A KEY TO NORTH AMERICAN SPECIES OF TRIOXYS HALIDAY (HYMENOPTERA: BRACONIDAE: APHIIDIINAE), WITH A SUMMARY OF THE GEOGRAPHIC DISTRIBUTION, HOSTS, AND SPECIES DIAGNOSTIC FEATURES

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Abstract.—A key to North American species of Trioxys (Hymenoptera: Braconidae: Aphidiinae) is provided along with summary tables on geographic origin, distribution, hosts, and diagnostic features. Accompanying the key are illustrations of the anterior portion of the forewing (stigma, R1 and Rs veins), propodeum, petiole, and genitalia, including the seventh metasomal sternite prongs and ovipositor sheaths.

Key Words: Aphidiinae, aphid, key, parasitoid, Acanthoecaudus, Betuloxyx, Binodoxys, Trioxys


Few keys exist for distinguishing North America aphidiines, and none are comprehensive for Trioxys. An early key by Gahan (1911) recognized four species of Trioxys, Smith (1944) recognized 11 species, and since then Trioxys has been broken into several distinct genera or subgenera (Mackauer 1960, Mackauer 1965, Starý and Schlinger 1967, Starý 1981, Starý and Remaudière 1982, van Achterberg 1997, Chen and Shi 2001, Davidian 2005). Keys have been developed for individual aphidiine genera in North America, including Johnson’s (1987) key to Praon Haliday, and Pike et al.’s (1999) key to Ephedrus Haliday. Keys specific to certain plant-aphid associations also exist, such as a key to the small grain aphid parasitoids (Pike et al. 1997a). An updated review of aphid parasitoids of the Pacific Northwest USA (Pike et al. 2000) brought together extensive information on trirophic associations and descriptions of new species, including species of Trioxys, but no keys were presented.
Trioxys can be recognized by the female's distinctive paired prongs, which are extensions of the seventh metasomal sternite, and the petiole bearing spiracular tubercles only. Four other aphidine genera in North America, Acanthocaudus Smith, Betuloxys Mackauer, Binodoxys Mackauer, and Cristicauus Starý and Remaudière, also possess metasomal sternite prongs. Acanthocaudus, Binodoxys, and Cristicauus differ in having secondary, as well as spiracular tubercles, on the petiole. Betuloxys bears only spiracular tubercles, but the apical portions of the prongs are differentiated, dilated, and bear several lanceolate, perpendicular setae on the dorsal surface. Acanthocaudus further differs from Trioxys, Betuloxys, Binodoxys, and Cristicauus in having a secondary projection on its prongs (Starý 1981).

Species within Trioxys can be distinguished by one or more of the following features: propodeal areola presence or absence, antennal flagellomere number, metasomal sternite prong shape and length, propong dorsal and ventral setae number, prong apical bristle type and number, ovipositor sheath shape, and forewing stigma and R1(=metacarpus) length. Information on host specificity is also helpful for species differentiation. The North American and world distributions, as well as host aphid associations of each species, as presently recognized, are provided in the paper.

Materials and Methods

Material examined.—Trioxys species examined were from authors' field collections and museum loans. Numbers of specimens examined and location are as follows: T. ameraceris — type USNM (National Museum of Natural History, Washington), 2 paratypes Czech (Czech Academy of Sciences, P. Starý collection); T. artenisiarum — type USNM, 24 paratypes [19 WSU (Washington State University-Prosser), 3 Czech and 2 USNM]; T. auctus — 2 UCB (University of California-Berkeley), 1 Czech; T. betulae — 5 Czech; T. bonnevilensis — 156 WSU, 20 Czech; T. californiae — type UCB; T. cirsii — 1 WSU, 1 Czech; T. complanatus — 21 WSU, 11 Czech; T. curvicaudus — 20 UCB, 5 WSU, 11 Czech; T. exareolatus — type USNM; T. gahanti — type USNM, 2 WSU; T. ibis — 2 Czech; T. infrequens — type USNM; T. latgei — 6 Czech; T. mexicanus — 2 Czech; T. monelliosis — 3 Czech; T. pallidus — 261 WSU, 35 Czech; T. roseae — type USNM, 6 paratypes [4 WSU, 6 Czech, 2 USNM]; T. setaceus — type USNM, paratypes (3 WSU, 2 Czech); T. sunnysidensis — type USNM, 40 paratypes [WSU 26, 8 USNM, 6 Czech]; T. tenuicaudus — 2 WSU, 1 Czech). Authors' collections were preserved in 70–95% ETOH, some as whole mounts on pointed or rectangular paper tabs, and some as whole and/or dissected mounts on glass slides.

Slide mounted whole specimen preparation.—Parasitoids were cleared and mounted using techniques by P. Starý, and modified by G. Graf of Washington State University as follows: (1) parasitoid immersed in 95% ETOH; (2) specimen transferred to new test tube of water and inverted several times; (3) water decanted and specimen placed in test tube of 10% KOH; (4) test tube placed in heating block for approximately 2 minutes at 98°C (heating time varied depending on sclerotization and state of specimen; dry materials required more time); (5) specimen removed from KOH, placed in test tube of water and washed and inverted several times to rinse off KOH; (6) specimen placed in 3 drops of mounting medium (200 g gum arabic, 550 g chloral hydrate, 60 ml glycerin, and 400 ml distilled water mixed and filtered through glass wool) and positioned; (7) coverslip placed over specimen; (8) code number written on slide and slide allowed to dry horizontally for 2–3 weeks on slide warmer at 50°C; (9) mount sealed around
coverslip with glyptal, an alkyd-based sealant, to prevent dehydration and crystallization (Pike et al. 2003); and (10) slide fully labeled.

Parasitoid dissection.—Specimens were sometimes dissected for better feature viewing after placement in mounting medium as follows: (1) head cut from body with antennae attached or separated; (2) mesonotum separated from body with wings attached or separated; (3) propodeum separated from body, petiole sometimes left connected to propodeum in smaller specimens; (4) hind legs separated from body; (5) metasoma cut and positioned for (a) dorsal view of petiole and (b) posterior view of metasoma, including lateral view of genitalia; and (6) genitalia removed from metasoma if not protruding or visible.

Slide mounted specimen measurements.—Whole and dissected mounts were reticle measured using a compound microscope at magnifications of 50–400×.

Dry mounted specimens.—Whole mounts were placed on pin-pointed or rectangular paper tabs.

Illustrations.—Line drawings of many specimens were based on features captured with a Nikon Coolpix 990T digital camera through an Olympus SZX12T dissecting microscope or with a DEC13T digital eyepiece camera through a Zeiss AxiolabT compound microscope. Illustrations of the wing, propodeum, petiole, genitalia and associated structures were provided for each species. For some rare species, illustrations were drawn from the type, i.e., T. californicus from the University of California Essig Museum of Entomology, and T. exareolatus, T. gahani, and T. infrequens from the National Museum of Natural History, Washington, DC. Other species were drawn from the type, para-type or other material, or redrawn after previously published drawings. Figs. 1–4, 7, 13, 17–23, 25–35, 37–52, 61–66b, 67, 77–84 were authors’ original drawings; Fig. 50 was authors’ conceptual illustration of the propodeum based on the original description (Smith 1944); Figs. 5, 6, and 8 were redrawn after Pike et al. 1997b; Fig. 9 after Mackauer 1959; Fig. 10 after Takada 1966; Figs. 11–12, 36 after Starý 1976; Fig. 14 after Tomano- vić and Kavallieratos 2002; Figs. 15–16 after Starý 1979; Fig. 24 after Starý and Zuparko 1995; Figs. 53–56 after Starý and Remaudièere 1977; Figs. 57–60 after Starý and Remaudièere 1982; Figs. 66c, 68 after Starý 1978; Figs. 69–72 after Pike et al. 1996; and Figs. 73–76 after Pike et al. 2000.

Terminology.—Descriptive morphology was after Sharkey and Wharton (1997).

RESULTS AND DISCUSSION

A listing of aphidine parasitoids of North America can be found in Marsh (1979). Research within the past decade (Pike et al. 1996, 1997a, 2000) has supplemented the listing of taxa and aphid host range information. Table 1 summarizes the full listing of North American species of Trioxys. Host range, faunal composition, and ecology of Trioxys parasitoids for much of North America have not been explored thoroughly. As indicated in the introduction, there is a lack of updated keys for many genera of Aphidiinae, including Trioxys. Table 2 outlines distinguishing characters used in the key.

The North American Trioxys fauna is currently comprised of 22 species, 15 native and 7 introduced (Table 1). Members of the genus are associated with assorted groups of aphids in arboricolaous, grassy riparian, sagebrush, and selected agroecosystem habitats. Eleven species of Trioxys utilize aphids in Myzocallidinae and Drepanosiphinae, most of which are arboricolous (i.e., aphids on alder, birch, crepe myrtle, elm, hazel, linden, maple, oak, pecan,
and walnut). *Trioxys complanatus* Quilis uses a myzocallidine aphid on alfalfa, viz. the spotted alfalfa aphid, *Therioaphis trifolii* (Monell) (Table 1). Nine species of *Trioxys* attack solely aphids in Aphiidiinae as follows: *T. auctus* (Haliday) on water lily aphid, *Rhopalosiphum nymphaeae* (L.) and bird cherry-oat aphid, *R. padi* (L.); *T. sunnysidensis* Fulbright and Pike on bird cherry-oat aphid; *T. artemisiarum* Pike and Starý and *T. bonnevillensis* Smith on sage aphids, *T. exar-
T. rosae

Figs. 69–84. Trioxys morphological features [columns 1, 2, 3, and 4 (left to right) = wings (part only), propodea, petioles, genitalia (includes last metasomal sternite prong and ovipositor sheath), respectively. 69–72, T. rosae. 73–76, T. setaceus. 77–80, T. sunnysidensis. 81–84, T. tenuicaudus.

colatus Viereck and T. rosae Pike and Starý on rose aphids; T. gahani Smith on blueberry aphid, Ericaiphis scamnelli (Mason) and Chaetosiphon; T. latgei Starý and Remaudière on juniper aphid, Sanbornia juniperi Pergande; and T. setaceus Pike and Starý on serviceberry aphid, Aegrythosiphon macrosiphum (Wilson) (Table 1). For two species of Trioxys, T. infrequens Smith and T. ovalis (Provancher), the hosts are unknown. Of the Trioxys species accidentally or purposely introduced into North America [T. auctus (Haliday), T. betulae Marshall, T. cirsii (Curtis), T. complanatus Quilis, T. ibis Mackauer, T. pallidus (Haliday), and T. tenuicaudus Starý], some have become adapted or partially adapted to native and/or long established introduced aphids.

Parasitoid determinations should be based on multiple factors whenever possible. Parasitoids which have been identified through the key should be checked against primary distinguishing features (Table 2), compared to the illustrations, and checked against the host aphid and distributional records where available.

Success in identifying parasitoids is facilitated when quality and quantity material are available. Freshly reared, cleared and mounted specimens are best. One of the challenges in making determinations with confidence is being able to see the key features. With point-
Table 1. *Trioxys* of North America: origin, hosts, North American distribution.

<table>
<thead>
<tr>
<th>Species</th>
<th>Origin</th>
<th>Host Aphids Subfamily (Genus)</th>
<th>Reported Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>ameraceris</em> Smith 1944</td>
<td>Nearctic</td>
<td>Drepanosiphinae (<em>Drepanaphis</em>)</td>
<td>E. Can., E. USA (Smith 1944, Marsh 1979)</td>
</tr>
<tr>
<td><em>artemisiarum</em> Pike and Starý 1997</td>
<td>Nearctic</td>
<td>Aphidinae [<em>Aphis</em> (<em>Zyxaphis</em>), <em>Microsiphoniella</em>]</td>
<td>WA (Pike and Starý 1997b)</td>
</tr>
<tr>
<td><em>auctus</em> (Haliday 1833)</td>
<td>Palearctic</td>
<td>Aphidinae (<em>Rhopalosiphum</em>)</td>
<td>E. Can. (QC)</td>
</tr>
<tr>
<td><em>boumevillensis</em> Smith 1944</td>
<td>Nearctic</td>
<td>Aphidinae (sage aphids¹)</td>
<td>ID, WA, UT, Mexico (Smith 1944, Starý and Remaudiére 1982, Pike et al. 2000)</td>
</tr>
<tr>
<td><em>californicus</em> Starý and Zuparko 1995</td>
<td>Nearctic</td>
<td>Myzocallisinae (<em>Eucallipterus</em>)</td>
<td>CA (Starý and Zuparko 1995)</td>
</tr>
<tr>
<td><em>circu</em>i (Curtis 1831)</td>
<td>European</td>
<td>Drepanosiphinae (<em>Drepanosiphum</em>)</td>
<td>WA (Pike et al. 2000)</td>
</tr>
<tr>
<td><em>complanatus</em> Quils 1931</td>
<td>Eurasian</td>
<td>Myzocallisinae (<em>Therioaphis</em>)</td>
<td>Can., USA (Marsh 1979, Pike et al. 2000)</td>
</tr>
<tr>
<td><em>exareolatus</em> Vieereck 1916</td>
<td>Nearctic</td>
<td>Aphidinae (<em>Macrospirum</em>)</td>
<td>CT (Vieereck 1916, Marsh 1979)</td>
</tr>
<tr>
<td><em>gahani</em> Smith 1944</td>
<td>Nearctic</td>
<td>Aphidinae (<em>Eriaphis</em>, <em>Chaetosiphon</em>)</td>
<td>NJ, WA (Smith 1944, Marsh 1979)</td>
</tr>
<tr>
<td><em>infrequens</em> Smith 1944</td>
<td>Nearctic</td>
<td>Unknown²</td>
<td>W. Can., CO (Marsh 1979)</td>
</tr>
<tr>
<td><em>lætei</em> Starý and Remaudiére 1977</td>
<td>Nearctic</td>
<td>Aphidinae (<em>Sanbornia</em>)</td>
<td>ME (Starý and Remaudiére 1977)</td>
</tr>
<tr>
<td><em>mexicanus</em> Starý and Remaudiére 1982</td>
<td>Nearctic</td>
<td>Myzocallisinae (<em>Myzocallis</em>)</td>
<td>Mexico (Starý and Remaudiére 1982)</td>
</tr>
<tr>
<td><em>monelliopsis</em> Starý and Marsh 1982</td>
<td>Nearctic</td>
<td>Myzocallisinae (<em>Monelliopsis</em>)</td>
<td>GA (Starý and Marsh 1982)</td>
</tr>
<tr>
<td><em>ovalis</em> (Provancher 1886)</td>
<td>Nearctic</td>
<td>Unknown²</td>
<td>E. Can. (Smith 1939, 1944, Marsh 1979)</td>
</tr>
<tr>
<td><em>palidis</em> (Haliday 1833)</td>
<td>Palearctic</td>
<td>Myzocallisinae (tree aphids³)</td>
<td>W. USA (Marsh 1979, Pike et al. 2000)</td>
</tr>
<tr>
<td><em>setaceus</em> Pike and Starý 2000</td>
<td>Nearctic</td>
<td>Aphidinae (<em>Acyrthosiphon</em>)</td>
<td>MT, WA (Pike et al. 2000)</td>
</tr>
<tr>
<td><em>sunnysidensis</em> Fulbright and Pike 2007</td>
<td>Nearctic</td>
<td>Aphidinae (<em>Rhopalosiphum</em>)</td>
<td>WA (Fulbright and Pike 2007)</td>
</tr>
</tbody>
</table>

¹ *Aphis* (*Zyxaphis*), *Artenisaphis*, *Epaneophilus*, *Flabellomicrosiphum*, *Microsiphoniella*, *Obtusicauda*, *Pleotrichophorus*, *Pseudoepaneophilus*.
² Reared from an aphid on *Helianthus* sp. (Smith 1939).
³ *Chromaphis*, *Eucallipterus*, *Hoplilcallis*, *Monelliopsis*, *Myzocallis*, *Panaphis*, *Tinocallis*, *Tuberculatus*.

mounted specimens on pins, it is not always possible to see or see clearly all of the distinguishing characters used in the key. Clearing and slide mounting representative specimens is recommended, if not essential. Slide mounts, when properly sealed and labeled, become permanent holdings and are easily viewable.

**Key to Female *Trioxys* of North America**

*Trioxyus ovalis* (Provancher) de-
Table 2. *Trioxys* of North America: Antennal segment no., prong dorsal setae no., prong apical bristle type and no., and propodeal sculpture.

<table>
<thead>
<tr>
<th>Species</th>
<th>Antennal Segment No.</th>
<th>Dorsal Setae No.</th>
<th>Apical Bristle Type</th>
<th>Apical Bristle No.</th>
<th>Propodeal Sculpture</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>ameraceris</em></td>
<td>11, 12 (rarely)</td>
<td>1–3</td>
<td>dilated</td>
<td>2</td>
<td>areola</td>
</tr>
<tr>
<td><em>artermisiarum</em></td>
<td>12</td>
<td>7</td>
<td>dilated</td>
<td>2</td>
<td>largely smooth, divergent posterior carinae</td>
</tr>
<tr>
<td><em>actus</em></td>
<td>12</td>
<td>4–6</td>
<td>simple, straight</td>
<td>2</td>
<td>areola</td>
</tr>
<tr>
<td><em>betulae</em></td>
<td>11</td>
<td>2–6</td>
<td>claw</td>
<td>1</td>
<td>areola</td>
</tr>
<tr>
<td><em>bonnevillelensis</em></td>
<td>11</td>
<td>4–5</td>
<td>dilated</td>
<td>2</td>
<td>smooth</td>
</tr>
<tr>
<td><em>californicus</em></td>
<td>13</td>
<td>3</td>
<td>clavlike</td>
<td>1</td>
<td>some carinae</td>
</tr>
<tr>
<td><em>cirsii</em></td>
<td>11</td>
<td>6–8</td>
<td>dilated</td>
<td>2 or 3</td>
<td>areola, may be incomplete</td>
</tr>
<tr>
<td><em>complanatus</em></td>
<td>11</td>
<td>2–4</td>
<td>clavlike</td>
<td>1</td>
<td>some carinae</td>
</tr>
<tr>
<td><em>curvicaudus</em></td>
<td>11</td>
<td>2–5</td>
<td>clavlike</td>
<td>1</td>
<td>areola</td>
</tr>
<tr>
<td><em>exareolus</em></td>
<td>11?</td>
<td>8</td>
<td>dilated</td>
<td>1</td>
<td>some carinae</td>
</tr>
<tr>
<td><em>gahani</em></td>
<td>11</td>
<td>7</td>
<td>dilated</td>
<td>2</td>
<td>largely smooth, divergent posterior carinae</td>
</tr>
<tr>
<td><em>ibis</em></td>
<td>12</td>
<td>1</td>
<td>clavlike</td>
<td>1</td>
<td>areola</td>
</tr>
<tr>
<td><em>infrequens</em></td>
<td>11</td>
<td>8</td>
<td>dilated</td>
<td>1</td>
<td>smooth</td>
</tr>
<tr>
<td><em>laltegi</em></td>
<td>11</td>
<td>3–4</td>
<td>simple, straight</td>
<td>2</td>
<td>areola</td>
</tr>
<tr>
<td><em>mexicanus</em></td>
<td>11</td>
<td>0</td>
<td>dilated</td>
<td>1</td>
<td>areola</td>
</tr>
<tr>
<td><em>monelliopsis</em></td>
<td>11</td>
<td>0</td>
<td>clavlike</td>
<td>1</td>
<td>areola</td>
</tr>
<tr>
<td><em>pallidus</em></td>
<td>11</td>
<td>3–4</td>
<td>clavlike</td>
<td>1</td>
<td>areola (part) or irregular lateral carinae</td>
</tr>
<tr>
<td><em>rosae</em></td>
<td>11</td>
<td>4–5</td>
<td>dilated</td>
<td>2</td>
<td>largely smooth, divergent posterior carinae</td>
</tr>
<tr>
<td><em>setaceus</em></td>
<td>11</td>
<td>6–8</td>
<td>dilated</td>
<td>2</td>
<td>some carinae</td>
</tr>
<tr>
<td><em>summyxidens</em></td>
<td>11 (rarely), 12</td>
<td>4–5</td>
<td>simple, straight</td>
<td>2</td>
<td>areola</td>
</tr>
<tr>
<td><em>temucicaudus</em></td>
<td>11</td>
<td>1</td>
<td>simple, straight</td>
<td>1</td>
<td>areola</td>
</tr>
</tbody>
</table>

scribed in 1886 from Ontario, Canada not included in key; type lost, description inadequate, placement uncertain.]

1. Propodeum with an areola (Fig. 2), may be open (Figs. 26, 82) .......................... 2
   - Propodeum without an areola, smooth (Fig. 18) or with some carinae (Figs. 22, 42) .......................... 13

2(1). Prong with clavlike (Figs. 24, 64) or dilated apical bristle(s) (Figs. 4, 8) .......................... 3
   - Prong with straight simple bristle(s) (Fig. 56) .......................... 10

3(2). Prong with single clavlike apical bristle (Fig. 64) .......................... 4
   - Prong with dilated apical bristle(s) (Figs. 4, 60) .......................... 8

4(3). Prong dorsal surface with setae (Fig. 8) .......................... 5
   - Prong dorsal surface without setae (Fig. 64); (host, *Monelliopsis nigropunctata* on pecan; Georgia) (Figs. 61–64) .......................... *monelliopsis* Starý and Marsh

5(4). Ovipositor sheath long and narrow (Fig. 48); stigma length 3× width; antenna 12-segmented; host, *Betulaphis quadrituberculata* on birch; Europe, New Brunswick (Figs. 45–48) .......................... *ibis* Mackauer
   - Not with combination of features above .......................... 6

6(5). Prongs fused from base for more than half their length (hosts, *Calaphis, Cletthropsis, Symydobius* on alder or birch; Asia, eastern Canada, Europe, Russia, (Figs. 13–16) .......................... *betulae* Marshall
   - Prongs distinctly separated .......................... 7

7(6). Prong dorsal surface with 2 setae (Fig. 36); prongs arcuate at apex (hosts, *Eucallipterus tiliae* on linden and *Tuberculatus* on oak; California, Europe, and Russia) (Figs. 33–36) *curvicaudus* Mackauer
   - Prong dorsal surface with 3–4 setae (Fig. 68); prongs relatively straight (hosts, various tree aphids, *Chromaphis, Eucallipterus, Hoplocallis, Monella, Monelliopsis, Myzocallis, Tuberculatus, Tino callis, Panaphis*; Asia, Australia, Europe, Russia, Tasmania [specimens with propodeal areola not observed in North America]) (Figs. 65–68) .......................... *pallidus* (Haliday) (in part)

8(3). Prong dorsal surface without setae (Fig. 60); 1 dilated apical bristle (host,
Myzocallis on oak; Mexico (Figs. 57–60) ....... mexicans Starý and Remaudière
– Prong dorsal surface with setae; 1–3 dilated apical bristles (Figs. 4, 28) ............ 9

(8). Prong dorsal surface with 2–3 setae (Fig. 4) (host, Drepanosiphum on maple; eastern Canada, Florida, Missouri, Ohio, Tennessee) (Figs. 4–1) ....... ancericis Smith

(10). Prong dorsal surface with 6–8 setae (Fig. 28) (host, Drepanosiphum on maple; known distribution, Asia, Australia, Europe, Washington) (Figs. 25–28) ciri (Curtis)

(12). Prong short and straight, with two long apical bristles (Fig. 56); petiole short, only slightly longer than wide (Fig. 55) (host, Sanbornia juniperi on juniper; Maine) (Figs. 53–56) ......... latgei Starý and Remaudière
– Not with the combination of features above ..................... 11

(11). Prong dorsal surface with one pre-apical seta (Fig. 84); ovipositor sheath very shallowly emarginate on ventral side (Fig. 84) (host, various tree aphids – Eucallipterus, Myzocallis, Tinocallis, Tuberculatus; Australia, Europe, Russia, and Washington) (Figs. 81–84) tennicaudus Starý
– Prong dorsal surface with 4 or more setae (Fig. 80) .................. 12

(14). Prong dorsal surface with 1 pre-apical seta (Fig. 84); ovipositor sheath very shallowly emarginate on ventral side, with two long apical bristles (Fig. 56); petiole short, only slightly longer than wide (Fig. 55) (host, Sanbornia juniperi on juniper; Maine) (Figs. 53–56) ......... latgei Starý and Remaudière
– Not with the combination of features above ..................... 11

(13). Petiole with numerous longitudinal striations in proximal half (Fig. 11) (host, Rhopalosiphum; Eurasia and Ontario [introduced]) (Figs. 9–12) ....... auctus (Haliday)
– Petiole without striations (Fig. 79) (host, Rhopalosiphum on wheat; Washington) (Figs. 77–80) ............ sunnyisidens Fullbright and Pike

(14). Antenna 11-segmented (host, Eucallipterus titiae; California; species rare, described from a single specimen) (Figs. 21–24) ......... californicus Starý and Zaparko
– Antenna 11–12 segmented ............ 14

(15). Petiole dilating from poorly prominent spiracular tubercles to apex (Fig. 7); antenna 12-segmented; (hosts, various sagebrush aphids – Aphis (Zyaphis), Macrosiphum; Washington) (Figs. 5–8) ....... antennisitarum Pike and Starý
– Petiole spiracles on prominently visible tubercles (Fig. 51) antenna usually 11-segmented; .................... 15

(16). Prong dorsal surface with 6–8 setae (Fig. 52) ............ 16
– Prong dorsal surface with 2–5 setae (Fig. 20) .................. 19

(17). Prong ventral surface with > 12 setae (Fig. 76) (host, Acyrthosiphon macrostigmus on western serviceberry; Montana and Washington) (Figs. 73–76) ......... 17
– Prong ventral surface with usually < 10 setae (Figs. 40, 44) (host, not Acyrthosiphon macrostigmus) .................. 18

(19). Propodeum entirely smooth (Fig. 18), R1 vein short, < 0.25× stigma length (Fig. 17) (hosts, sage aphids – Aphis (Zyaphis), Artemisiaaphis, Epameibaphis, Flabellonicrosiphum, Macrosiphoniella, Obtusiscanda, Pleitrichophorus, Pseudoeameibaphis; Idaho, Mexico, Utah, and Washington) (Figs. 17–20) ............ bonnevillensis Smith
– Propodeum with at least some carinae (Figs. 30), R1 vein length variable ......... 20

(20). Propodeum smooth except for divergent carinae in posterior declivity (Fig. 70); R1 vein 0.3× stigma length (Fig. 69) (host, Macrosiphum rosae on rose; Washington) (Figs. 69–72) ............ rosae Pike and Starý
– Propodeum with irregular lateral carinae (Figs. 30, 66a, 66b); R1 vein 0.4× stigma length or greater (Figs. 29, 65) ............ 21

(21). [Species in couplet morphologically similar – check for a match with correct host] Ovipositor sheath ventral margin with 5–7 setae excluding apical setae (Fig. 68) (hosts, various tree aphids – Chromaphis, Eucallipterus, Hoplocallis, Monellia, Monelliospis, Myzocallis, Tuberculatus, Tinocallis, Panaphis; California, Oregon, Washington (Figs. 65–68) ......... pallidus (Haliday) (in part)
– Ovipositor sheath ventral margin with 3–4 setae excluding apical setae (Fig. 32) (hosts, Therioaphis – North America; Pterocalis – Eurasia) (Figs. 29–32) ......... complanatus Quilis
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LITERATURE CITED


