



## Description of the Adult Male of *Stylops nubeculae* Pierce (Strepsiptera: Stylopidae), a New Record for Canada

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### Abstract

The morphology of the adult male of *Stylops nubeculae* Pierce, encountered in stylopized gasters of two adult bees of *Andrena peckhami*, is described for the first time. This species was previously known only from the endoparasitic adult female found in Colorado, USA. We report a new locality for this species in Alberta, Canada.

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

### Introduction

Straka (2019) has reported 27 species of Strepsiptera from Canada, 15 of which belong to the family Stylopidae, although the newly added Canadian strepsipteran species have yet to be disclosed. The Stylopidae parasitize four bee families (Andrenidae, Colletidae, Halictidae, and Melittidae; Kathirithamby 2018), and this family of twisted-wing parasites consists of 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). The latter is the largest genus, with 117 species described (Kathirithamby 2018). However, the number of *Stylops* species was recently reduced to 67 valid species (Straka *et al.* 2015), suggesting thorough molecular analyses may also clarify the true species number in the remaining strepsipteran genera.

Adult males of Stylopidae are relatively difficult to collect because of their small size and short life-span (Kathirithamby 2009). They possess six-segmented antennae with antennomere III bearing a long flabellum, and four-segmented tarsi lacking claws. Furthermore, the free labrum on adult males of *Stylops* distinguishes this genus from the other genera of Stylopidae (Kathirithamby 1989). Herein we provide the first description of the male of *Stylops nubeculae*, and hereby add this species as a new record to reported Canadian Strepsiptera (see Leech 1966; Peck 1991; Kenner 2002).

### Methods

Two adult females of *Andrena peckhami* were collected using blue vane traps between July 6–14, 2015, and July 11–19, 2016. Each of these bees was stylopized by a single intact puparium protruding from the abdomen (gaster). The specimen from 2016 was coated in gold using an Edwards S150B Gold Sputter Coater prior to examination of the intact puparium (Fig. 1A) using an Hitachi SU8010 FE-SEM. The terminology of Kinzelbach (1978) was used to describe the cephalotheca.

The pinned bee of *A. peckhami* collected in 2015 was rehydrated in water for two hours before the male strepsipteran was removed from the protruding puparium (Fig. 1B,C). This male was initially examined, described, and illustrated using an Olympus SZ-ST dissecting microscope and a Zeiss SteREO DiscoveryV8 dissecting microscope

with Zen 2.3 lite software, before using a Nikon Stereoscope SMZ-10 and a Dino-Eye USB digital colour camera, which allowed dimensions of body parts to be recorded.

## Results

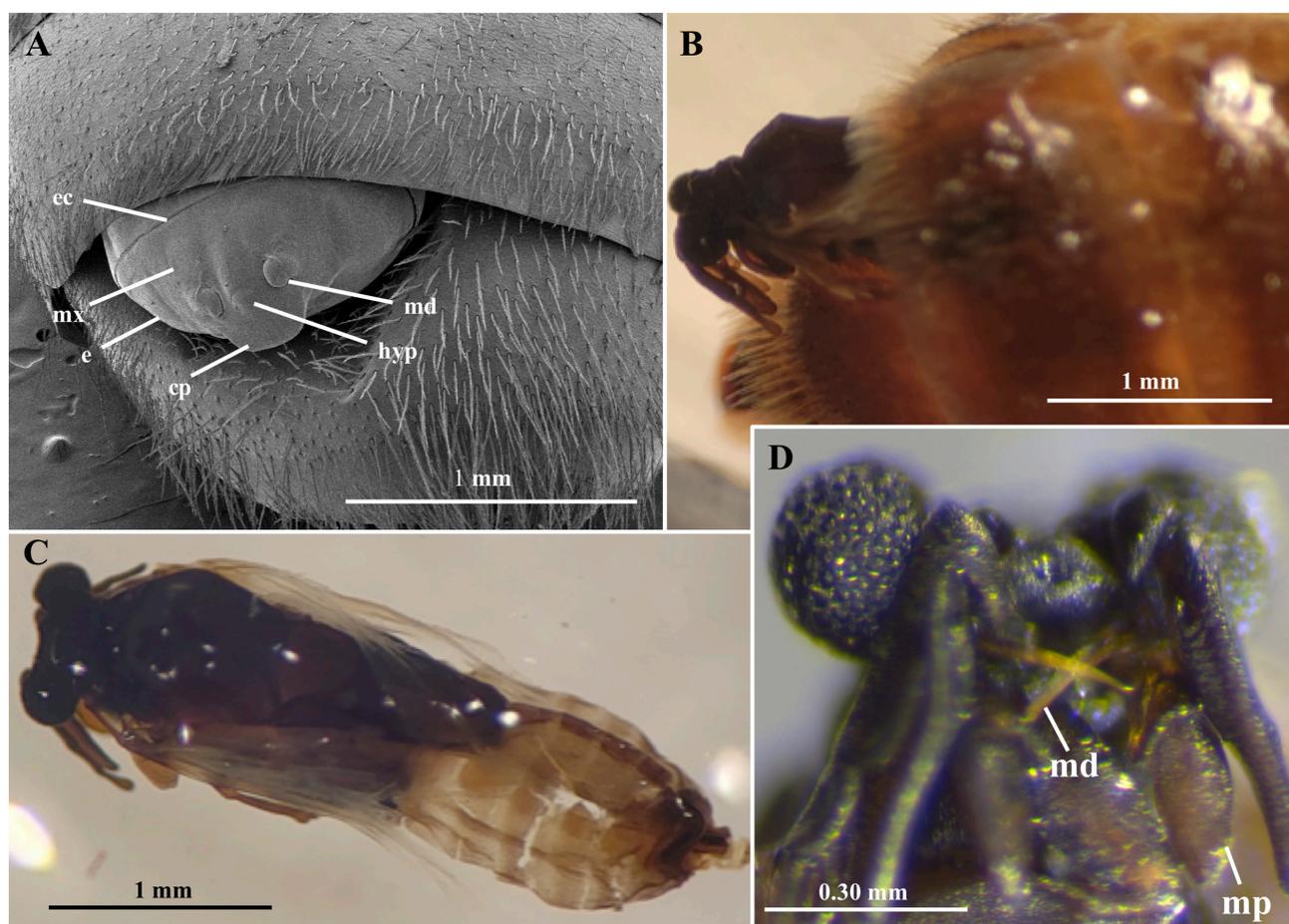
**Material examined.** Puparium, Arrowwood, Alberta, Canada, 50°35'09.4"N 113°05'12.6"W, 11.VII–19.VII.2016, host (*Andrena peckhami* Cockerell) with one puparium was collected by blue vane trap; this specimen was examined via SEM, Coll, S. Johnson.

Male (Catalogue No. RSKM\_ENT\_E-172079) 3.4 km from High River, Alberta, Canada, 50°36'04.2"N 113°50'04.2"W, 06.VII–14.VII.2015, host (*Andrena peckhami*) with one puparium was collected by blue vane trap; the male within the puparium was removed to examine its morphology, Coll, S. Johnson.

**Cephalotheca (n=1)** (Fig. 1A). Cephalotheca black laterally, and yellow around the midline. Eye sockets found laterally, maxillae located on either side of the midline above the mandibles, mandibles on either side of the midline below the maxillae, hypopharyngeal sclerite present below the mandibles, clypeus below the hypopharyngeal sclerite overhangs the rest of the cephalotheca.

**Adult male (n=1)** (Fig. 1B,C). Total length 3.33 mm; length of the metathorax 1.89 mm; width of the metathorax 0.71 mm; length of the antenna 0.99 mm.

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



**FIGURE 1.** A: SEM of the puparium of *Stylops nubeculae* protruding from the abdomen of *Andrena peckhami* (2016 specimen), B: Adult male *S. nubeculae* protruding between the tergites of its host bee, *A. peckhami* (2015 specimen), after the cephalotheca of the puparium had been removed, and the male had been pulled out slightly, C: Dorsal view of the adult male fully removed from its host, D: Photograph of the ventral head region of *S. nubeculae* of Fig. 1C, showing the crossed mandibles (brownish-yellow) and maxillary palps (brown).—Abbreviations: cp—clypeus, e—eye socket, ec—ecdysial suture line, hyp—hypopharyngeal sclerite, md—mandible, mp—maxillary palp, mx—maxilla.

Head elongated laterally (Fig. 1D); length 0.21 mm, width 0.78 mm. Eyes prominent, 58 ommatidia per compound eye when viewed ventrally. Antenna six segmented (Fig. 2), antennomere I 0.18 mm long, antennomere II 0.07 mm long, antennomere III enlarged as a flabellum 0.71 mm long, antennomere IV 0.34 mm long, antennomere V 0.20 mm long, antennomere VI 0.20 mm long. Maxillary palp (Figs. 1D, 3) curved anteriorly and over twice as long as its base. Maxillary base 0.11 mm long; palp's terminal segment 0.26 mm long. Mandible (Figs. 1D, 4) 0.22 mm long, dorsally beveled at tip, slightly shorter than the maxillary palp.

Metathorax (Fig. 5). Prescutum with three scutae, the lateral two rounded anteriorly, whereas the central scuta resembling a hexagon but with unequal side lengths, protruding from the scutum, prescutum 0.35 mm in length and 0.61 mm in width; scutellum short and curved anteriorly, 0.43 mm in length; postlumbium has anterior depression and is constricted along the horizontal midline, 0.32 mm in length and 0.42 mm in width; postnotum constricts at the postlumbium, but widens posteriorly, and is rounded at the posterior end, a depression is present running towards the posterior end, though this may be an artifact, postnotum 0.73 mm long and 0.40 mm wide.

Fore Wing (Fig. 6). The fore wing 0.59 mm long, broadens continually to posterior, rounded posteriorly. Venation is greatly reduced due to the reduction of wing size. Pigmentation on the posterior end switches from dark to light. This switch is denoted by the solid line outlining the lighter region in Fig. 6.

Hind Wing. The hind wings became too damaged during dissection to provide an accurate illustration; thus, venation cannot be determined.

Legs (Figs. 7–9). Fore coxa 0.42 mm long, fore femur 0.48 mm long, fore tibia spatulate and 0.49 mm long, fore tarsomere I slightly curved and 0.15 mm long, tarsomere II 0.12 mm long, tarsomere III 0.14 mm long and tarsomere IV 0.12 mm long. Mid coxa 0.45 mm long, mid femur 0.56 mm long, mid tibia 0.34 mm long, mid tarsomere I 0.14 mm, tarsomere II 0.15 mm, and tarsomeres III, and IV are equal in length at 0.13 mm. Hind coxa 0.30 mm long, hind femur 0.53 mm long, hind tibia 0.45 mm long, hind tarsomere I 0.15 mm, II 0.16 mm, III 0.14 mm, and IV 0.12 mm long. Ventral surface of last tarsomeres IV of each leg hairy without claws.

Abdomen. Abdomen sclerotized, 10-segmented.

Aedeagus (Fig. 10). Aedeagus 0.33 mm long with terminal hook 0.10 mm long, at ca. 73° angle to shaft; shaft greater than two times longer than the terminal hook, shaft enlarged posteriorly, 0.23 mm long, terminal hook beveled.

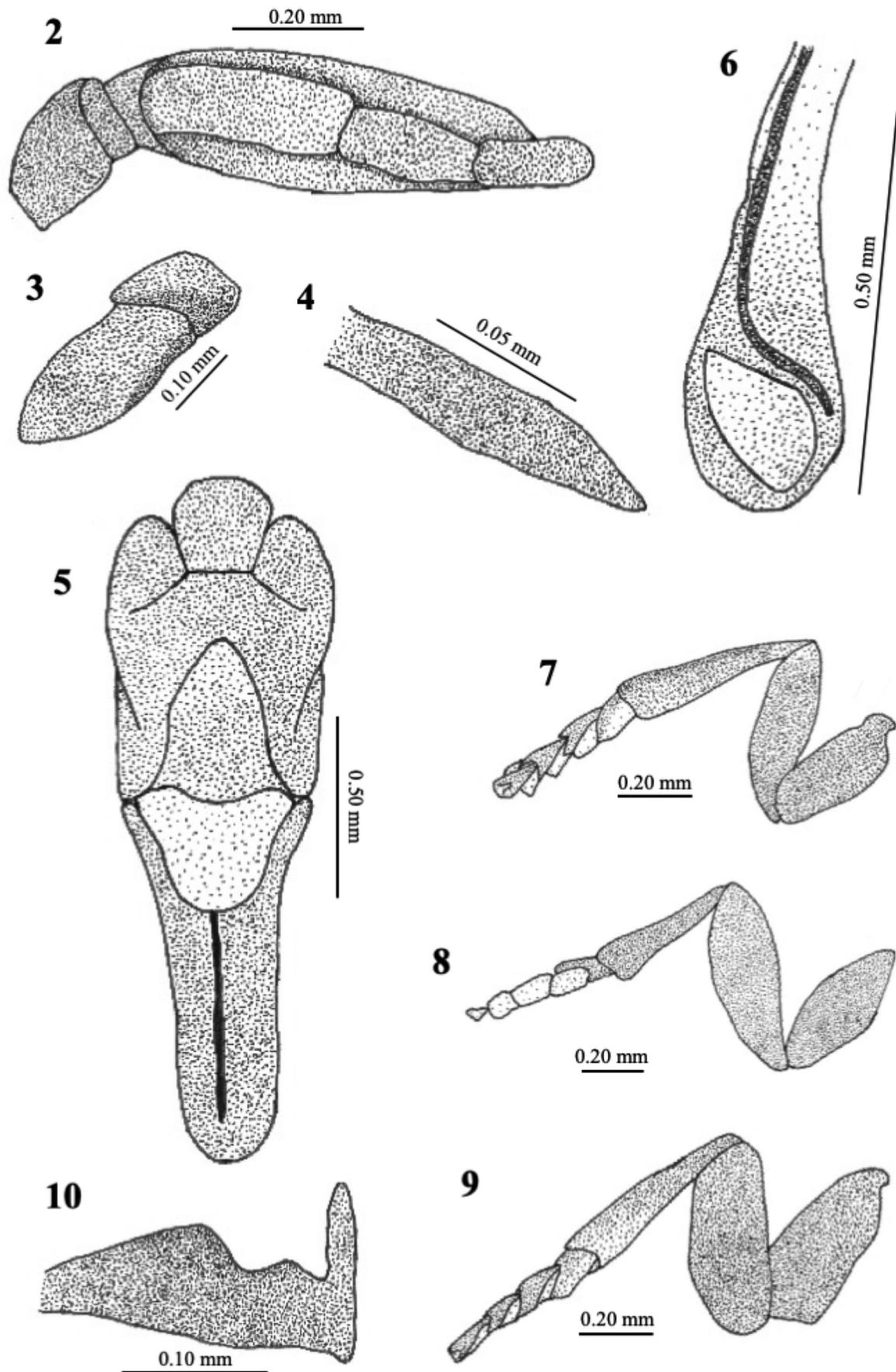
**Remarks.** This male is assigned to the genus *Stylops* of the family Stylopidae, based on the six-segmented antennae with an enlarged antennomere III, a large postlumbium, a hook-like aedeagus, and a scutellum that is at least as long as the prescutum (Bohart 1936; Bohart 1941; Kinzelbach 1978). Further support for the classification to *Stylops* is that the male was removed from a puparium protruding from the gaster of an *Andrena* bee, the recognized host of *Stylops* (Kathirithamby 1989). We classify this male specimen as *S. nubeculae* based on *i*) examination of females collected around Alberta, Canada within additional adult bees of *A. peckhami*, which were compared to the description in Bohart (1941); *ii*) this parasitic specimen's adult host, *A. peckhami* represents the identical subgenus of *A. nubecula* (*Cnemidandrena*), in which *S. nubeculae* had previously been found to stylopize (Pierce 1909); and *iii*) our male specimen does not resemble the four previously described Canadian male *Stylops* (Pierce 1918; Griffith 1832; Bohart 1941; Balzer & Davis 2019). For instance, antennomere VI of *S. shannoni* is slightly shorter than IV (Pierce 1918), whereas in *S. nubeculae* it is 1.5 times shorter than antennomere IV. In *S. leechi*, antennomere IV is twice as long as V, the scutellum reaches near the prescutum, and the postlumbium is longer than it is wide (Bohart 1941). In *S. nubeculae*, antennomere IV is 1.5 times longer than V, there is a large sclerotized space between the scutellum and prescutum, and the postlumbium is wider than it is long. In *S. childreni*, antennomere VI is longer than V (Griffith 1832), but in *S. nubeculae* these two antennomeres are the same length. Finally, the base of the shaft of the aedeagus of *S. advarians* is thin (Balzer & Davis 2019), whereas it is greatly enlarged in *S. nubeculae*.

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

**Host.** *Andrena peckhami* Cockerell.

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

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