



## Description of the Adult Male of *Stylops advarians* Pierce (Strepsiptera: Stylopidae)

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The morphology of the adult male of *Stylops advarians* Pierce is described for the first time. This species was previously known only from the endoparasitic adult female and the host-seeking, first-instar larva. Members of *Stylops* are cosmopolitan, and *Stylops advarians* can be found parasitizing *Andrena milwaukeensis* Graenicher in western Canada.

**Key words:** *Andrena milwaukeensis*, morphology, Stylopinae, Canada

Fifteen of Canada's 27 species of Strepsiptera belong to the Stylopidae (Straka 2019), the largest family of twisted-wing parasites comprising 163 known species in nine genera: *Crawfordia* Pierce, 1908; *Eurystylops* Bohart, 1943; *Halictoxenos* Pierce, 1909; *Hylecthrus* Saunders, 1850; *Jantarostylops* Kulicka, 2001; *Kinzelbachus* Özdikmen, 2009; *Melittostylops* Kinzelbach, 1971; *Rozeia* Straka, Jůzova & Batelka, 2014; and *Stylops* Kirby, 1802 (Kathirithamby 2018). Members of Stylopidae parasitize bees (Hymenoptera) of four families: Andrenidae, Colletidae, Halictidae, and Melittidae (Kathirithamby 2018). *Stylops* is the largest genus with as many as 117 described species, and most parasitize mining bees of *Andrena* (Kathirithamby 2018). However, following the descriptions of three male *Stylops* (Griffith 1832; Pierce 1918; Bohart 1941), adult males of *Stylops* have not been described from Canada for over 75 years. Adult males of Stylopidae are characterized by having six-segmented antennae with antennomere III bearing a long flabellum, and four-segmented tarsi without claws; however, males of *Stylops* are distinct from the other genera by having their labrum free (Kathirithamby 1989).

### Methods

Foraging bees of *Andrena milwaukeensis* Graenicher were collected by sweep netting and examined in the laboratory for the presence of *Stylops*. One female of *A. milwaukeensis* taken on May 14, 2018 had two male puparia extruded from its abdomen. Upon microscopic examination (and after directly shining a light failed to illicit their eclosion—James *et al.* 2016), both males appeared dead and the specimen was placed in 70% ethanol until dissection. One male was removed from its puparium and examined using a Nikon Stereoscope SMZ-10 and a Dino-Eye USB digital colour camera, which allowed dimensions of body parts to be recorded. The specimen was kept intact during its measurement.

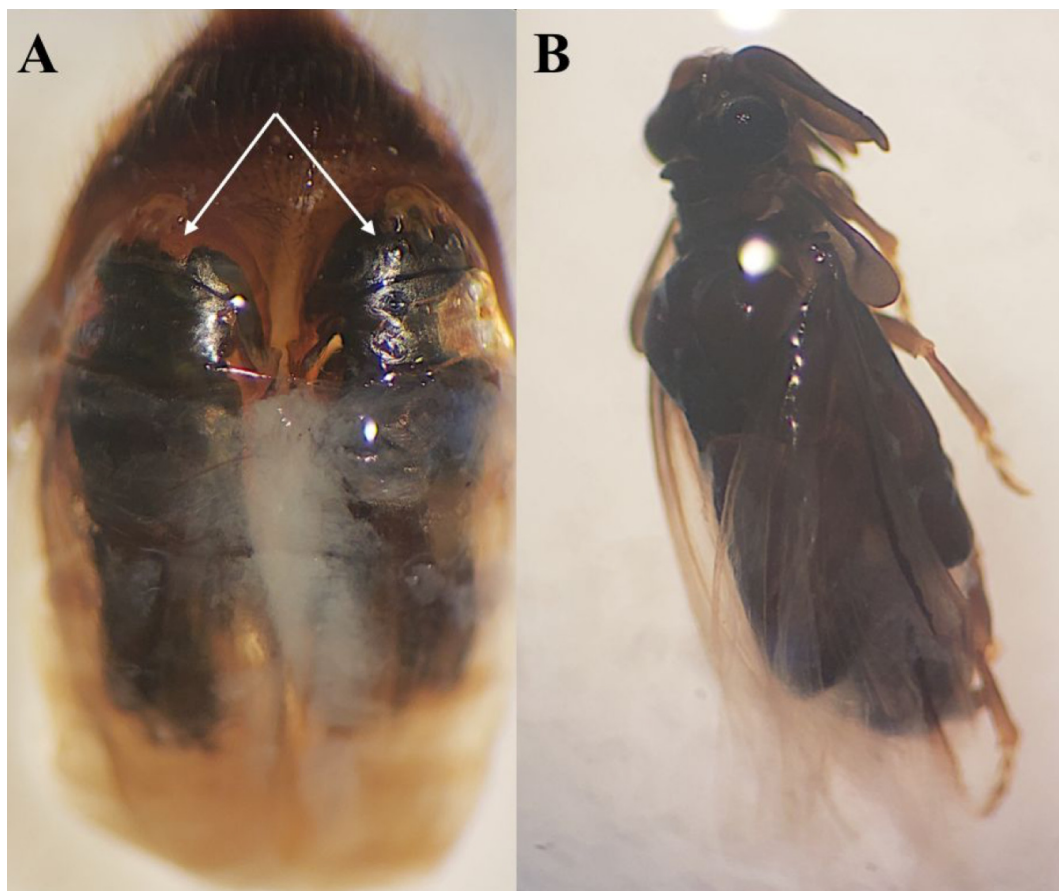
This specimen is stored in 70% ethanol and is deposited in the Royal Saskatchewan Museum, Regina, Saskatchewan, Canada.

**Species Identification.** Total genomic DNA was extracted from the entire body of the second male *Stylops* found within that same host which contained two puparia, then amplified for cytochrome oxidase I (Balzer *et al.*, unpublished). Sequences were compared to other *Stylops* species found in the GenBank database of the National Centre for Biotechnology Information ([www.ncbi.nlm.nih.gov/genbank/](http://www.ncbi.nlm.nih.gov/genbank/)) to confirm its identification as *S. advarians* (Jůzova *et al.* 2015)

## Results

**Material examined.** Paratype male (Catalogue No. RSKM\_ENT\_E-216645) Cosmopolitan Park, Saskatoon, Saskatchewan, Canada, 52°07'24.4"N 106°39'17.3"W, 14.V.2018, host (*Andrena milwaukeensis* Graenicher) with two puparia was collected by sweep netting; one male was removed from its puparium (Fig. 1A right) for recording its morphology, Coll, Z.S. Balzer.

**Adult male (n=1)** (Fig. 1B). Total length 2.69 mm; length of the metathorax 1.79 mm; width of the metathorax 0.64 mm; length of the antenna 0.69 mm.



**FIGURE 1.** A: Dorsal view of gaster of a female bee of *Andrena milwaukeensis*, with the tergites removed, showing stylopization by two puparia (arrows) of *Stylops advarians*. Posterior end of gaster is at the top. B: Adult male of *Stylops advarians* after removal from its puparium located at gaster's left side.

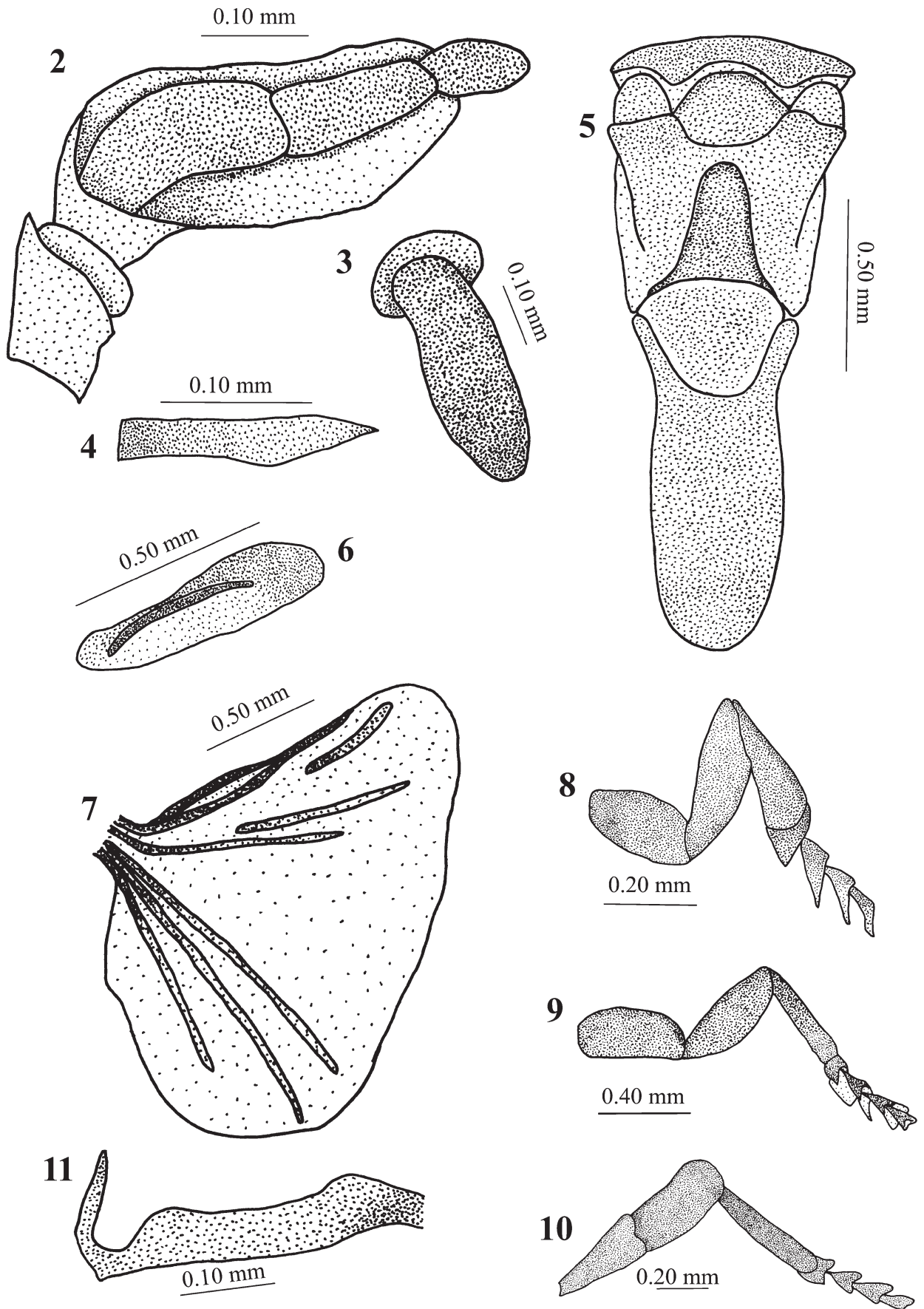
Colour. Head deep brown, thorax deep brown, abdomen light brown, and hind wings clear.

Head elongated laterally; length 0.28 mm, width 0.61 mm. Eyes prominent, 49 ommatidia per compound eye when viewed ventrally. Antenna six segmented (Fig. 2), antennomere I 0.13 mm long, antennomere II 0.05 mm long, antennomere III enlarged as a flabellum 0.52 mm long, antennomere IV 0.26 mm long, antennomere V 0.14 mm long, antennomere VI 0.11 mm long. Maxillary palp (Fig. 3) curved anteriorly and over twice as long as its base. Maxillary base 0.15 mm long; palp 0.37 mm long. Mandible (Fig. 4) 0.17 mm long, beveled at tip, less than half the length of the maxillary palp.

Metathorax (Fig. 5). Metaprescutum slightly rounded anteriorly, separated from the prescutum by a depressed scutal area; prescutum with three scutae rounded anteriorly, protruding from the scutum, prescutum 0.42 mm in length and 0.64 mm in width; scutellum long and curved anteriorly, 0.27 mm in length; postlumbium almost as long as wide, slightly constricted near anterior end, 0.40 mm in length and 0.36 mm in width; postnotum constricts at the postlumbium, but widens posteriorly, and is rounded at the posterior end, postnotum 0.70 mm long and 0.52 mm wide.

Fore Wing (Fig. 6). The fore wing 0.65 mm long, continually broadening at apical end.

Hind Wing (Fig. 7). Hind wing with two detached veins— $R_2$  and  $R_3$ ,  $R_2$  slightly shorter than  $R_3$ ,  $R_3$  almost touches the wing margin;  $R_3$  located above the apex of  $R_4$ . MA is slightly shorter than  $CuA_1$ ;  $CuA_1$  nearly touches the wing margin. CuP is just over two-thirds the length of  $CuA_1$ .



**FIGURES 2–11.** *Stylops advarians*, adult male. 2: antenna, 3: maxillary palp, 4: mandible, 5: metathorax, 6: right fore wing, 7: right hind wing, 8: prothoracic leg, 9: mesothoracic leg, 10: metathoracic leg, 11: aedeagus.

Legs (Figs. 8–10). Fore coxa 0.33 mm long, fore femur 0.37 mm long, fore tibia spatulate and 0.30 mm long, fore tarsomere I slightly curved and 0.08 mm long, tarsomere II 0.13 mm long, tarsomeres III and IV 0.14 mm long. Mid coxa 0.46 mm long, mid femur 0.33 mm long, mid tibia 0.35 mm long, mid tarsomere I 0.08 mm, tarsomeres II, III, and IV are equal in length at 0.12 mm. Hind coxa 0.31 mm long, hind femur 0.40 mm long, hind tibia 0.43 mm long, hind tarsomere I 0.12 mm, II 0.13 mm, III 0.12 mm, and IV 0.11 mm long. Ventral surface of last tarsomeres IV of each leg hairy without claws.

Abdomen. Abdomen sclerotized, 10-segmented.

Aedeagus (Fig. 11). Aedeagus 0.35 mm long with terminal hook 0.12 mm long, at ca. 67° angle to shaft; shaft almost two times longer than the terminal hook, shaft thin, 0.23 mm long, terminal hook beveled.

**Remarks.** This male is included in the genus *Stylops* of the family Stylopidae, based on the six-segmented antennae with an enlarged antennomere III, a large postlumbium, a hook-like aedeagus, and a scutellum that is at least as long as the prescutum (Bohart 1936; Bohart 1941; Kinzelbach 1978). These puparia were found in an *Andrena* bee, the recognized host of *Stylops* (Kathirithamby 1989), further supporting our classification. Our male specimen resembles *Stylops leechi* Bohart (1941) as the metathoracic scutellum reaches close to the prescutum, and the postlumbium is longer than it is wide, but differs because the fourth antennal segment is not more than twice as long as the fifth. Our specimen does not closely resemble *S. shannoni* Pierce or *S. childreni* Gray, the other known Canadian *Stylops* species for which adult males have been described (Pierce 1918; Griffith 1832). The differences between *S. advarians* and the males of those two species include the lengths of the antennomeres, and the morphology of the metathorax. In *S. advarians*, the length of antennomere IV is twice as long as antennomere VI, whereas in *S. shannoni* antennomere VI is slightly shorter than IV. In *S. advarians*, antennomere V is slightly longer than antennomere VI, whereas in *S. childreni* antennomere VI is longer than V. The scutellum of *S. childreni* is circular, whereas the scutellum of *S. advarians* is elongated and rounded anteriorly.

Using molecular analysis, we confirmed that this male specimen matches material identified as *Stylops advarians* (Balzer *et al.*, unpublished), the same species ascribed by molecular methods to the first-instar larvae collected independently and subsequently described (Balzer & Davis, 2019) at this same field site. Due to the extreme sexual dimorphism of the adults, and the cryptic nature of Strepsiptera (Kathirithamby *et al.* 2015), it is useful to use molecular tools to accurately identify strepsipteran species, and to match adult males with adult females and with the liberated, host-seeking first-instar larvae of the same species.

**Female.** Described by Pierce (1909).

**First-instar larva.** Described by Balzer & Davis (2019).

**Host.** *Andrena milwaukeensis* Graenicher.

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