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A new species of *Epeolus* Latreille, 1802
(Hymenoptera: Apidae) from western North America

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A new species of *Epeolus* Latreille, 1802 (Hymenoptera: Apidae) from western North America

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Abstract. A new species of *Epeolus* Latreille, 1802 (Hymenoptera: Apidae)—*E. emiliae* Onuferko and Sheffield, **new species**—is described from North America west of the Great Plains. It is morphologically most similar to *Epeolus autumnnalis* Robertson, 1902, a species known exclusively from east of the Rocky Mountains. DNA barcode sequences from representatives of *E. autumnnalis* and *E. emiliae* share a barcode index number (i.e., BIN: BOLD:AAF2361), but the two species exhibit marked and consistent differences in integument coloration and the patterns of pubescence on the metasoma, and their distributional ranges, based on known specimens, show no overlap. This discovery increases the number of species of *Epeolus* confirmed in Canada to 14, and North America north of Mexico to 44. Modifications to existing identification keys to Canadian and all North American species of *Epeolus* are provided, as well as a differential diagnosis, to enable the identification of *E. emiliae*. Additionally, three new provincial records are reported for species of *Epeolus* occurring in Canada: *E. interruptus* Robertson, 1900 from Alberta and Quebec and *E. scutellaris* Say, 1824 from Saskatchewan.

Key words. DNA barcode, identification key, morphology, Nomadinae.

ZooBank registration: urn:lsid:zoobank.org:pub:811B569E-9BF6-4319-B1FA-DD7A357B0847

Introduction

Epeolus Latreille, 1802 (Hymenoptera: Apidae: Nomadinae) is one of the most diverse genera of cleptoparasitic bees in North America, with 43 valid species recently confirmed north of Mexico (Onuferko 2018). The genus, which consists of brood parasites of polyester (or cellophane) bees of the genus *Colletes* Latreille, 1802 (Hymenoptera: Colletidae: Colletinae), was recently revised for Canadian, American, Neotropical North American, and European species (Onuferko 2017, 2018, 2019; Bogusch and Hadrava 2018, respectively) as well as for the predominantly eastern Palaearctic tarsalis species group (Astafurova and Proshchalykin 2021a). The most recent treatments of North American *Epeolus* preceding the aforementioned studies include Mitchell's (1962) revision of the species occurring in the eastern United States, Brumley's (1965) unpublished thesis, which revised the species occurring in the western United States, and Romankova's (2004) key to the *Epeolini* of Ontario. However, the taxonomy of Nearctic *Epeolus* remained problematic until very recently, in part due to Brumley's (1965) work never having been formally published and his thesis not having been made readily or widely available. Consequently, the new taxa he described and synonymies he proposed were not valid under the code of the International Commission on Zoological Nomenclature. The taxonomic impediment for New World *Epeolus* was largely removed with the publication of 24 new synonymies, 18 new species (mostly from the United States), one new combination, and one status change from subspecies to species between 2017 and 2019 (Onuferko 2017, 2018, 2019). Although the understanding of the taxonomy, ecology, and evolutionary history (see Onuferko et al. 2019) of *Epeolus* has greatly improved in recent years, much remains to be learned about this genus, and new discoveries continue to be made (Astafurova and Proshchalykin 2021a, b, c; Bogusch 2021).

The purpose of the present study is to document, diagnose, illustrate, and describe a new species of *Epeolus* from western North America, which is very similar to *E. autumnalis* Robertson, 1902, and provide means of distinguishing it from its congeners. Additionally, new provincial records are presented for two species of *Epeolus* that occur in Canada.

Materials and Methods

Specimens were studied from nine entomological collections in Canada and the United States abbreviated as follows, with the names of the curators/collection managers indicated in parentheses.

- CMNC** Canadian Museum of Nature, Gatineau, QC, Canada (J.-M. Gagnon and F. Génier)
CNC Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON, Canada (S. Cardinal and T. Martin)
CSUC C. P. Gillette Museum of Arthropod Diversity, Fort Collins, CO, USA (P.A. Opler)
DEBU University of Guelph Insect Collection, Guelph, ON, Canada (S. Paiero)
LEM Lyman Entomological Museum, Sainte-Anne-de-Bellevue, QC, Canada (J. Gillung and S. Boucher)
RAM Royal Alberta Museum, Edmonton, AB, Canada (T. Cobb and M. Buck)
RSKM Royal Saskatchewan Museum, Regina, SK, Canada (C.S. Sheffield)
UCBME University of California, Bohart Museum of Entomology, Davis, CA, USA (S. Heydon and T.J. Zavortink)
USNM U.S. National Entomological Collection, National Museum of Natural History, Washington, D.C., USA (S.G. Brady and E. Okonski)

Morphological features were studied under a standard dissecting microscope, with measurements taken using a calibrated micrometer within the eyepiece. To extract the terminalia, a single pinned male specimen was relaxed for one day in a sealed plastic container into which a paper towel dampened with water-diluted isopropanol was placed. An insect pin (size 000) was used to sever the conjunctival membrane between the sixth and seventh terga and fifth and sixth sterna. The detached apical structures were placed in a glass vial to which aqueous potassium hydroxide (KOH) was added (prepared by dissolving a pellet of KOH in about 1 mL of water) to digest the soft tissues. After approximately six hours, the dissected terga, sterna, and genitalia were removed and transferred to a small glass vial containing a minute amount of glycerin for long-term storage, with the vial's rubber stopper pinned under the specimen.

The terminology for morphological features used here is the same as in Onuferko (2017, 2018, 2019), which generally follow Michener (2007) and Rightmyer (2008), except following Prentice (1998) the terms *frontal area* and *vertexal area* are used instead of *frons* and *vertex*, respectively. For clarity, definitions of non-standard terms are repeated here as follows. *Length* refers to measurements made along the longitudinal axis of a bee specimen whereas *width* refers to measurements made along its lateral axis. However, in reference to the longitudinal extent of the metasomal fasciae (the transverse bands of pale short, appressed setae on the metasomal terga), the more intuitive term *breadth* is used instead of *length*. The term *frontal keel* refers to the elevated carinate frontal line, which extends from the frontal area to the supraclypeal area. The pair of longitudinal bands of pale short, appressed setae originating in the anterior half of the mesoscutum are termed *paramedian bands*. *Bigibbous* is a descriptive term for the pair of rounded convexities on the mesoscutellum of *Epeolus* species. In many species of *Epeolus*, the basal and apical fasciae on the first metasomal tergum are joined on each side by a *lateral longitudinal band*. The area on the disc of the first metasomal tergum that is covered in dark short, appressed setae and partially or fully enclosed by bands of pale short, appressed setae (or fasciae) is referred to as the *discal patch*. The following abbreviations (in parentheses) are used: length of the lateral margin of the axilla (AL), diameters of punctures (d), flagellomere (F), interspaces between punctures (i), median ocellar diameter (MOD), mesoscutellar width (MSCW), metasomal sternum (S), and metasomal tergum (T).

From a subset of specimens, DNA was extracted (from one or more legs) to amplify and sequence the DNA barcode region (a 658-bp fragment of the cytochrome *c* oxidase subunit I (COI) mitochondrial gene) (Hebert et al. 2003a, b). All DNA barcode sequences were obtained through the Centre for Biodiversity Genomics at the University of Guelph in Guelph, Ontario, Canada. In an automated process for operational taxonomic unit designation, high-quality sequences were assigned barcode index numbers (BINs) using the Refined Single Linkage algorithm (Ratnasingham and Hebert 2007, 2013). New and previously published (Sheffield et al. 2009; Hebert et al. 2016; Onuferko 2018) sequences were downloaded as FASTA files and imported into Geneious 11.1.5 (Kearse et al. 2012), where they were aligned into a matrix using the Geneious (multiple) alignment algorithm. A neighbor-joining (NJ) tree was therein

generated based on the Tamura-Nei genetic distance model (Tamura and Nei 1993) to visualize sequence similarity/dissimilarity. New sequence data are contained in the project – ENAM *Epeolus* of North America on the Barcode of Life Data System (BOLD) (<https://www.boldsystems.org/>) and are also deposited in GenBank (<https://www.ncbi.nlm.nih.gov/genbank/>).

The description follows the format used by Onuferko (2017, 2018, 2019) and is mostly based on the holotype, with references to paratypes explicitly stated as such and the allotype forming the basis for the description of the sex opposite that of the holotype. Because *Epeolus* is largely sexually monomorphic (apart from the usual differences in the number of flagellomeres and metasomal segments and terminalia), a full description is given for the male (the sex of the holotype) whereas a shortened description that lists only key differences is given for the female (the sex of the allotype).

Modifications to the dichotomous identification keys to both sexes of *Epeolus* of Onuferko (2017, 2018) to include the newly described species are presented with complete illustrations. High-quality photographs were taken using the Leica Z16 APO A imaging system and focus-stacked with the accompanying LAS software. The resulting composite images were cropped, resized, and marked with arrows and lines in PaintShop Pro (Jasc Software, Inc.) and assembled into labeled figure plates in Adobe Photoshop 2020 (Adobe Inc.).

A range map was constructed in RStudio (version 1.1.463) as in Onuferko (2017, 2018), with the following packages installed in R (version 3.5.2) (R Core Team 2018) used: mapproj (Bivand and Lewin-Koh 2018), raster (Hijmans 2018), rgdal (Bivand et al. 2018), and rgeos (Bivand and Rundel 2018). To map the cartographic boundaries of Canada and the United States, shapefiles were obtained from Statistics Canada (2019) and the US Census Bureau (2015), respectively. For all other Global Administrative Boundaries (source = <https://gadm.org/>), the function ‘getData’ {raster} was used to download geographic data. The data points signifying collection localities and splined convex hull polygons representing estimated species ranges are based on known as well as approximated georeferenced occurrence records. The map includes new records as well as records of *E. autumnalis* based on specimens examined by the primary author but published previously (see Supplementary material 1 in Onuferko 2018).

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Superfamily Apoidea Latreille, 1802
Family Apidae Latreille, 1802
Subfamily Nomadinae Latreille, 1802
Tribe Epeolini Robertson, 1903

Epeolus emiliae Onuferko and Sheffield, new species

(Fig. 1, 2B, 3B, 4B, 5–9)

Proposed common name. Emilia’s epeolus.

Etymology. The specific epithet honors the primary author’s daughter, Emilia V. Onuferko. The noun is feminine and declined in the genitive case.

Materials examined. Primary type material. CANADA: **British Columbia:** ♂, holotype (Fig. 1D), Okanagan-Similkameen (49.5406° N, 119.5732° W), 27.viii–08.ix.2015, ex blue vane trap, D. Marks and J. Heron leg. (RSKM_RSKM_ENT_E-191681).

Secondary type material. CANADA: **British Columbia:** 1 ♂, paratype, Kelowna (Quails’ Gate Winery) (49.8385° N, 119.5712° W), 31.viii–24.ix.2016, ex blue vane trap, C. Dawson and J. Heron leg. (RSKM_RSKM_ENT_E-191679); 1 ♂, paratype, Okanagan-Similkameen (49.5406° N, 119.5732° W), 27.viii–08.ix.2015, ex blue vane trap, D. Marks and J. Heron leg. (BOLD sample ID: CCDB-25139 G09, RSKM_RSKM_ENT_E-185215); 1 ♂, paratype (Fig. 1C), Vernon, 15.ix.1919, E.R. Buckell (CNC 719832). USA: **California:** 1 ♀, paratype, 2 mi SW of Sugar Loaf Mountain, Modoc County, 12.ix.1969, E.E. Grissell and R.F. Denno leg. (UCBME P 0219060); **Colorado:** 1 ♀, allotype (Fig. 1A–B), Grand Junction, “9-6-32”, L.G. Davis leg. (CSUC); **Idaho:** 1 ♂, paratype,

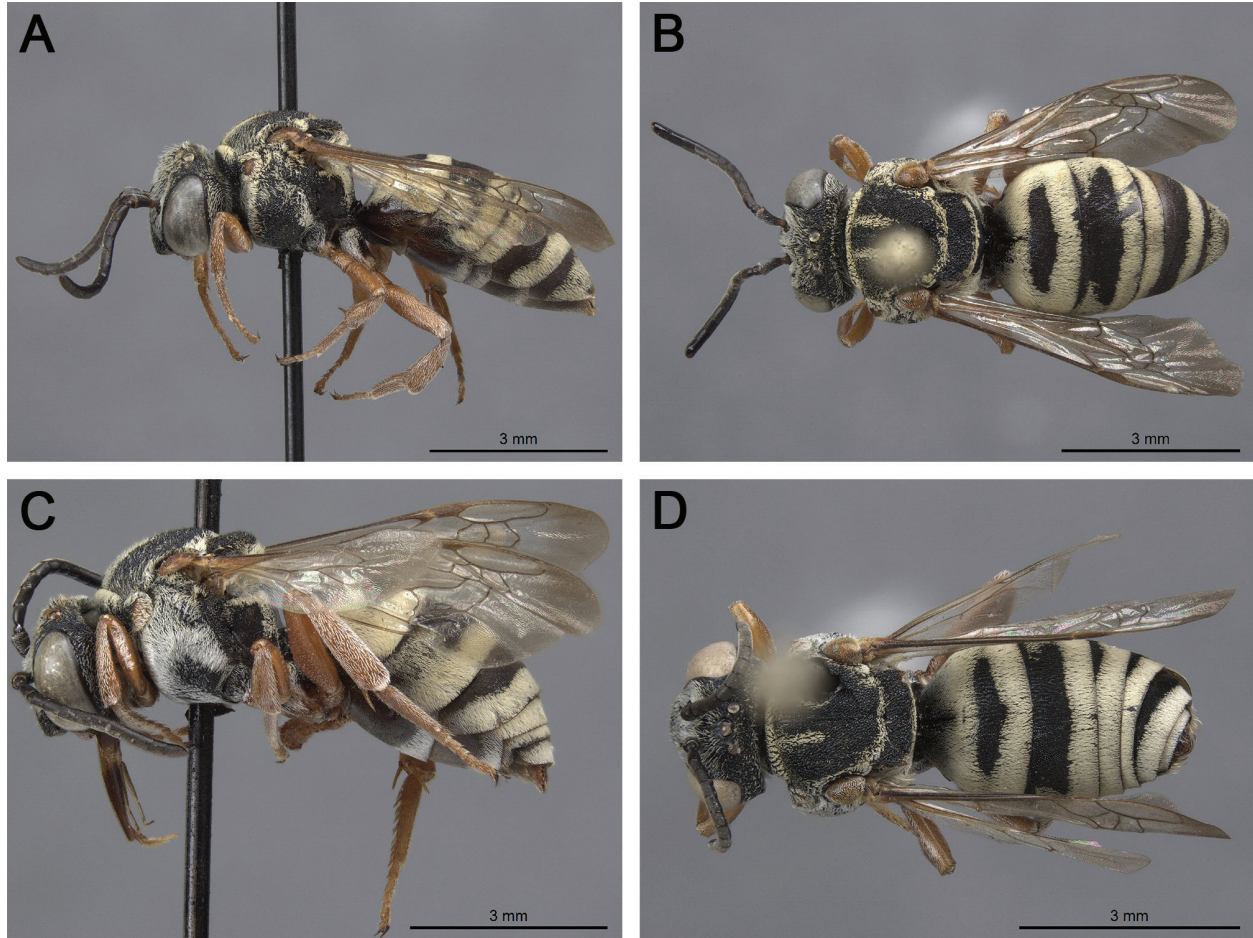


Figure 1. *Epeolus emiliae* new species. A–B. Allotype, ♀ (CSUC). A) Habitus, lateral view. B) Habitus, dorsal view. C) Paratype, ♂ (CNC 719832), habitus, lateral view. D) Holotype, ♂ (RSKM RSKM_ENT_E-191681), habitus, dorsal view.

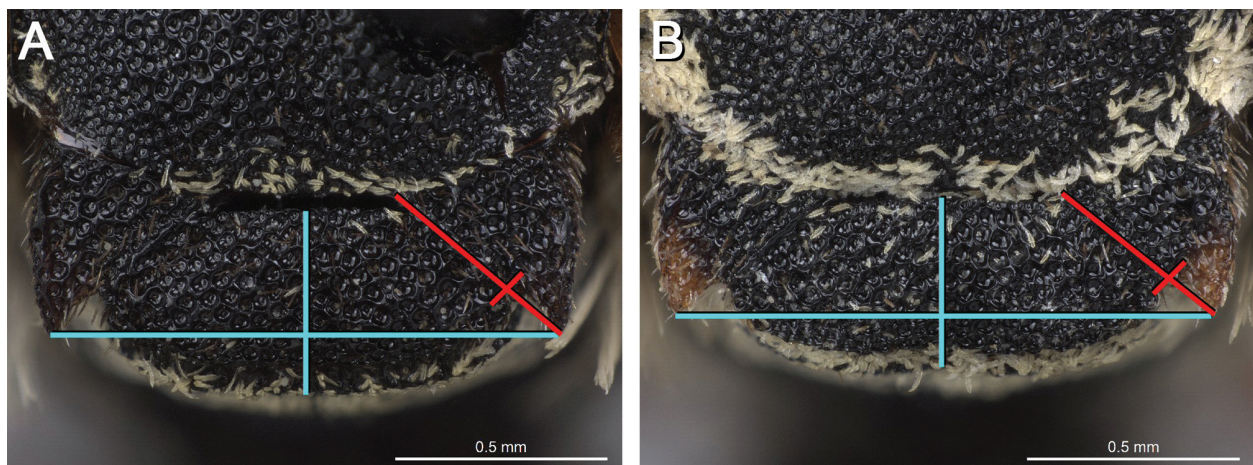


Figure 2. Axillae and mesoscutellum of female, dorsal view. A) *Epeolus autumnalis* Robertson, 1902 (BOLD sample ID: sheffT-52, RSKM RSKM_ENT_E-0101152). B) *E. emiliae* new species, paratype (UCBME P 0219060). Blue lines indicate the posterior extent of the axilla relative to the length of the mesoscutellum; red lines indicate the extent of the free portion of the axilla relative to its entire medial length.

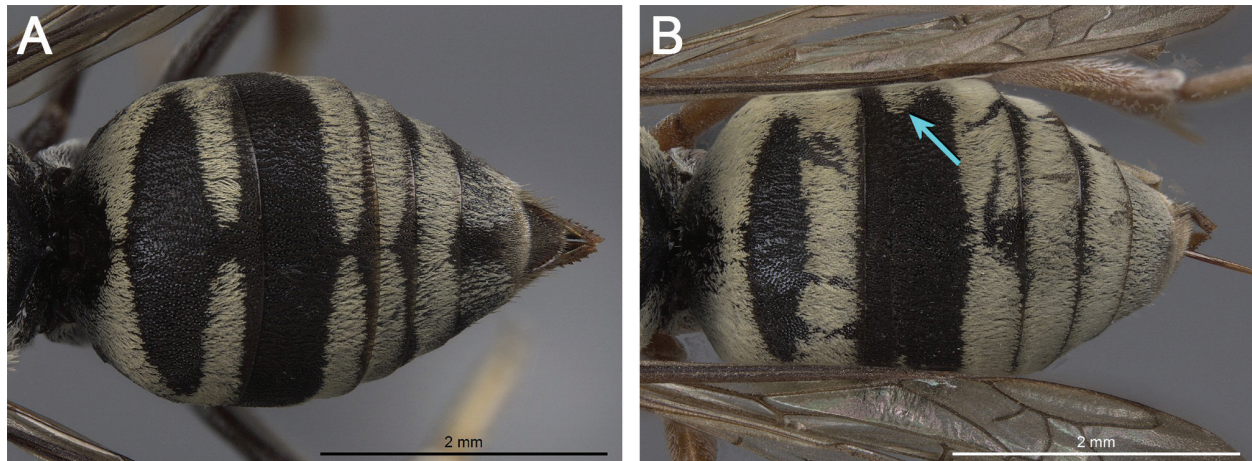


Figure 3. Metasoma of female, dorsal view. **A)** *Epeolus autumnalis* Robertson, 1902 (BOLD sample ID: 00-NS-0187, RSKM RSKM_ENT_E-0101148). **B)** *E. emiliae* **new species**, paratype (UCBME P 0219060) (blue arrow indicates anterolateral extension of T2 fascia).

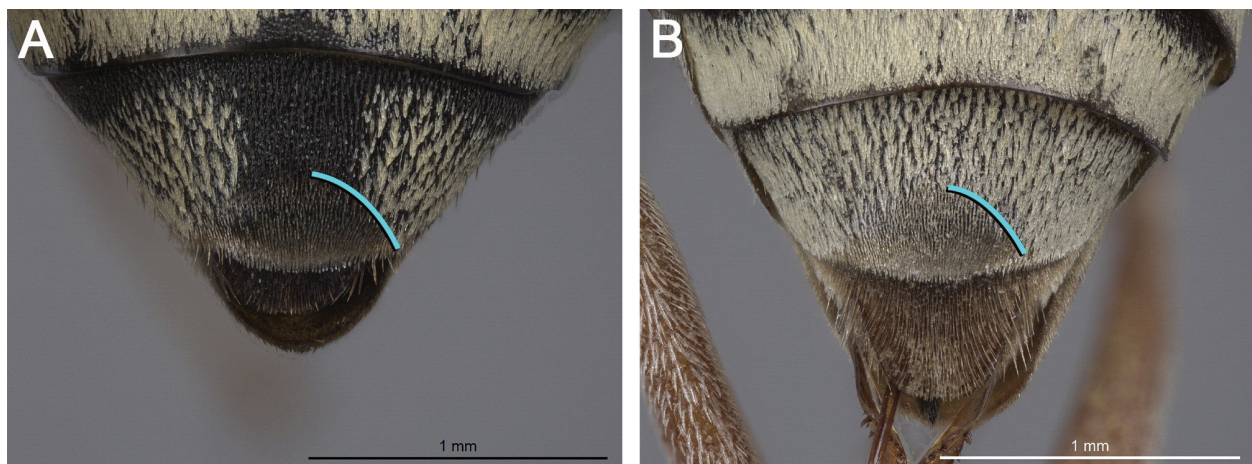


Figure 4. Pseudopygidial area of female, dorsal view. **A)** *Epeolus autumnalis* Robertson, 1902 (DEBU debu00402177). **B)** *E. emiliae* **new species**, paratype (UCBME P 0219060). The pseudopygidial area is the apical portion of T5 that changes slope from the rest of the tergum and is covered in short, coppery or silvery hairs (posteromesad the light blue lines).

Massacre Rocks State Park, Power County, 16.ix.1955, W.F. Barr leg. (USNM); **Oregon:** 1 ♀, paratype, Echo, 15.v.1904, E.S.G. Titus leg. (USNM).

Non-preserved material. USA: **Washington:** 1 ♀, 619 Tanglewood Dr., Richland (46.2722° N, 119.3112° W), 17.x.2021, L. Hill leg. (iNaturalist (<https://www.inaturalist.org>) record #98573666).

Diagnosis. The following morphological features in combination can be used to tell *E. emiliae* apart from all other North American *Epeolus*: the axillae are large, each with the tip extending well beyond the midlength of the mesoscutellum but not as far back as its posterior margin, and dilated laterally (Fig. 2B); the axillae (except sometimes the tips) and mesoscutellum are black (Fig. 2B); the mesopleura are closely ($i \leq 1d$) and evenly punctate; the T1 discal patch is wide but the lateral longitudinal band on each side is at least (and usually more than) half as wide as the breadth of the apical fascia in dorsal view (Fig. 1B, D, 3B); T1–T4 (in females) or T1–T6 (in males) have complete fasciae that reach or are very little removed from the apical margins of the terga (Fig. 1B, D, 3B); and the T2 fascia has a pair of anterolateral extensions (Fig. 1, 3B). *Epeolus emiliae* is most similar to *E. autumnalis*,

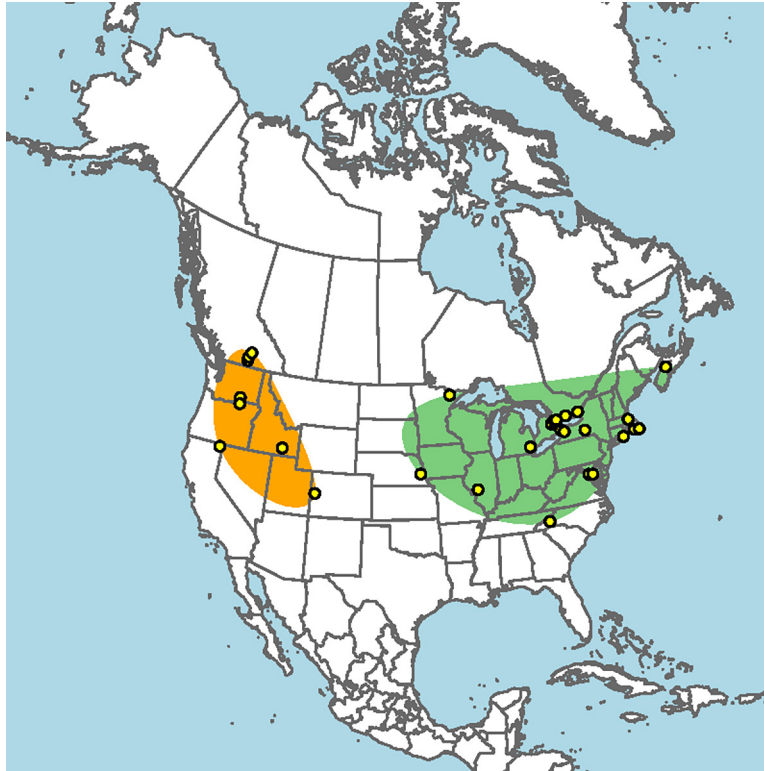


Figure 5. Approximate geographic ranges of *Epeolus autumnnalis* Robertson, 1902 (green) and *E. emiliae* **new species** (orange) based on occurrence records known to the authors (yellow circles).

with the above features related to surface sculpture and structure shared between the two species. However, in *E. autumnnalis* the axillae, including the tips, are invariably black (Fig. 2A); the legs, at least from the coxae to femora, are partially to predominantly dark brown/black (Fig. 3A) (they are entirely reddish orange from the femora to tarsi in *E. emiliae*, as shown in Fig. 1, 3B); the T1 discal patch is so wide that the lateral longitudinal band is barely visible in dorsal view (Fig. 3A); the T1–T3 apical fasciae are commonly narrowed or narrowly interrupted medially (although sometimes evenly broad) and at least somewhat removed from the apical margins of the terga (Fig. 3A); the T2 fascia does not have anterolateral extensions (Fig. 3A); and T5 of the female has a pair of large patches of pale tomentum surrounding the pseudopygidial area (Fig. 4A) (there is a single large, continuous patch of pale tomentum (or fascia) surrounding the pseudopygidial area in *E. emiliae*, as shown in Fig. 4B).

Description. Male. Measurements. Length 9.2 mm; head length 2.2 mm; head width 2.9 mm; fore wing length 6.7 mm.

Integument coloration. Dark brown to black except as follows. Mandible, including preapical (almost submedial) tooth but excluding usual large apical tooth (rutellum) and extreme base (difficult to see in holotype because mandibles closed; described from paratype); labrum; pronotal lobe; tegula; coxae partially; trochanters partially to entirely; and femora to tarsi entirely reddish orange. Antenna entirely dark brown in holotype, but scape and F1 reddish orange in part in multiple paratypes. Axilla entirely black in holotype, but with tip reddish orange in multiple paratypes. Wing membrane dusky subhyaline, slightly darker beyond venation.

Pubescence. Face with tomentum densest around antennal socket. Tomentum slightly sparser on clypeus; upper paraocular and frontal areas and vertexal area mostly exposed. Dorsum of mesosoma and metasoma with bands of off-white to pale-yellow short, appressed setae. Mesoscutum with paramedian band. Mesopleuron densely hairy, except for two sparsely hairy patches (one beneath base of fore wing (hypoepimeral area) and larger circular patch occupying much of ventrolateral half of mesopleuron). Metanotum with tomentum uninterrupted, uniformly pale yellow. T1 with discal patch umbrella-shaped and not especially wide—lateral longitudinal band at least half as wide as breadth

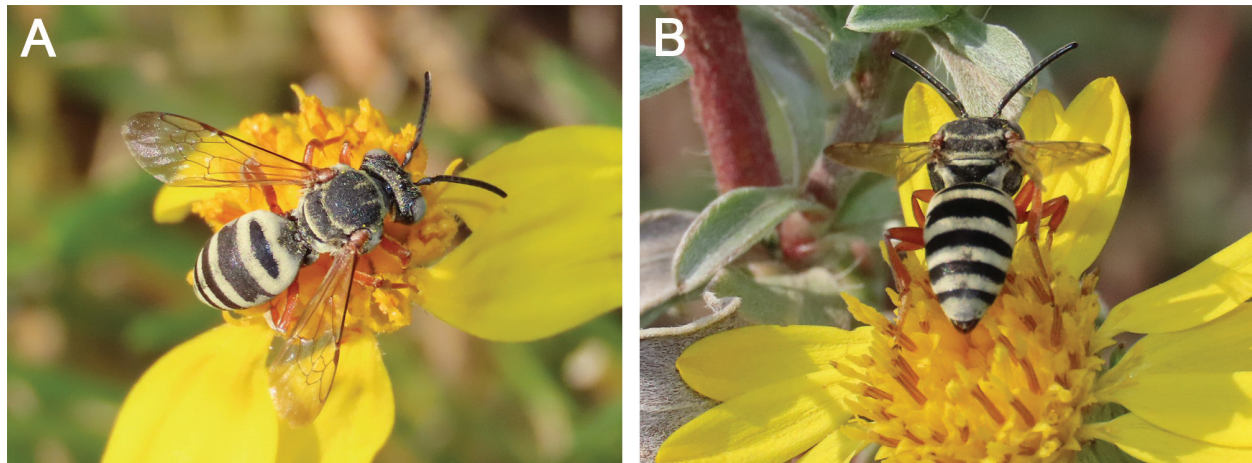


Figure 6. Female *Epeolus emiliae* new species visiting flowers of hairy golden aster (*Heterotheca villosa* (Pursh) Shinners (Asteraceae)) (location: Richland, Washington, USA). A) Shown with the specimen in dorsal view. B) Shown with the specimen in posterior view and the pseudopygidial area visible. Images courtesy of L. Hill.



Figure 7. A neighbor-joining tree that includes all COI sequences on BOLD assigned the BIN BOLD:AAF2361 as well as a sequence of a member of the nearest BIN (BOLD:AAF2273), generated in Geneious and based on the Tamura-Nei genetic distance model. The sequence for *Epeolus emiliae* new species is newly published whereas all others were downloaded from the BOLD Public Data Portal (www.boldsystems.org/index.php/Public_BINSearch?searchtype=records). Each sample is labeled with the following information in the following order: species name, BOLD sample ID, country and province or state of collection, sequence length (with the number of ambiguous bases indicated in square brackets), BIN uniform resource identifier, and GenBank accession number. Scale bar = 2% pairwise distance.

of apical fascia in dorsal view. T1 with basal and apical fasciae and T2–T6 with apical fasciae complete, T2 fascia with pair of basomedially convergent anterolateral extensions. S4 and S5 with long (>1 MOD), curved, coppery to silvery subapical hairs.

Surface sculpture. Labrum with sparser punctures ($i=1-2d$) than clypeus ($i<1d$). Small impunctate dull/textured spot laterad lateral ocellus. Mesoscutum, mesoscutellum, and axilla coarsely and densely rugose-punctate. Tegula densely punctate mesally ($i\leq 1d$), less so laterally ($i=1-2d$). Mesopleuron with ventrolateral half densely punctate ($i\leq 1d$), interspaces shining; mesopleuron with punctures similar in size and more or less equally dense throughout. Metasomal terga with punctures very fine, dense ($i\leq 1d$), evenly distributed on disc. Pygidial plate with large deep punctures closely clustered, except along margins.

Structure. Preapical mandibular tooth inconspicuous, blunt and obtuse. Labral apex with pair of small denticles (separated by shallow concavity), each preceded by longitudinal carina. Frontal keel not strongly raised. Scape (excluding radicle) with greatest length $1.8\times$ greatest width. F2 noticeably longer than wide (L/W ratio = 1.3). Preocipital ridge separated from hypostomal carina below by about 1.0–1.5 MOD. Mesoscutellum weakly bigibbous. Axilla large, its lateral margin half as long as mesoscutellar width ($AL/MSCW$ ratio = 0.5) and tip extending well beyond midlength, but not as far back as posterior margin, of mesoscutellum, tip distinctly pointed, but mesally unattached to



Figure 8. Dissected S7 (left) and S8 (right), ventral view, of male *Epeolus emiliae* **new species** (BOLD sample ID: CCDB-25139 G09, RSKM RSKM_ENT_E-185215) (with posterior ends oriented toward the top).

mesoscutellum for less than $\frac{2}{5}$ medial length of axilla; axilla with lateral margin arcuate and carinate. Fore wing with three submarginal cells (second submarginal crossvein incomplete in left fore wing of one (female) paratype, and second and third submarginal crossveins present but greatly reduced in both fore wings of one (male) paratype). Pygidial plate apically rounded.

Female. F2 longer than wide (L/W ratio = 1.5); T5 with large, continuous patch of pale tomentum (or fascia) bordering and contacting pseudopygidial area; T5 with pseudopygidial area lunate, its apex less than twice as wide as medial length, indicated by silvery setae on impressed disc of apicomedial region elevated from rest of tergum; T6 not fasciate; pygidial plate apically truncate, with smaller punctures; S4 and S5 with much shorter hairs (S5 with apical fimbria of coppery to silvery hairs extending beyond apex of sternum by $\sim\frac{1}{3}$ MOD).

Distribution. United States west of the Great Plains to southern British Columbia (Fig. 5).

Ecology. Host records. Unknown.

Floral records. *Heterotheca villosa* (Pursh) Shinnery (Asteraceae) (Fig. 6).

Remarks. *Epeolus emiliae* shares a BIN (i.e., BOLD:AAF2361) with *E. autumnalis*, its presumed sister species. The available DNA barcode sequence for *E. emiliae* exhibits as much as 99.5% similarity to sequences of *E. autumnalis* (determined using the BOLD Identification Engine: https://www.boldsystems.org/index.php/IDS_OpenIdEngine) and does not cluster separately from them (see Fig. 7), suggesting conspecificity, albeit due to the inclusion of a short sequence (366 bp) of *E. autumnalis* in the NJ tree. The (male) specimen (BOLD sample ID: sheffT-53) with which the 366-bp sequence is associated agrees fully with the current morphological diagnosis for *E. autumnalis* (Onuferko 2018). Despite the short sequence's position in the NJ tree, which should be interpreted cautiously (see <https://www.boldsystems.org/index.php/resources/boldfaq#reg6>), it is matched with 100% similarity to the nine (out of ten) BIN-compliant sequences presently available for *E. autumnalis* and has no unique nucleotides. By contrast, the only sequence available for *E. emiliae* has five nucleotides (40 – T; 235 – T; 262 – A; 634 – C; 637 – A) that are not shared with any sequences of *E. autumnalis*, although to determine whether or not they are diagnostic will require barcoding additional representatives of *E. emiliae*. In any case, the presence of multiple consistent and pronounced morphological differences in integument coloration and the patterns of pubescence on the metasoma as well as the apparent lack of range overlap between the two forms sharing this BIN support their treatment as separate species.

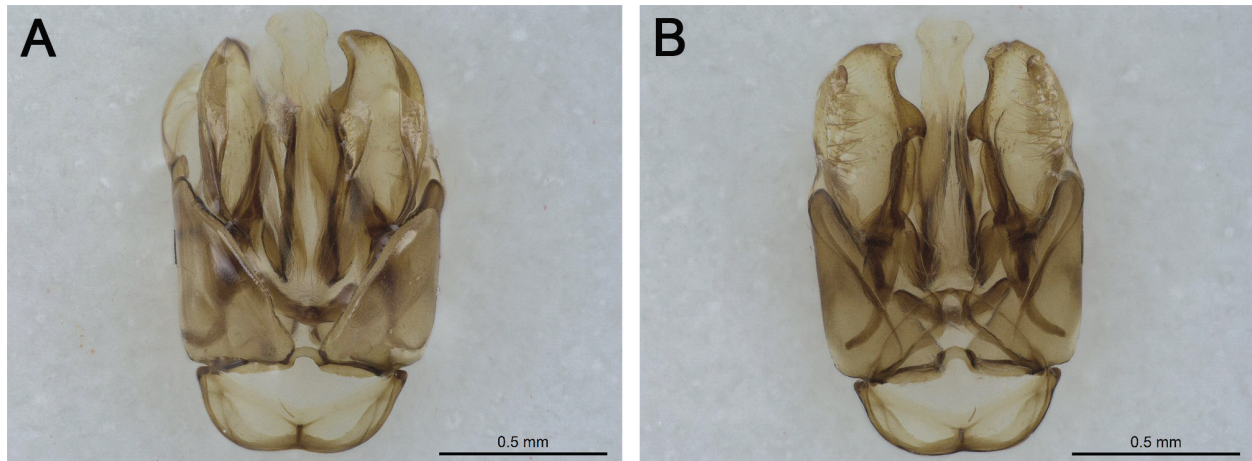


Figure 9. Dissected genitalia of male *Epeolus emiliae* new species (BOLD sample ID: CCDB-25139 G09, RSKM RSKM_ENT_E-185215) (with posterior end oriented toward the top). A) Dorsal view. B) Ventral view.

The male hidden sterna of *E. emiliae* (Fig. 8) closely resemble those of *E. autumnalis* (see Onuferko 2017: pl. 2C), although there is generally little variation in the form of S7 and S8 among species of *Epeolus*. The genitalia are also very similar between the two species (see Fig. 9; Onuferko 2017: pl. 3C), and, as in most species of *Epeolus* (see Onuferko et al. 2019), in both *E. autumnalis* and *E. emiliae* the penis has a pair of fleshy lateral lobes.

This discovery presents yet another example of a case of speciation within *Epeolus* attributed to an east–west divide in North America. A plurality of sister species/clades of North American *Epeolus* with disjunct distributions are separated by the Great Plains and/or Rocky Mountains, which represent significant (modern and historical) barriers to gene flow (Onuferko et al. 2019).

Although distinct from *E. autumnalis*, to confirm that the western form constituted an undescribed species, comparisons were made to descriptions and images of primary types (if available) of North American Epeolini with unplaced names. The list includes *Triepeolus cuneatus* Cockerell, 1917, *Triepeolus hopkinsi* Cockerell, 1905, *Triepeolus isocomae* Cockerell, 1904, *Triepeolus pomonalis* Cockerell, 1916, *Epeolus scelestus* var. *tubercularis* Brues, 1903, and *Triepeolus sequior* Cockerell, 1921, whose placement within *Triepeolus* Robertson, 1901, remains unconfirmed (Rightmyer 2008). The possibility that the species resembling *E. autumnalis* was described previously under any of these unplaced names was ruled out on the basis of pronounced morphological differences as follows.

In the (male) holotype of *T. cuneatus* (USNM, catalog number: 534625), which was studied from images available on the U.S. National Entomological Collection website (<https://collections.nmnh.si.edu/search/ento/>), the axillae are small with relatively straight lateral margins (as opposed to large with convex lateral margins) and the T1 discal patch is strongly rectangular (as opposed to umbrella-shaped). The whereabouts of the (male) holotype of *T. hopkinsi* is unknown; according to the original description (Cockerell 1905), the specimen has been returned to Mr. (Henry Lorenz) Viereck, but the repository was not indicated. However, the species was described as having pale grayish-creamy markings, a strongly bilobed mesoscutellum, and a narrow pygidial plate. By contrast, in *E. emiliae* the pale hairs are off-white/pale yellow, the mesoscutellum is only weakly bigibbous, and (as in most species of *Epeolus*) the pygidial plate is broadly rounded posteriorly. In the (male) holotype of *T. isocomae* (USNM, catalog number: 534639), which was studied from images available at <https://collections.nmnh.si.edu/search/ento/>, the mandibles are simple (as opposed to bidentate). According to Cockerell's (1916) original description, the (male) holotype of *T. pomonalis* belongs to Pomona College, but the specimen could not be found there and appears to have been lost (see Rightmyer 2008). Nevertheless, it was described as having black (as opposed to reddish orange) tegulae and legs as well as pale tomentum all along the margins of the mesoscutum except anteriorly in the middle (as opposed to only along the lateral and posterior margins) and resembling *Triepeolus lunatus* (Say, 1824) (as *T. concolor*) and *Triepeolus remigatus* (Fabricius, 1804) in the original description (Cockerell 1916). Unfortunately, the original description of *E. scelestus* var. *tubercularis* is short and insufficiently detailed and the type repository is not indicated (Brues 1903), but the (female) holotype was described as differing from “typical *scelestus*” in terms of integument coloration, and Rightmyer (2008) indicated that the name is likely a junior synonym of *Triepeolus scelestus* (Cresson, 1878). Since the type locality (Austin, TX, USA) for *E. scelestus* var. *tubercularis* is well outside the known range of *E. emiliae*, it seems highly improbable

that both names correspond to the same species. Lastly, in the (male) holotype of *T. sequior* (American Museum of Natural History, New York, NY, USA, catalog number: AMNH_IZC 00323957), which was studied from images kindly supplied to the authors by Museum Specialist Corey Smith, the tegulae are dark brown/black (as opposed to reddish orange), the axillae are small (unlike in *E. emiliae*), and the profemora and protibiae (except their apices) are dark brown/black (as opposed to entirely reddish orange).

As a result of the discovery of the new species *E. emiliae*, the total numbers of *Epeolus* species confirmed from Canada and the United States are now 14 and 44, respectively. With the modifications to the existing keys presented below, both sexes of *E. emiliae* can be readily identified among Canadian *Epeolus* as well as all North American members of the genus known from north of Mexico.

Modifications to the key to species of *Epeolus* in Canada of Onuferko (2017) to include *E. emiliae* new species

Note that the couplet below replaces couplet 6 of the original key and the latter is no longer needed.

- 6(4). Axilla with tip extending well beyond midlength of mesoscutellum; axilla large and robust (AL/MSCW ratio >0.4), its lateral margin arcuate (except sometimes in *E. autumnalis*) (Onuferko 2017: fig. 13a, b) 7
- Axilla with tip at most extending to midlength of mesoscutellum; axilla small (AL/MSCW ratio <0.4), its lateral margin relatively straight (Onuferko 2017: fig. 13c, d) **couplet 9 of the original key (Onuferko 2017)**
- 7(6). T1 in dorsal view with lateral longitudinal band at least half as wide as breadth of apical fascia (Fig. 1B, D, 3B); T1–T3 with fasciae on or very little removed from apical margins of terga and complete, those of T2 and T3 more or less evenly broad (Fig. 1B, D, 3B) ***E. emiliae* new species**
- T1 in dorsal view with discal patch so wide that lateral longitudinal band barely visible (its width less than half maximum breadth of apical fascia) (Fig. 3A; Onuferko 2017: fig. 9d); T1–T3 with apical fasciae at least somewhat removed from apical margins of terga medially, commonly narrowed or narrowly interrupted medially (Fig. 3A; Onuferko 2017: fig. 9d, pl. 1C, L, M) **couplet 7 of the original key (Onuferko 2017)**

Modifications to the key to species of *Epeolus* in North America north of Mexico of Onuferko (2018) to include *E. emiliae* new species

Note that the couplet below replaces couplet 16 of the original key and the latter is no longer needed.

- 16(11). Axilla with tip clearly not reaching band of pale tomentum along posterior margin of mesoscutellum; axilla (except sometimes tip) and mesoscutellum entirely black (Fig. 2; Onuferko 2018: fig. 16D) .. 17
- Axilla with tip extending to or beyond band of pale tomentum along posterior margin of mesoscutellum (may be just short of band at apicomедial extent of mesoscutellum); axilla with few exceptions reddish orange to some degree (commonly beyond tip); mesoscutellum entirely black to entirely reddish orange (Onuferko 2018: fig. 24D, 71D, 73D, 79D, 83D) **couplet 17 of the original key (Onuferko 2018)**
- 17(16). Legs, at least from coxae to femora, partially to predominantly dark brown/black (Fig. 3A; Onuferko 2018: fig. 16A–C); T1 in dorsal view with discal patch so wide that lateral longitudinal band barely visible (its width less than half maximum breadth of apical fascia) (Fig. 3A; Onuferko 2018: fig. 16B); T1–T3 with apical fasciae at least somewhat removed from apical margins of terga medially, commonly narrowed or narrowly interrupted medially (Fig. 3A; Onuferko 2018: fig. 16A–C); T2 fascia without anterolateral extensions (Fig. 3A; Onuferko 2018: fig. 16A–C); T5 of female with pair of large patches of pale tomentum surrounding pseudopygidial area (Fig. 4A) [east of the Rocky Mountains] ***E. autumnalis* Robertson, 1902**

- Legs, at least from femora to tarsi, entirely reddish orange (Fig. 1, 3B); T1 in dorsal view with lateral longitudinal band at least half as wide as breadth of apical fascia (Fig. 1B, D, 3B); T1–T3 with apical fasciae on or very little removed from apical margins of terga and complete, those of T2 and T3 more or less evenly broad (Fig. 1B, D, 3B); T2 fascia with pair of anterolateral extensions (Fig. 1, 3B); T5 of female with single large, continuous patch of pale tomentum surrounding pseudopygidial area (Fig. 4B) [west of the Great Plains] *E. emiliae* new species

New provincial records of *Epeolus* in Canada

Epeolus interruptus Robertson, 1900

Material examined. **Alberta:** 1 ♂, Gold Canyon (Lethbridge) (49.6547° N, 112.8197° W), 03.vii.2020, ex yellow pan trap, M. Buck leg. (RAM pmae00155702); 1 ♂, Writing-on-Stone Provincial Park (Davis Coulee), Warner County (49.0733° N, 111.6292° W), 21.vii.2020, ex *Dalea candida*, M. Buck leg. (RAM pmae00157527); **Quebec:** 1 ♀, Lakeside, 19.vii.1931, J.W. Buckle leg. (LEM); 1 ♂, Mont-Saint-Hilaire, 25.vii.1926, J.W. Buckle leg. (LEM), 1 ♀, same collection data as for preceding, except 30.vii.1927 (LEM).

Epeolus scutellaris Say, 1824

Material examined. **Saskatchewan:** 1 ♀, 7.6 km NNW of Webb, active sand dune (50.2431° N, 108.2503° W), 03.viii.2019, T.M. Onuferko leg. (CMNC).

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