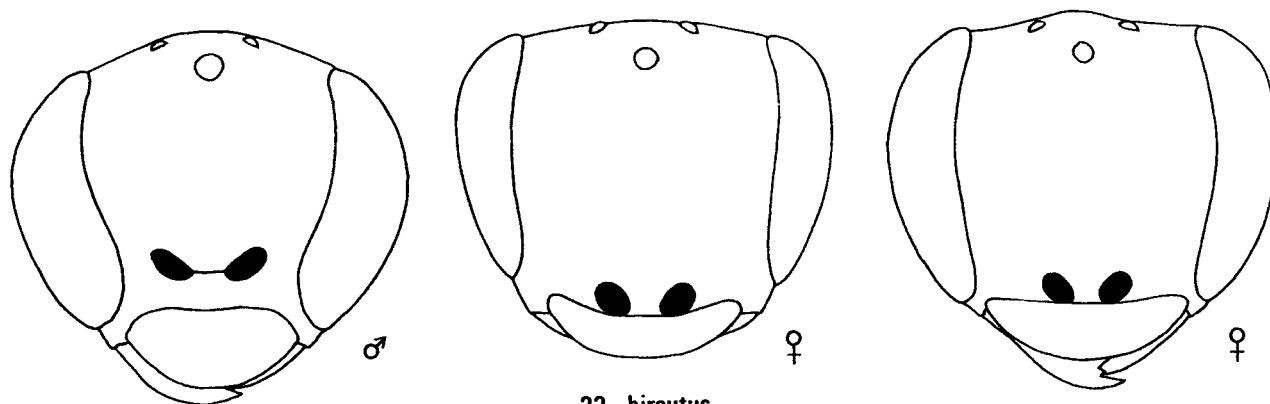
Fig. 43. Lateral view.

Fig. 44. Ventral view of apex and lateral view.

Figs. 45-48. *Poecilopompilus*.

Figs. 45-46. Lower face.

Figs. 47-48. Male genital capsule.



31 concolor

32 hirsutus

33 luxus



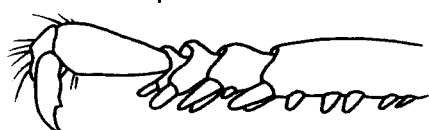
♀ 34 concolor



36 hirsutus ♀



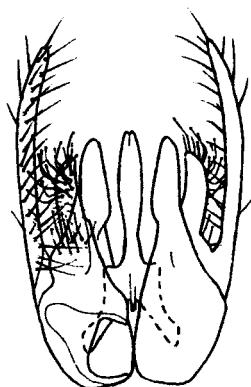
♀ 38 concolor



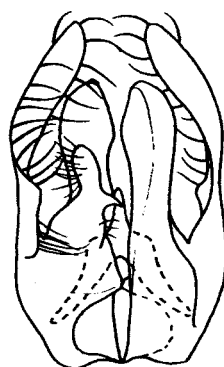
♀ 35 hirsutus



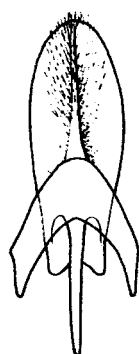
37 luxus ♀



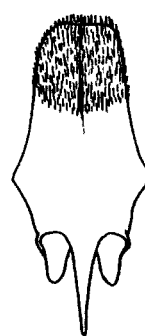
39 concolor



40 luxus



41 concolor



42 luxus



43 luxus



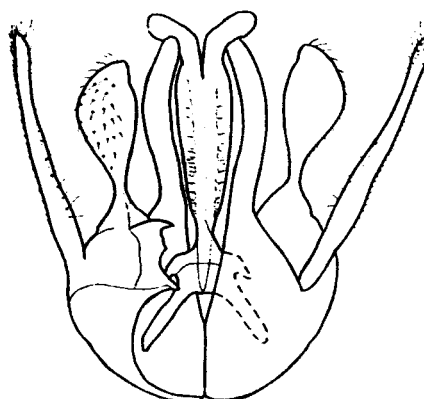
44 hirsutus



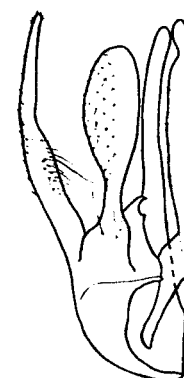
45 algidus coquilletti



46 interruptus interruptus



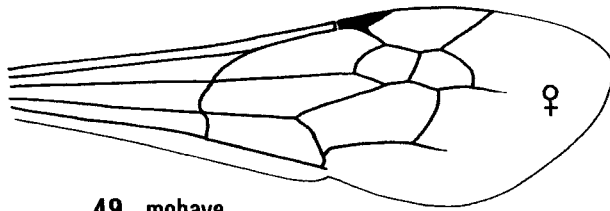
47 algidus coquilletti



48 interruptus interruptus

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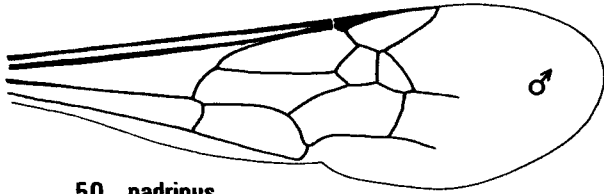
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Figs. 49-50. Anterior wing.
Figs. 51-52. Posterior wing.
Fig. 53. Apical segment of anterior tarsus.
Figs. 54-55. Pronotum, dorsal view.
Figs. 56-60. Male subgenital plate.
Figs. 56-58. Ventral view.
Figs. 59-60. Lateral view.
Figs. 61-66. Male genital capsule.



49 mohave



51 ingenuus



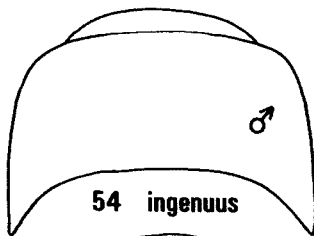
50 padrinus



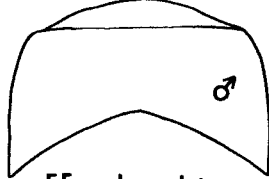
52 parvus



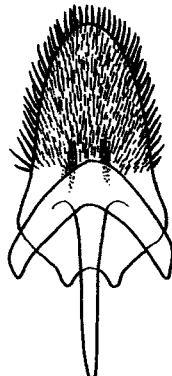
53 parvus ♂



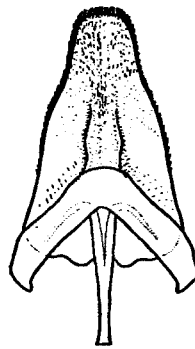
54 ingenuus



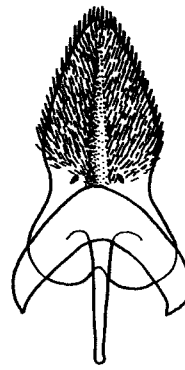
55 subangulatus



56 asignus



57 crassicornis



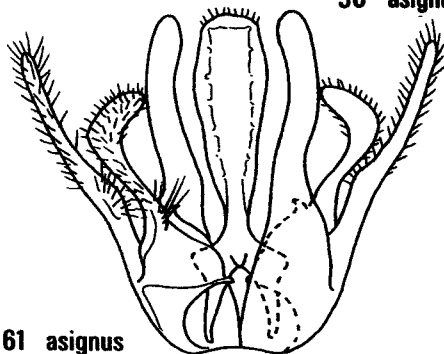
58 macswaini



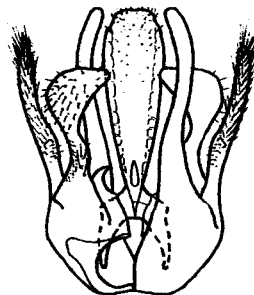
59 ingenuus



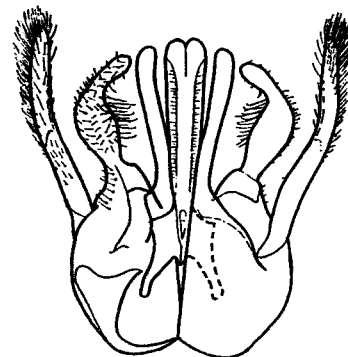
60 padrinus



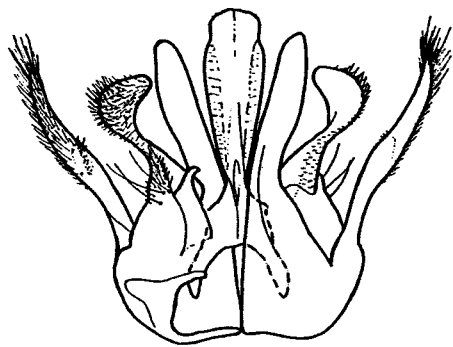
61 asignus



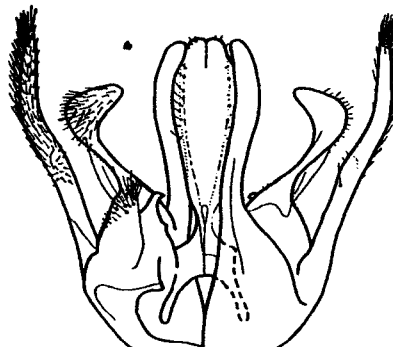
62 calefactus



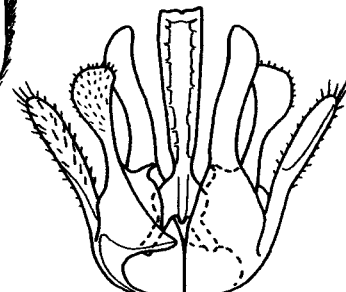
63 crassicornis



64 hyacinthinus



65 ingenuus



66 macswaini

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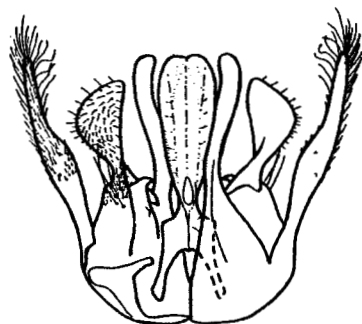
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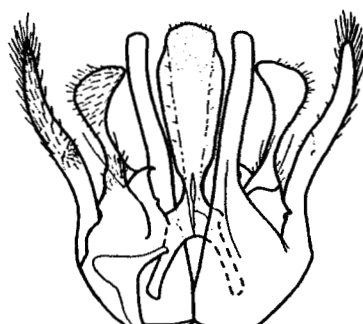
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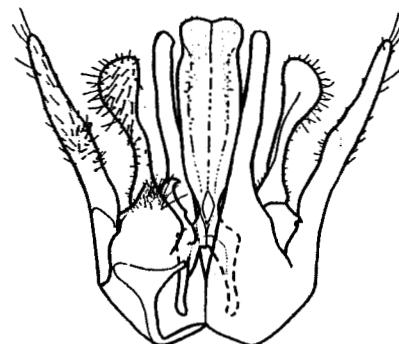
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67 padrinus



68 parvus



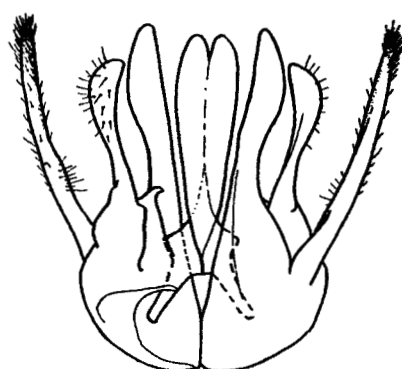
69 subangulatus



70 smithianus ♂



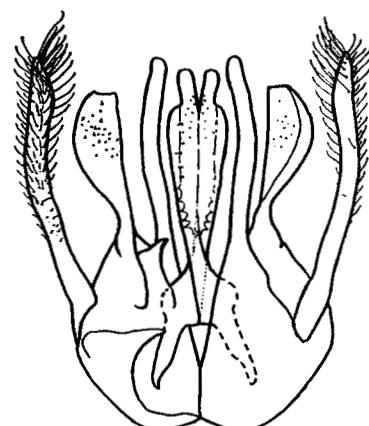
♀ 71 biedermanni



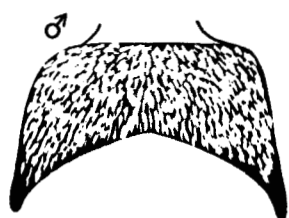
72 biedermanni



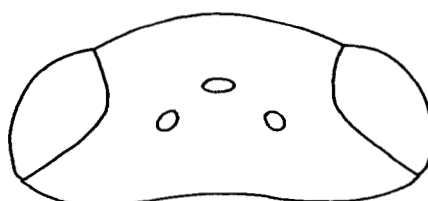
73 birkmanni



74 humilis



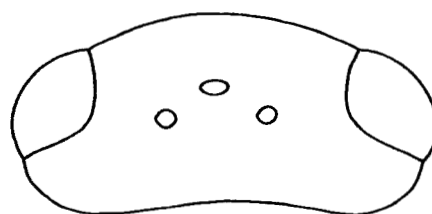
75 quinquenotatus hurdi



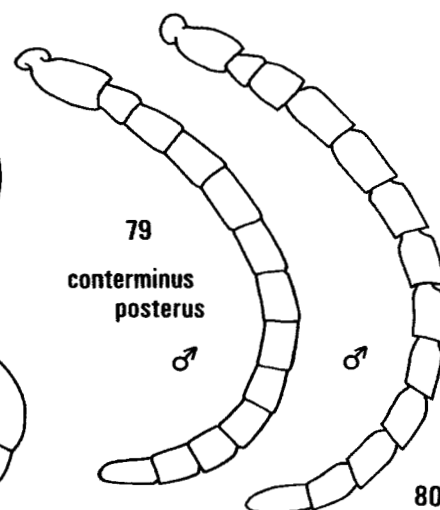
77 biguttatus californicus ♂



76 biguttatus californicus



78 oregon ♂



79
conterminus
posterus

80
snowi

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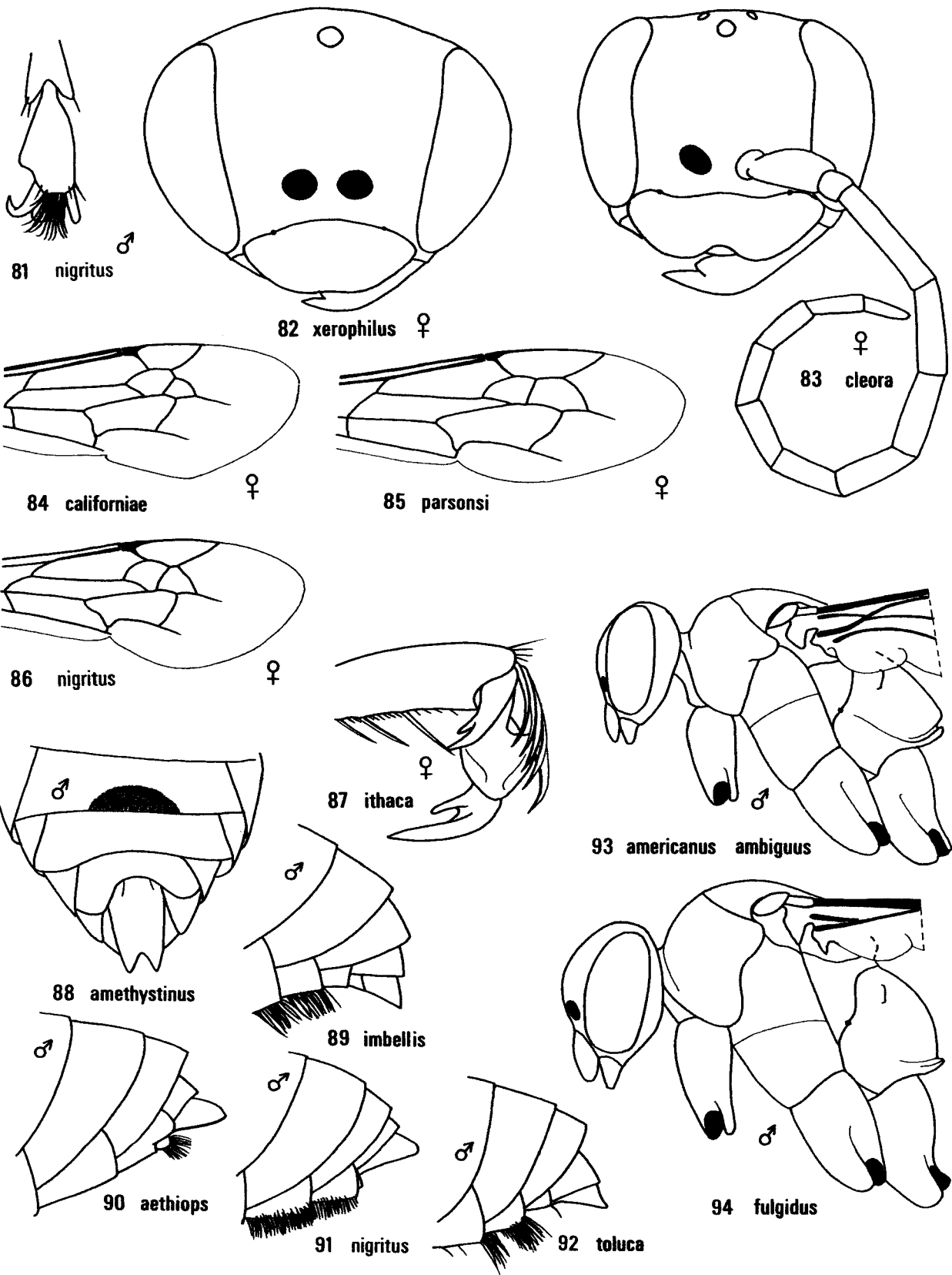


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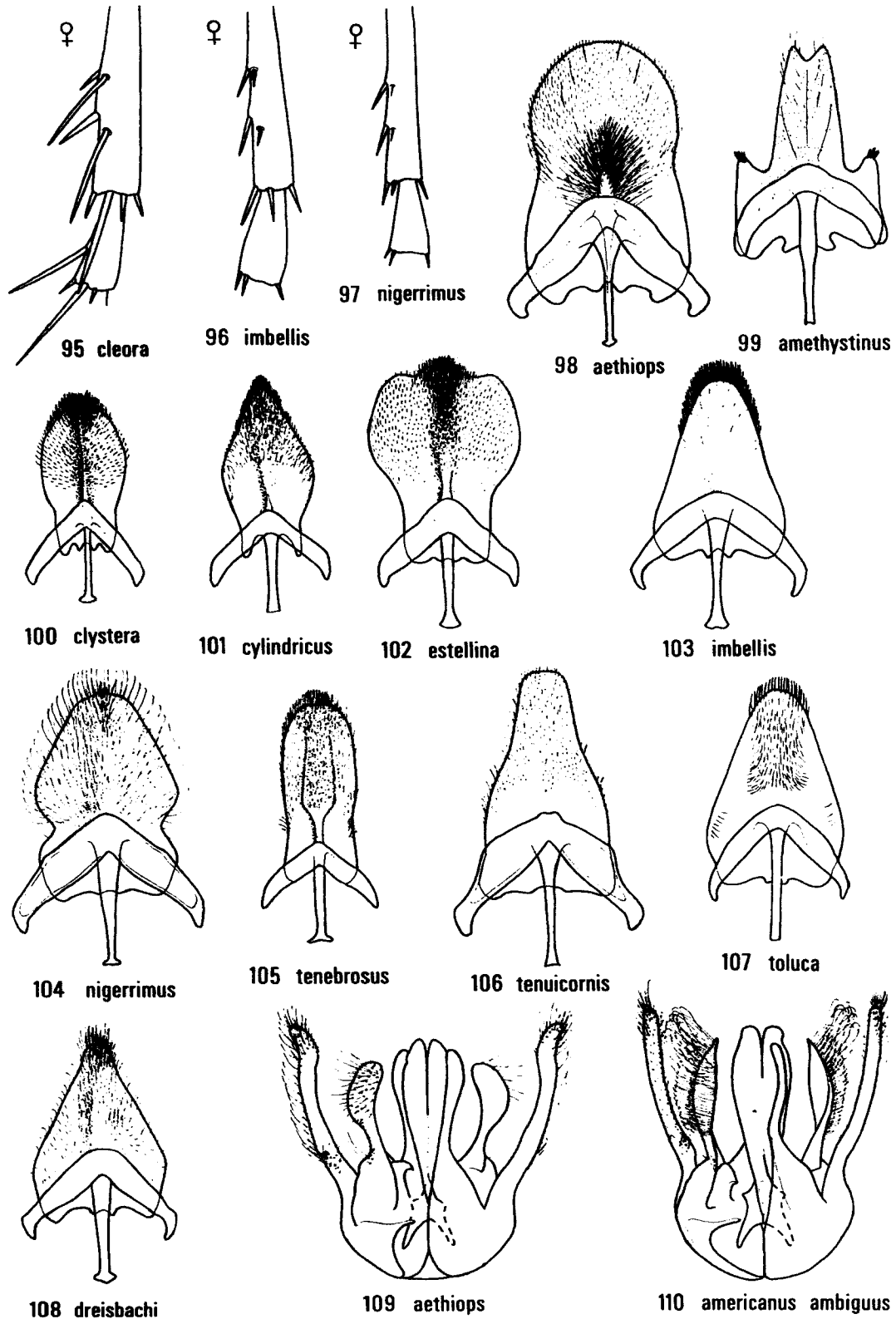


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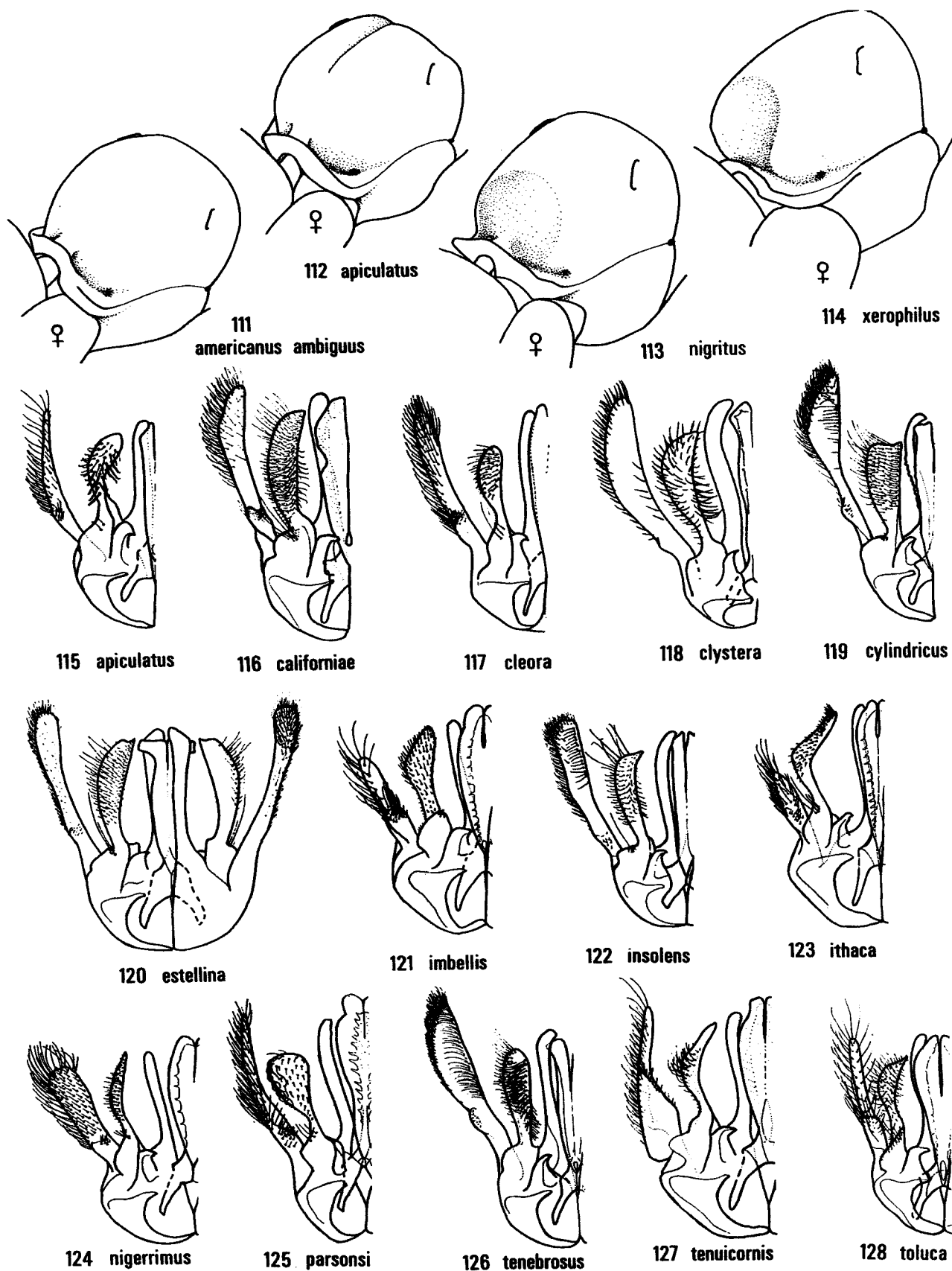


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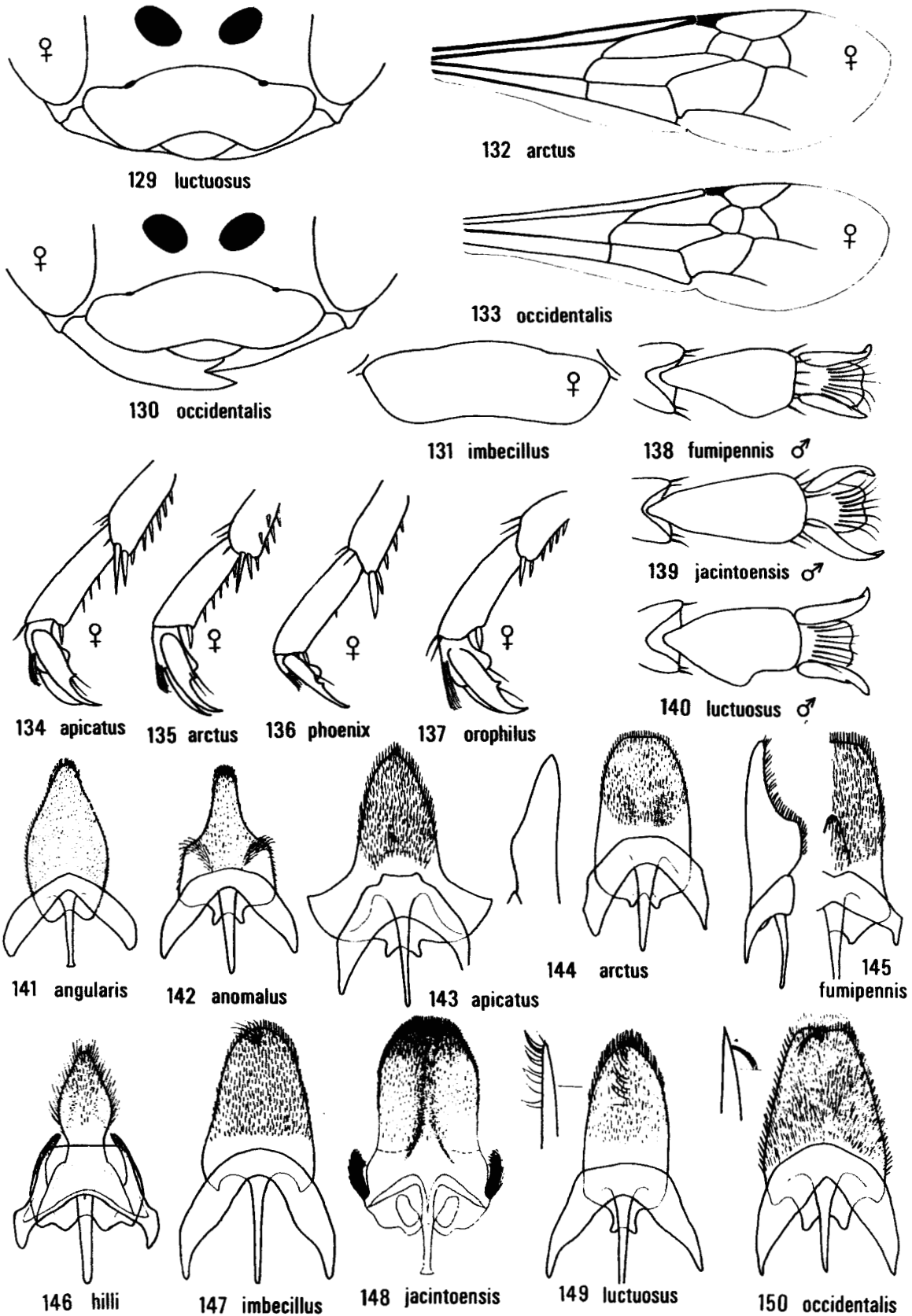


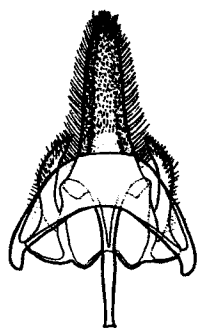
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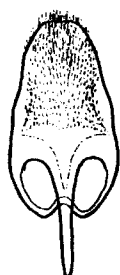
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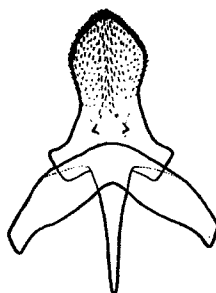
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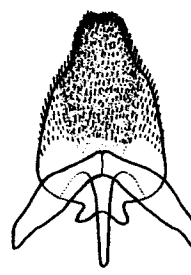
151 orophilus



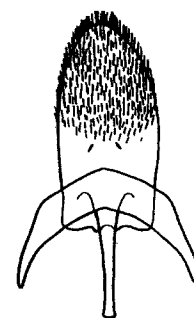
152 pacis



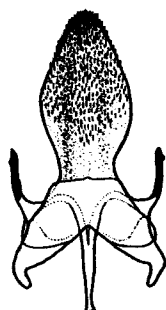
153 phoenix



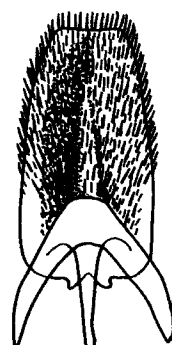
154 parvulus



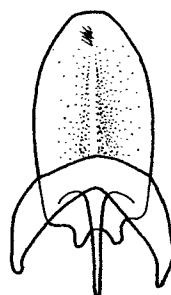
155 perfasciatus



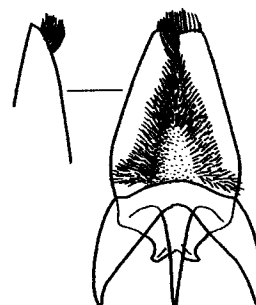
156 rufopictus



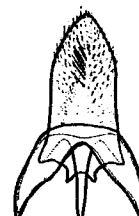
157 scelestus



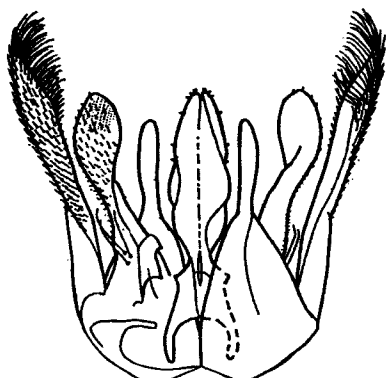
158 silvivagus



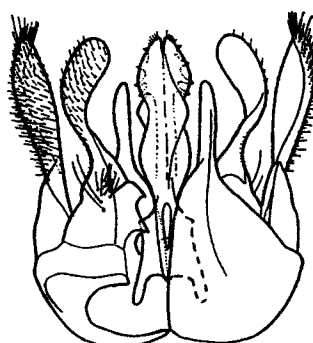
159 solonus



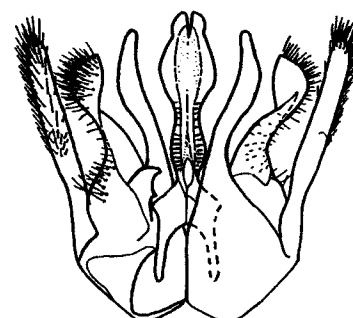
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161 angularis



162 anomalus



163 apicatus



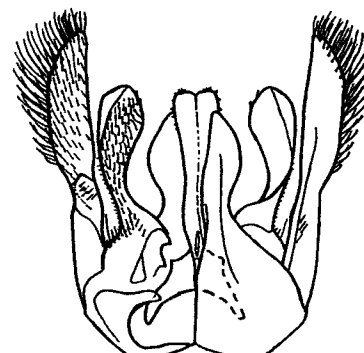
164 fumipennis



165 hilli



166 jacintoensis



167 luctuosus

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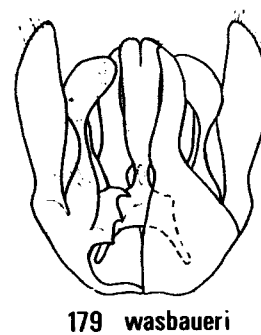
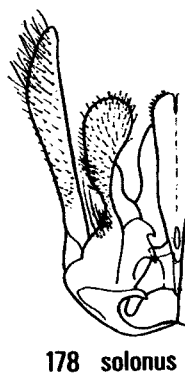
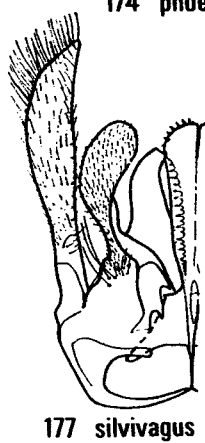
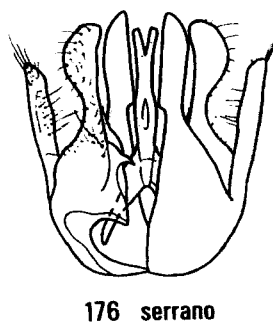
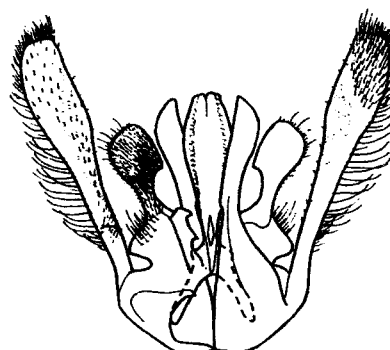
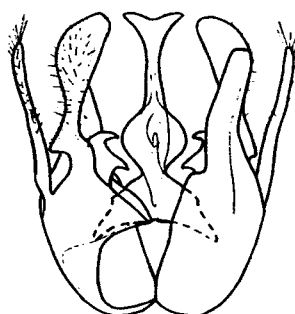
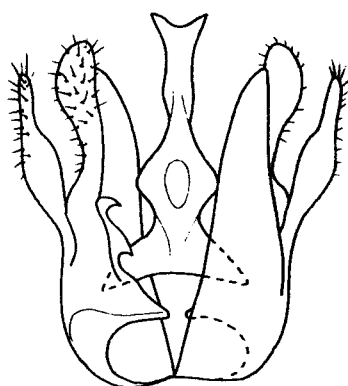
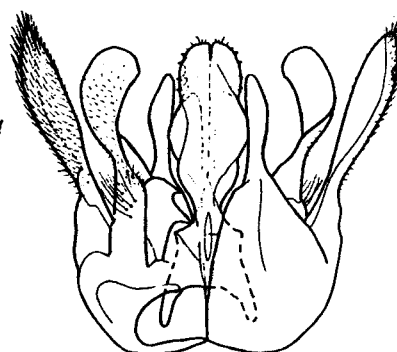
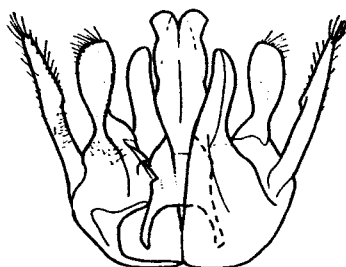
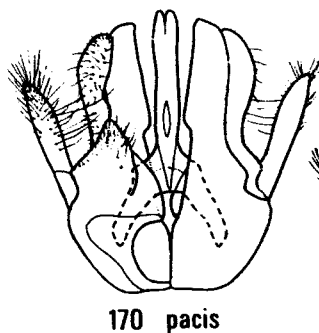
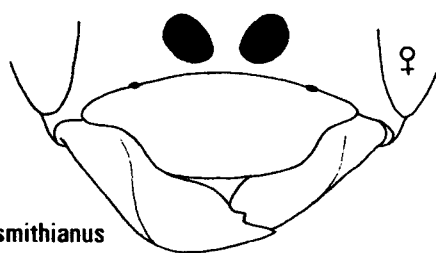
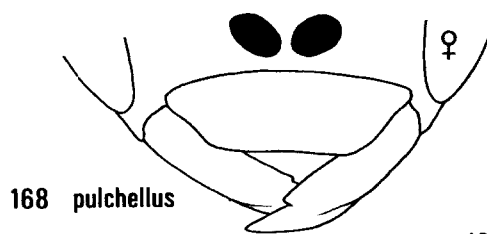


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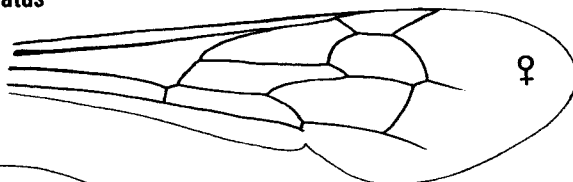
180 taeniatus



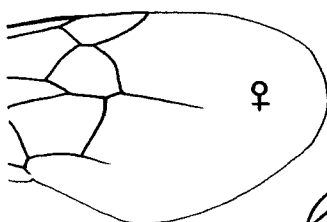
181 medianus



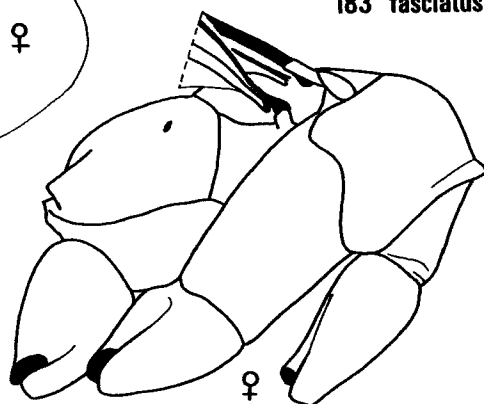
182 taeniatus



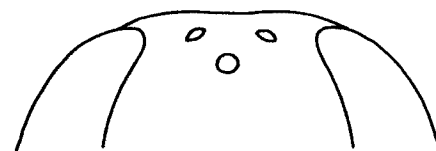
183 fasciatus



184 taeniatus



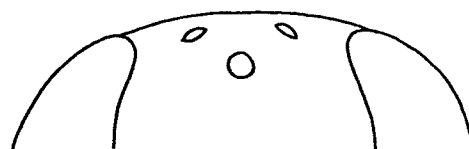
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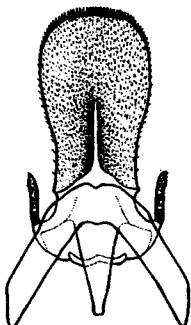
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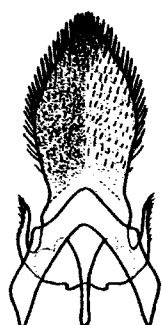
187 completus ♀



188 medianus ♀



189 basalis



190 completus



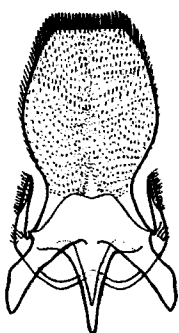
193 basalis



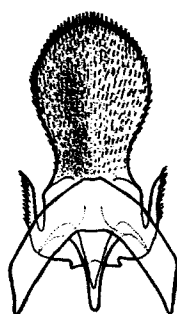
194 completus



195 fasciatus



191 medianus



192 taeniatus



196 medianus



197 taeniatus



198 yucatanensis

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<i>Penstemon</i>	90	<i>Sphaeralcea</i>	53,81,91
<i>Penstemon oreocharis</i>	36	<i>Sphaeralcea angustifolia</i>	28,42,46,51
<i>Petalostemum</i>	81	<i>Sphenosciadium</i>	9
<i>Petalostemum occidentale</i>	46,51	<i>Spiraea</i>	22
<i>Peucetia viridans</i>	49	<i>Stanleya pinnata</i>	86
<i>Phacelia</i>	21	<i>Stillingia</i>	23,34
<i>Phidippus</i>	81,86	<i>Tachardiella cornuta</i>	26,28,32,34
<i>Phidippus clarus</i>	89	<i>Tamarix</i>	9,30,34,42,46,55,91
<i>Phidippus whitmani</i>	86	<i>Tamarix gallica</i>	10,28,32,54
<i>Philodromidae</i>	51	<i>Tellima</i>	52
<i>Pirata sedentarius</i>	59	<i>Tephrosia</i>	91
<i>Pisauridae</i>	57	<i>Tetradymia canescens</i>	30,34
<i>Pluchea</i>	49	<i>Tetradymia comosa</i>	30,91
<i>Pluchea sericea</i>	89	<i>Thanatus formicinus</i>	52
<i>Polygonum</i>	46,49	<i>Theridiidae</i>	23
<i>Polygonum californicum</i>	88	<i>thistle</i>	62,86
<i>Polytaenia Nuttallii</i>	34,46	<i>Thysanella fimbriata</i>	33
<i>Pompilus scelestus</i>	18	<i>Tibellus duttoni</i>	86
<i>Pompilus unguicularis</i>	22	<i>Tibellus gertschi</i>	51
<i>Populus trichocarpa</i>	22,26,77,79,81,82,85,88,90	<i>Trichostema</i>	91
<i>Prosopis</i>	9,23,33,54,55	<i>Trifolium</i>	62
<i>Prosopis juliflora</i>	10,26,31,33,85	<i>Trochosa avara</i>	43,61,80,81
<i>Psilostrophe Cooperi</i>	36	<i>Trochosa pratensis</i>	62,82
<i>Psoralea</i>	87		
<i>Psoralea lanceolata</i>	30		
		<i>Umbellularia</i>	51
<i>Quercus dumosa</i>	86,88,90,91	<i>Urtica holosericea</i>	31
<i>Quercus lobata</i>	9,10,13,21,26,32,39,46,66,67,85,88,90,91		
<i>Ranunculus</i>	52,62	<i>Verbesina</i>	55
<i>Raphanus</i>	55	<i>Vicia</i>	46,62
<i>Ratibida</i>	91	<i>Viguiera deltoidea var. Parishii</i>	14
<i>Rhamnus</i>	31,82		
<i>Rhamnus californica</i>	39	<i>Wislizenia</i>	9
<i>Rhus laurina</i>	46	<i>Wislizenia refracta</i>	23,28,30,32,33,34,36,37,39,51,52,55,91
<i>Ribes aureum</i>	36,42,90		
<i>Robinia</i>	46,47	<i>Xanthium spinosum</i>	39
<i>Rubus vitifolius</i>	62	<i>Xysticus</i>	72,91
<i>Rudbeckia</i>	86	<i>Xysticus cunctator</i>	73
		<i>Xysticus ferox</i>	52
<i>Salix</i>	31,52,59,62,90	<i>Xysticus gulosus</i>	52,86
<i>Salticidae</i>	27,83		
<i>Salticus</i>	86	<i>Yucca</i>	46
<i>Salvia</i>	31	<i>Yucca elata</i>	47
		<i>Yucca Whipplei</i>	74