

***Culicoides* (Diptera: Ceratopogonidae) of Ontario: A Dichotomous Key and Wing Atlas**

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Abstract

Culicoides Latreille, 1809 (Diptera: Ceratopogonidae) is a diverse genus of tiny biting flies that are both pests and vectors of pathogens of medical, veterinary, and economic importance. Herein, we provide an identification key and wing atlas of adult female biting midges for the 40 *Culicoides* species that have been recorded or are likely to be present in Ontario, Canada. The key includes: *C. albertensis* Wirth and Jones, *C. alexanderi* Wirth and Hubert, *C. arboricola* Root and Hoffman, *C. atchleyi* Wirth and Blanton, *C. baueri* Hoffman, *C. bergi* Cochrane, *C. bickleyi* Wirth and Hubert, *C. biguttatus* (Coquillett), *C. chiopterus* (Meigen), *C. cockerellii* (Coquillett), *C. crepuscularis* Malloch, *C. denticulatus* Wirth and Hubert, *C. downesi* Wirth and Hubert, *C. flukei* Jones, *C. footei* Wirth and Jones, *C. franclemonti* Cochrane, *C. frohnei* Wirth and Blanton, *C. furensoides* Williams, *C. guttipennis* (Coquillett), *C. haematopotus* Malloch, *C. jamnbacki* Wirth and Hubert, *C. nanus* Root and Hoffman, *C. obsoletus* (Meigen), *C. paraimpunctatus* Borkent, *C. parapiliferus* Wirth and Blanton, *C. piliferus* Root and Hoffman, *C. sanguisuga* (Coquillett), *C. snowi* Wirth and Jones, *C. sphagnumensis* Williams, *C. spinosus* Root and Hoffman, *C. stellifer* (Coquillett), *C. stilobezzioides* Foote and Pratt, *C. testudinalis* Wirth and Hubert, *C. travisi* Vargas, *C. utowana* Jamnback, *C. variipennis* (Coquillett), *C. venustus* Hoffman, *C. villosipennis* Root and Hoffman, *C. wisconsinensis* Jones, and *C. yukonensis* Hoffman. We provide a pictorial key based on novel and existing published observations of the morphological features observed from these 40 species, and include a pictorial wing atlas. This key will allow for the identification of *Culicoides* from Ontario down to the lowest taxonomic level possible including: one subgenus (with three species), one species group (with 11 species), and 26 separate species.

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Introduction

The genus *Culicoides* Latreille (Diptera: Ceratopogonidae) is an abundant, diverse, and economically important group of hematophagous flies, known as biting midges. *Culicoides* can be found worldwide on most major land masses, with the exception of New Zealand and Antarctica, and together represent the most diverse genus in the family Ceratopogonidae, with more than 1,300 described species (Borkent and

Dominiak 2020). These tiny flies, also called no-see-ums or punkies are typically less than 3 mm in length and well known for their irritating bites, as well as their ability to serve as vectors of a variety of pathogens that can affect humans, livestock, and wildlife (Borkent 2004).

Biology

The life cycle of *Culicoides* normally comprises four stages: egg, larva (with four instars), pupa and adult, although two species are parthenogenetic (Borkent

2004). Larval *Culicoides* require water or moisture and often inhabit streams, pools, moist soil, dung, or vegetation (Wirth and Hubert 1989). Currently, there is only taxonomic information available for the larvae and pupae for approximately 19% of the world's *Culicoides*, meaning that immature stages of many species, and their associated habitats, are still undescribed (Borkent 2012b). Development takes weeks to months, and overwintering occurs in a larval stage in temperate regions (Sick et al. 2019). Most adults survive for around 10–20 days (Mellor et al. 2000) and are typically active at dusk (Blanton and Wirth 1979) or in a crepuscular pattern (Kline and Roberts 1982).

Female *Culicoides* are hematophagous, and most species require a blood meal for their eggs to reach maturity, although autogeny does occur in both nature and a laboratory setting (Glukhova and Dubrovskaja 1972). Blood feeding habits differ widely, but many North American species are considered either primarily ornithophilic, primarily mammalophilic, or generalist (Jamnback 1965; Blanton and Wirth 1979; Hair and Turner 1968). Within these categories, species will often exhibit further feeding specialization, such as primarily utilizing large mammal hosts, or feeding from specific areas of the host such as the lower legs or flank (Nielsen 1971). Finally, there are some *Culicoides* species with less typical feeding habits like *C. testudinalis* Wirth and Hubert, which feeds on turtles (Jamnback 1965), and others with reduced mandibular teeth, suggesting a shift from blood-feeding to flower-feeding (Wirth and Hubert 1962). Determining which species feed on which host/hosts is essential in determining whether a species is or has the potential to act as a vector of a pathogen (Kettle 1977).

***Culicoides* as a Vector**

Various *Culicoides* species around the world have been implicated as vectors for at least 66 viruses, 15 protozoa, and 26 species of nematodes (Borkent 2004). Examples include veterinary arboviruses affecting livestock and wildlife such as bluetongue virus (BTV), epizootic hemorrhagic disease virus (EHDV), Schmallenberg virus, and African horse sickness virus (Borkent 2004; Harrup et al. 2015; Borkent 2017). Because of the lack of *Culicoides* surveillance activity in Canada, little is known of the country-level distribution of these biting midges acting as vectors. *Culicoides sonorensis* is considered one of the main vectors of BTV and EHDV in North America (Tabachnik 1996; Carpenter et al. 2015). It was previously suggested that the increased rates of BTV and EHDV in eastern Canada were due to a recent range expansion of the western species *C. sonorensis* (Jewiss-Gaines et al. 2017; Purse et al. 2015; Allen et al. 2019). However, recent data from Shults et al. (2022a, 2022b) suggested that this eastern

Canadian species believed to be *C. sonorensis* is actually *C. albertensis* Wirth and Jones. *Culicoides albertensis* is sympatric with *C. sonorensis* but not a confirmed vector of BTV and EHDV (Shults et al. 2022b). An alternative explanation for higher rates of *Culicoides*-borne disease in eastern Canada is that other species, such as *C. stellifer* (Coquillett) and *C. venustus* Hoffman, which have been implicated as vectors of EHDV in the southern United States, could be responsible for the spread (McGregor et al. 2019; Shults et al. 2020). There has been a northward expansion of several *Culicoides*-borne viruses in North America, increasing the likelihood of these diseases being spread to Ontario and other disease-free regions (Ruder et al. 2015; Stallknecht et al. 2015; Allen et al. 2019). Potential reasons for this northward expansion include strong wind currents, movement of livestock hosts or range shifts associated with climate change (Zuliani et al. 2014; Elbers et al. 2015; Samy and Peterson, 2016). The paths of *Culicoides*-borne diseases are often ecologically complex and may include multiple vectors and host species within a single region (Purse et al. 2015). Since many species of *Culicoides* worldwide are vectors of economically important viruses that affect wild and domestic ruminants, such as deer, cattle, sheep, and goats, as well as equines, having sound morphological identifications is important for successful surveillance, management, and mitigation strategies (Harrup et al. 2015).

***Culicoides* Identification**

Species level identification of *Culicoides* is difficult for a variety of reasons. Specimen collection is time-consuming and often requires specialized traps and/or equipment particular to each life stage. Observing such tiny organisms requires the use of high magnification, usually a microscope, to see even the most basic characteristics. Furthermore, specimens must also often be slide-mounted to observe diagnostic characters. Morphological identification of *Culicoides* often depends upon published species descriptions, which vary widely, and are often dated, cryptic, and based on subjective traits (Borkent and Grogan 2009). The identification process requires access to keys and descriptions from multiple sources (Swanson 2012), as well as a high degree of expertise in working with biting midges. The ability to identify *Culicoides* species is of increasing importance as the current climate crisis affects the distributions of several arthropod species of veterinary importance (Elbers et al. 2015; Vigil et al. 2018).

In the Nearctic region north of Mexico, there are 150 known species of *Culicoides*, comprising 13 subgenera, seven species groups, and nine unplaced species (Borkent and Grogan 2009). The subgenera and species groups are important for understanding and identifying this diverse genus, and are generally phenetic, or based

on shared morphological characteristics. However, many researchers agree that the current taxonomic organization, which is ambiguous and fails to incorporate many species, needs to be thoroughly revised to reflect groups of evolutionarily related species based on derived traits, rather than on only their current morphology (Borkent and Grogan 2009, Harrup et al. 2015, Borkent and Dominiak 2020). In addition to these taxonomic challenges, most identification keys to *Culicoides* are dated, difficult to follow, and may only include species from limited geographic areas, specific subgenera, or species groups. This is especially true in Canada and the Nearctic, as there are no comprehensive keys to North American *Culicoides* in the literature (Borkent and Dominiak, 2020).

Key Preparation

Here we present a key for the 40 species of *Culicoides* in Ontario, using adult female morphology. We include *C. atchleyi*, which has been reported in Alaska, Nova Scotia, and New Mexico (Wirth et al. 1985) and was included due to the extremely wide distribution which extends over Ontario.

This key is based on the morphological characteristics of adult female *Culicoides* specimens, the specimens used for reference in this key have typically been stored in ethanol or slide mounted. For most species female wing patterns are more distinct, and male representatives are less frequently obtained via light traps (Gonzalez et al. 2013; Venter et al. 2009), which are the predominant method of collecting *Culicoides*. However, in some limited cases, keys using male features are available (Vargas 1960), and males can provide additional diagnostic characteristics (Swanson 2012). Additionally, there are keys for several described pupae of *Culicoides* species (Borkent 2012a; Shults and Borkent 2018).

Traditional *Culicoides* species descriptions often rely on characteristics that require specimens to be dissected and slide-mounted, as described in Borkent and Spinelli (2007), to observe morphology under high magnification. The goal of this publication is to provide a means for the morphological identification of *Culicoides* species, with a focus on ease of use and reducing the necessity for slide-mounting specimens. Wherever possible, this key uses characteristics that are visible under lower magnification, and a strong stereomicroscope will often suffice for visualizing characteristics in whole, unmounted specimens. In addition, we avoid using measurements and ratios on the wings, and we only suggest simple antennal ratios in some dichotomies. However, even when visible, some characteristics will be difficult to identify and define in an unmounted specimen, such as spermathecae. Therefore, slide-mounting may still be helpful or necessary to differentiate some species. It is also important to note that characteristics

such as macrotrichia may fall off of specimens as they are collected to varying degrees, and therefore this should only be used as a diagnostic characteristic if the macrotrichia are present on a specimen.

Species not recorded in Ontario but occurring in bordering States or Provinces were not included in the current key as it was beyond the scope of this paper, but are mentioned in reference to similar species in the species information pages when relevant. Several of these species occurring at least in part in New York and/or New Brunswick (*C. (Beltranmyia) hollensis* Melander and Brues, *C. (B.) bermudensis* Williams, and *C. (Oeacta) furens* (Poey) (Jamnback 1965; Borkent and Grogan 2009)) are collected exclusively in salt marshes on the east coast (Jamnback 1965) and are therefore unlikely to be encountered in Ontario. Other species occurring at least in part in Quebec and/or New York and/or Michigan (*C. (Amossovia) beckae* Wirth and Blanton, *C. (Drymodesmyia) hinmani* Khalaf, *C. (Avaritia) juddi* Cochrane, *C. (Silvaticulicoides) loisae* Jamnback, *C. (Avaritia) pechumani* Cochrane, and *C. scanloni* Wirth and Hubert (Borkent and Grogan 2009) are more likely to be encountered in Ontario based on larval habitat and are mentioned in reference to similar species.

Morphological identification is imperative for building DNA barcode reference libraries for species. Future directions should focus on a larger cladistics interpretation of the genus, as this key and many other sources are purely based on morphological taxonomy (Borkent 2012b). This key helps alleviate the taxonomic impediment of Canadian *Culicoides*, as it gives the first comprehensive compilation of all diagnostic information and distributions of female *Culicoides* that are found in Ontario.

Materials and Methods

Specimens

Many whole specimens used for reference images were collected in June and July of 2019 on the University of Guelph Campus, using UV light traps (UV LED CDC Trap with 6V12AH/20HR Rechargeable Valve Regulated Lead-Acid Battery, Bioquip Products Inc., California, USA). Light traps equipped with LEDs emitting ultraviolet light were used because they have been found to catch some species of *Culicoides* in a higher abundance and/or diversity (Nelder et al. 2010; Viennet et al. 2011; Vigil et al. 2014). Three collection events (19 June 2019, 9 July 2019, and 19 July 2019) were conducted by setting out traps $\frac{3}{4}$ full with a concentrated salt solution made by mixing 1 L of water, 0.4 kg of sodium chloride (salt), and 2 drops of unscented soap. Traps were set up in an agricultural area: the Ontario Veterinary College Dairy Barn in the cattle enclosure (43.528696, -80.230604), and in a natural area: the University of

Guelph Arboretum (43.538184, -80.218447) in the late afternoon, and collected in the early morning of the next day. From these traps, 162 individual *Culicoides* specimens were collected and identified representing 12 species, one subgenus, and one species group (Appendix 1). Additional whole specimens were obtained from the CFIA National Centre of Animal Diseases, Lethbridge Laboratory (Lethbridge, Alberta, Canada) from pre-existing Canadian collections that were conducted during 2014–2016. Whole specimens were stored individually in 95% ethanol. Specimens from the 2019 summer collection were not slide mounted, as they were being stored for future molecular work. Slide-mounted specimens or images of slide-mounted specimens were obtained from the CFIA National Centre of Animal Diseases Lethbridge Laboratory, the Canadian National Collection of Insects, Arachnids and Nematodes, The Smithsonian's National Museum of Natural History, The New York State Museum, the Southeastern Cooperative Wildlife Disease Study, and the Florida State Collection of Arthropods. Distribution maps for each species were made using the online tool SimpleMappr (Shorthouse 2010).

Identification

Culicoides that were collected in the summer of 2019 were identified to genus using the key to Ceratopogonidae found in Downes and Wirth (1981), and then were identified further down to subgenus, species group, or species (Appendix 1). Additional taxonomic keys reviewed for general information on *Culicoides* included Fox 1955, Hair et al. 1966, Wirth et al. 1985, Wirth and Jones 1956, Foote and Pratt 1954, Cochrane 1974, Hoffman 1925, Jamnback 1965, Williams 1955, Root and Hoffman 1937, and Wirth and Blanton 1969a. To identify the *Culicoides haematopotus* group (*C. footei*, *C. haematopotus*), we used Atchley and Wirth (1979). To identify the subgenus *Avaritia* (*C. obsoletus*, *C. sanguisuga*, *C. chiopterus*), we used Jamnback and Wirth (1963). To identify the *guttipennis* species group (*C. guttipennis*, *C. villosipennis*, *C. flukei*, *C. arboricola*), we used Wirth and Blanton (1967). To identify the *pulicaris* species group (*C. yukonensis*, *C. paraimpunctatus*) and *cockerellii* (*C. cockerellii*, *C. frohnei*), we used Wirth and Blanton (1969a). To identify the *piliferus* species group (*C. alexanderi*, *C. bicklei*, *C. denticulatus*, *C. downesi*, *C. franclemonti*, *C. jamnbacki*, *C. parapiliferus*, *C. piliferus*, *C. snowi*, *C. testudinalis*, *C. utowana*), we used Wirth and Hubert (1962), Wirth and Blanton (1974), Cochrane (1974), and Jamnback (1965).

Imaging

All images in this publication were taken by authors L. Janke, S. Vigil, and T. Furukawa-Stoffer. For many of the images used in this publication, the following is the protocol used by the first author. Photographs for

whole specimens were taken while they were submerged in 95% ethanol. The imaging program Leica LAS X (version 3.6.0.20104; Leica Microsystems, Wetzlar, Germany), the camera Leica MC170 HD (Leica Microsystems, Wetzlar, Germany), and the scope M205 A (Leica Microsystems, Wetzlar, Germany) were used for most pictures. Specimens with the least amount of wing damage and desiccation were selected for imaging. Pictures of six orientations were taken and used for each whole specimen: right lateral, left lateral, ventral, close-up of the head, close-up of external genitalia, and wings. Slide-mounted specimens were also imaged using the same microscope, and usually included a lateral, head, internal genitalia, and wing image.

Checklist

Table 1. Checklist of the *Culicoides* Latreille of Ontario, organized by subgenus and then species group or section, if applicable.

<i>Amossovia</i> Glukhova, 1989
<i>C. arboricola</i> Root and Hoffman, 1937
<i>C. flukei</i> Jones, 1956
<i>C. guttipennis</i> (Coquillett, 1901)
<i>C. villosipennis</i> Root and Hoffman, 1937
<i>Avaritia</i> Fox, 1955
<i>C. chiopterus</i> (Meigen, 1930)
<i>C. obsoletus</i> (Meigen, 1818)
<i>C. sanguisuga</i> (Coquillett, 1901)
<i>Beltranmyia</i> Vargas, 1953
<i>C. crepuscularis</i> Malloch, 1915
<i>C. sphagnumensis</i> Williams, 1955
<i>C. wisconsinensis</i> Jones, 1956
<i>Culicoides</i> Latreille, 1809
<i>C. cockerellii</i> (Coquillett, 1901)
<i>C. frohnei</i> Wirth and Blanton, 1969
<i>C. paraimpunctatus</i> Borkent, 1995
<i>C. yukonensis</i> Hoffman, 1925
<i>Diphaomyia</i> Vargas, 1960
<i>C. baueri</i> Hoffman, 1925
<i>C. bergi</i> Cochrane, 1973
<i>C. footei</i> Wirth and Jones, 1956
<i>C. haematopotus</i> Malloch, 1915
<i>Hoffmania</i> Fox, 1948
<i>C. venustus</i> Hoffman, 1925
<i>Monoculicoides</i> Khalaf, 1954
<i>C. albertensis</i> Wirth and Jones, 1957
<i>C. variipennis</i> (Coquillett, 1901)
<i>Oecaeta</i> Poey, 1853
<i>C. furensoides</i> Williams, 1955
<i>C. stellifer</i> (Coquillett, 1901)

<i>Silvaticulicoides</i> Glukhova, 1977
<i>C. biguttatus</i> (Coquillett, 1901)
<i>C. spinosus</i> Root and Hoffman, 1937
<i>Wirthomyia</i> Vargas, 1973
<i>C. stilobezzioides</i> Foote and Pratt, 1954
Unplaced subgenus
<i>piliferus</i> species group Root and Hoffman
<i>C. alexanderi</i> Wirth and Hubert, 1962
<i>C. bickleyi</i> Wirth and Hubert, 1962
<i>C. denticulatus</i> Wirth and Hubert, 1962
<i>C. downesi</i> Wirth and Hubert, 1962
<i>C. franclemonti</i> Cochrane, 1974
<i>C. jamnbacki</i> Wirth and Hubert, 1962
<i>C. parapiliferus</i> Wirth and Blanton, 1974
<i>C. piliferus</i> Root and Hoffman, 1937
<i>C. snowi</i> Wirth and Jones, 1956
<i>C. testudinalis</i> Wirth and Hubert, 1962
<i>C. utowana</i> Jamnback, 1965
<i>saundersi</i> species group
<i>C. atchleyi</i> Wirth and Blanton, 1969
Unplaced subgenus/species group
<i>C. nanus</i> Root and Hoffman, 1937
<i>C. travisi</i> Vargas, 1949

Table 2. Checklist of the nine *Culicoides* Latreille species that are found in bordering Canadian provinces and/or United States, in alphabetical order.

<i>C. (Amossovia) beckae</i> Wirth and Blanton, 1967
<i>C. (Beltranmyia) hollensis</i> (Melander and Brues, 1903)
<i>C. (Beltranmyia) bermudensis</i> Williams, 1956
<i>C. (Oecacta) furens</i> (Poey, 1853)
<i>C. (Drymodesmyia) hinmani</i> Khalaf, 1952
<i>C. (Avaritia) juddi</i> Cochrane, 1973
<i>C. (Silvaticulicoides) loisae</i> Jamnback, 1965
<i>C. (Avaritia) pechumani</i> Cochrane, 1974
<i>C. scanloni</i> Wirth and Hubert, 1962 (<i>piliferus</i> species group Root and Hoffman)

Glossary/Characteristics

For the identification of the genus *Culicoides* using the key to Ceratopogonidae in Downes and Wirth (1981), these features must be visible on the entire specimen: the empodia, flagellomeres, eyes, thorax shape, and palpus (Fig. 1). Diagnostic characters for the wing are: *r-m* crossvein, radial cells (r_1 & r_{2+3}), medial veins (M_1 , M_2), costal vein (*C*) (Fig. 2), as well as the macrotrichia and wing pattern of pale and dark spots (Fig. 3).

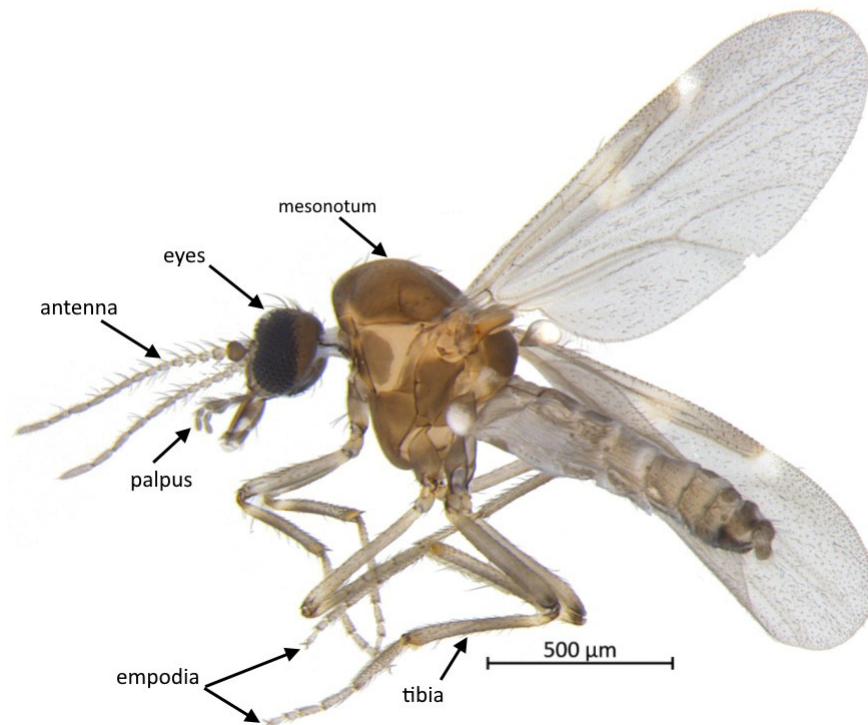


Figure 1. Lateral view of *Culicoides biguttatus* (female) showing important external diagnostic characteristics. The empodia cannot be seen clearly in this image.

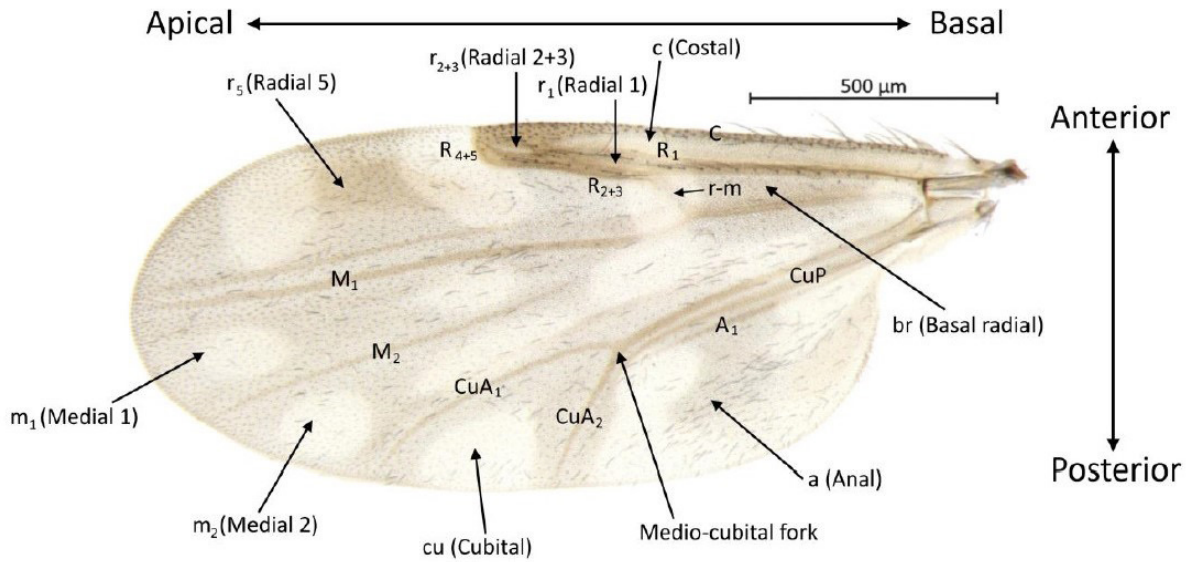


Figure 2. Wing image of *Culicoides crepuscularis* (female) from a whole specimen, showing wing veins and cell names. Veins are in upper case, except for *r-m*, and cells are in lower case. Cells are named in the figures to help differentiate cell and vein names. Wing veins: *C* = costa, *R*₁ = first radial vein, *R*₂₊₃ = second and third radial vein, *R*₄₊₅ = fourth and fifth radial vein, *r-m* = radial-medial cross vein, *M*₁ = first medial vein, *M*₂ = second medial vein, *CuA*₁ = first anterior branch of cubital vein, *CuA*₂ = second anterior branch of cubital vein, *CuP* = posterior branch of cubital vein, *A*₁ = anal vein. Nomenclature is from Downes and Wirth (1981).

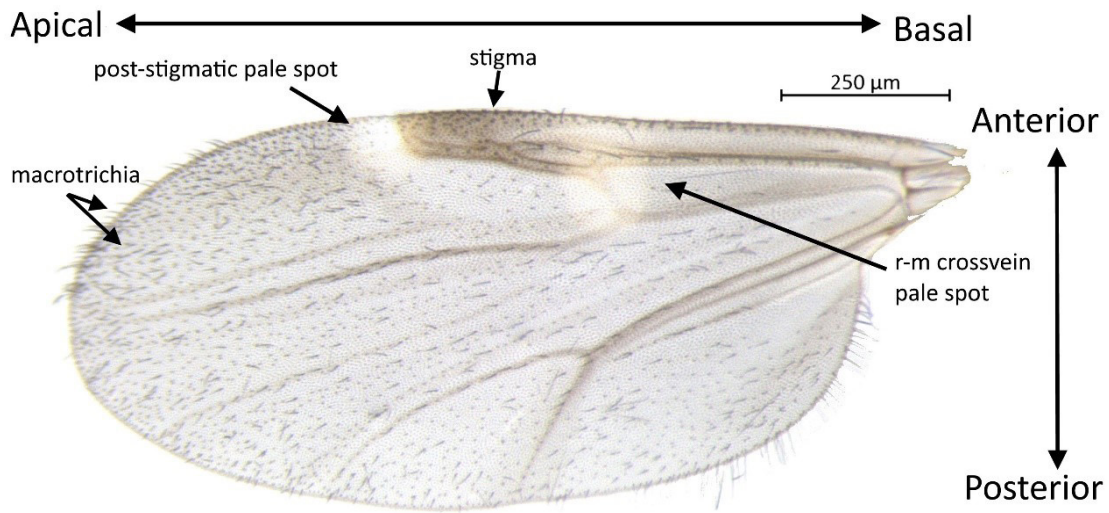


Figure 3. Wing image of *Culicoides biguttatus* (female) showing additional diagnostic wing characteristics for *Culicoides* spp., including the stigma, the post-stigmatic pale spot, and the *r-m* crossvein pale spot.

In using this key for identification to subgenus, species group, and species for female *Culicoides*, these diagnostic characteristics must be seen on the specimen: the tibiae, which may be uniformly brown or have pale bands (Fig. 1), a clear view of the wing veins and cells (Fig. 2), macrotrichia and wing patterns (Fig. 3), the 3rd palpal segment shape, size, and sensory pit (Figs. 4, 5), and in some cases, the shape and relative size of the spermatheca(e) (Fig. 6).

All images used in this publication are from females. However, *Culicoides* species exhibit sexual dimorphism in various morphological characteristics, including but not limited to: flagellomere shape and size, wing shape and pattern, and third palpal segment shape and size (Swanson 2012) (Fig. 10).

Terminology

Antennal sensoria: Hair-like sensory detectors found on the antenna.

Empodium/Empodia (pl): A small appendage between the claws on the tarsi.

Flagellomeres: Terminal segments of the antennae. Strictly speaking the antennomeres refer to the three basic parts of the antennae (scape, pedicel, flagellum), and the flagellomeres represent the more terminal antennomeres (Cumming and Wood 2017).

Macrotrichia: Small hairs on the wings.

Mesonotum: The dorsal surface of the thorax.

Palpus/Palpi (pl): A sensory structure for touching or tasting in the mouth area of insects.

Spermatheca/Spermathecae (pl): The internal genitalia of a female fly for sperm storage.

Stigma: Dark spot at apical area of the costal vein (C).

Wing cells: The areas enclosed by veins on the wings.

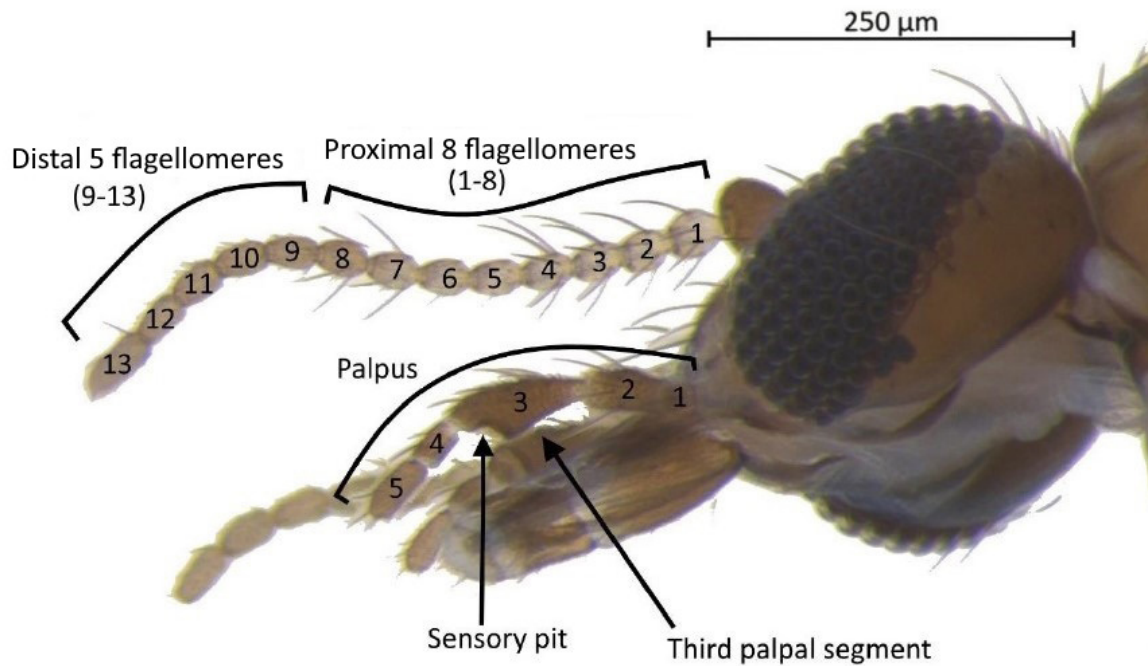


Figure 4. Close-up view of a *Culicoides albertensis* head from a whole specimen (female), outlining the five palpal segments and sensory pit organ in the third palpal segment. The 13 flagellomeres (usually separated into distal 5 flagellomeres and proximal 8 flagellomeres) are mentioned in the species information sheets, and used in some couplets of the dichotomous key.

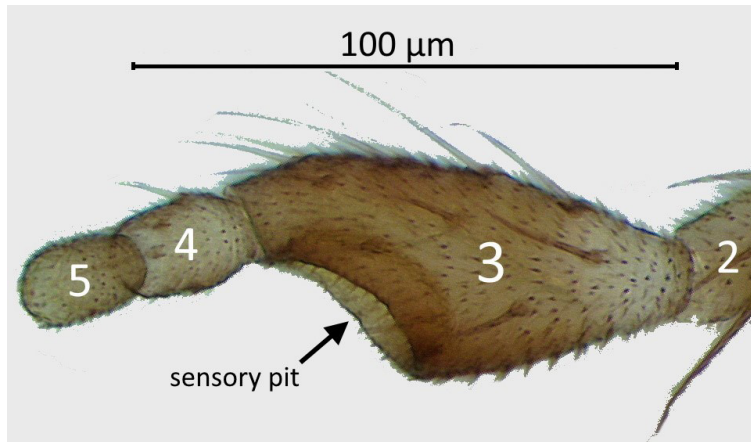


Figure 5. A close-up of the third papal segment of *Culicoides trvisi* (female), showing the sensory pit.

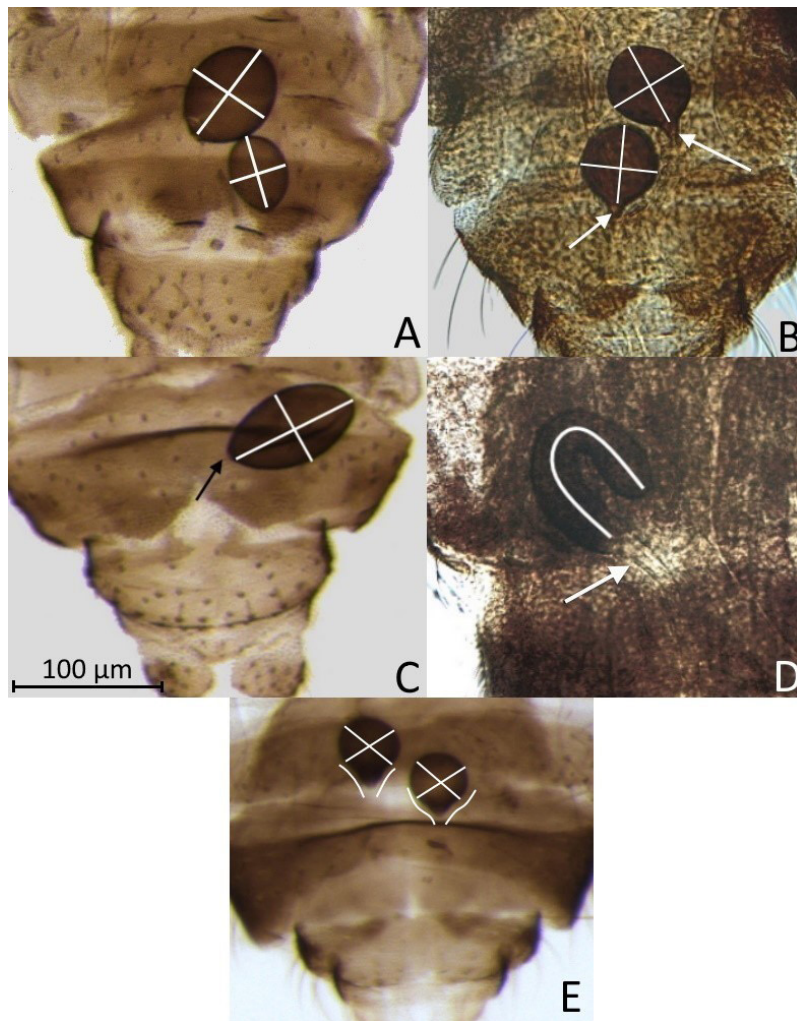


Figure 6. *Culicoides* spp. spermathecae images from slide mounted specimens showing differences in number, shape, neck, and size. White lines show the area/shape of the spermatheca, and arrows show the necks. **A.** *Culicoides snowi* with two, rounded, non-necked, unequal spermathecae. **B.** *Culicoides biguttatus* with two, rounded, necked, equal spermathecae. **C.** *Culicoides sphagnumensis* with one, oval, necked spermatheca (neck is very faint in the image). **D.** *Culicoides variipennis* with one C-shaped, necked spermatheca. **E.** *Culicoides guttipennis* with two, pear-shaped, necked, subequal spermatheca. Shape and size of spermathecae may vary intraspecifically, or could vary depending on orientation of the specimen.

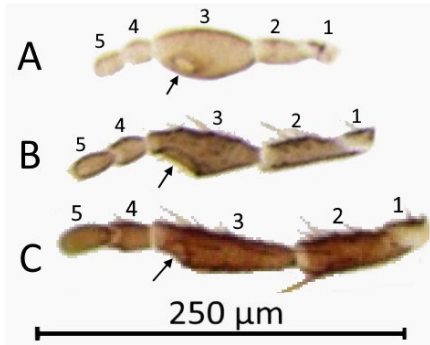


Figure 7. Comparison of the shapes of the 3rd palpal segment from slide mounted specimens (female). **A.** Swollen and globular segment of *Culicoides nanus*. **B.** Moderately swollen, triangular segment of *Culicoides sphagnumensis*. **C.** Narrow, elongate segment of *Culicoides variipennis*. Black arrows indicate the sensory pit.

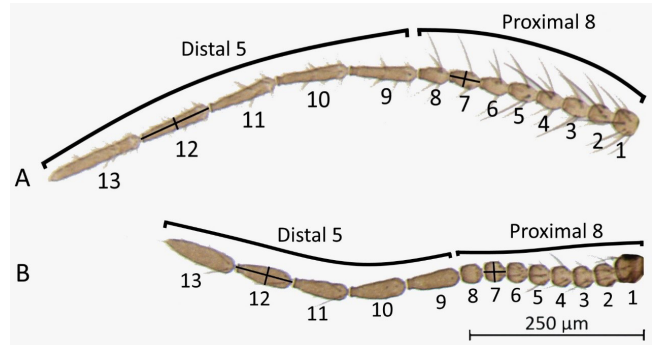


Figure 8. A comparison of flagellomeres shapes from slide mounted specimens (female). **A.** *Culicoides villosipennis*; proximal 1–8 flagellomeres are barrel shaped (length 2X width), and distal 9–13 flagellomeres are very elongate (length >3X width). **B.** *Culicoides stilobezzioides*; proximal 1–8 flagellomeres are rounded (length ≈ width), and distal 9–13 flagellomeres are elongate (length 2–3X width).

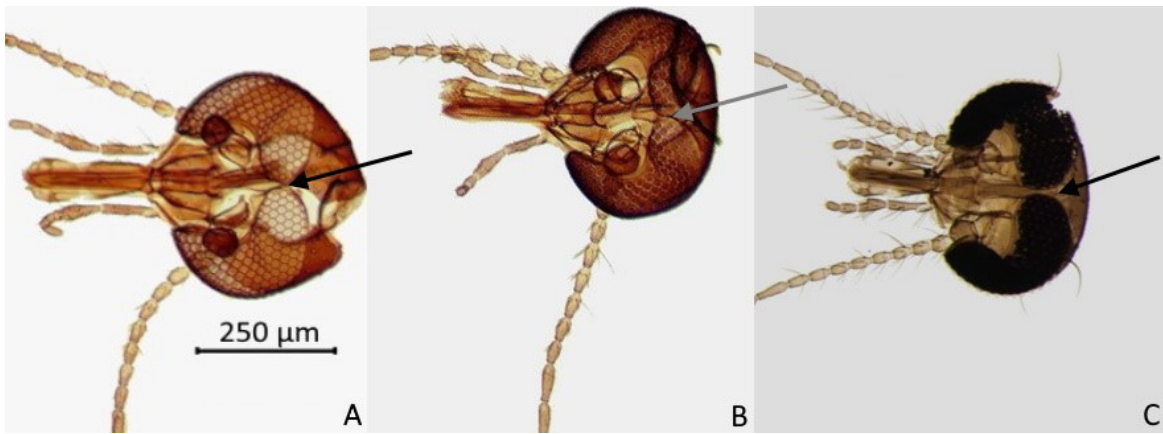


Figure 9. A comparison of slide mounted eye characteristics. **A.** *Culicoides yukonensis* with eyes touching at one point. **B.** *Culicoides paraimpunctatus* with eyes touching for a short distance. **C.** *Culicoides spinosus* with separated eyes that do not touch.



Figure 10. Wing comparison from whole specimens (female). **A.** *Culicoides albertensis*; wing non-hairy, heavily patterned. **B.** *Culicoides biguttatus*; wing hairy, relatively plain.

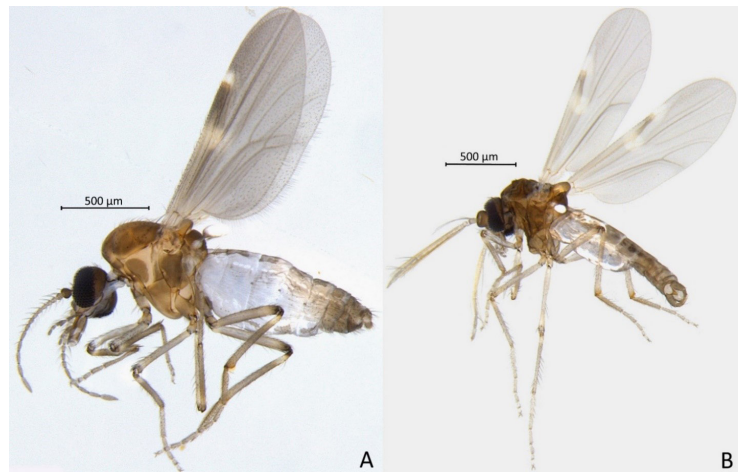


Figure 11. Male and female *Culicoides* whole specimens. **A.** *Culicoides biguttatus*; female. **B.** Subgenus *Avaritia*; male.

Wing Atlas

***Amosovia* Glukhova 1989**

C. arboricola Root and Hoffman, 1937



C. flukei Jones, 1956



C. guttipennis (Coquillett, 1901)



C. villosipennis Root and Hoffman, 1937



***Avaritia* Fox 1955**

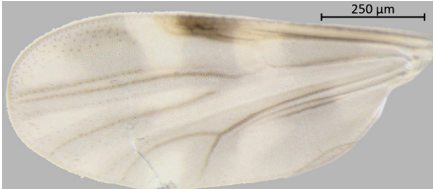
C. chiopterus (Meigen, 1930)



C. obsoletus (Meigen, 1818)



C. sanguisuga (Coquillett, 1901)



***Beltranmyia* Vargas, 1953**

C. crepuscularis Malloch, 1915



C. sphagnumensis Williams, 1955

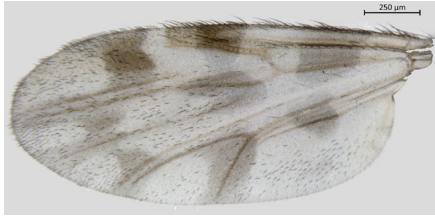


C. wisconsinensis Jones, 1956



Culicoides Latreille, 1809

C. cockerellii (Coquillett, 1901)



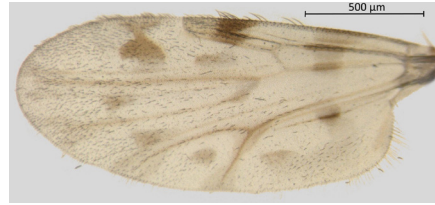
C. frohnei Wirth and Blanton, 1969



C. paraimpunctatus Borkent, 1995

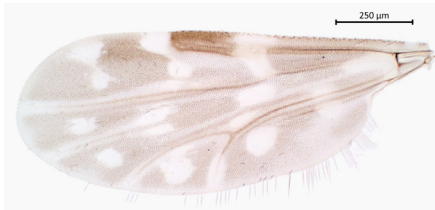


C. yukonensis Hoffman, 1925

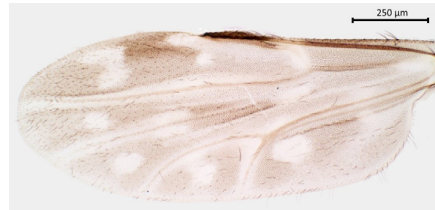


Diphaomyia Vargas 1960

C. baueri Hoffman, 1925



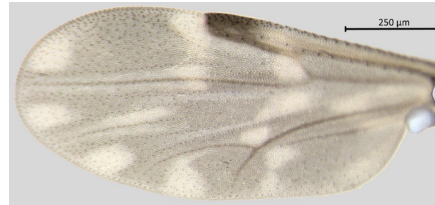
C. bergi Cochrane, 1973



C. footei Wirth and Jones, 1956



C. haematopotus Malloch, 1915



Hoffmania Fox, 1948

C. venustus Hoffman, 1925



Monoculicoides Khalaf, 1954

C. albertensis Wirth and Jones, 1957

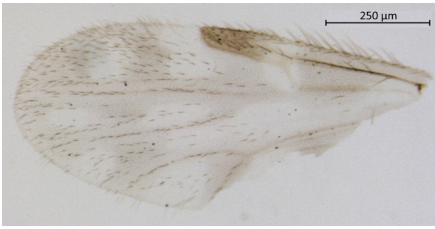


C. variipennis (Coquillett, 1901)

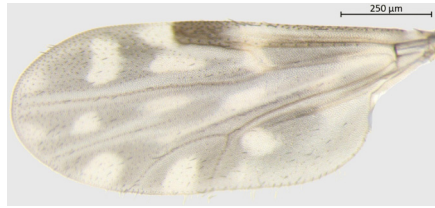


Oecacta Poey 1853

C. furensoides Williams, 1955

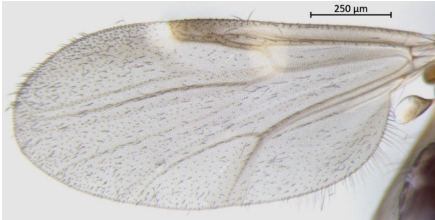


C. stellifer (Coquillett, 1901)



Silvaticulicoides Glukhova, 1977

C. biguttatus (Coquillett, 1901)



C. spinosus Root and Hoffman, 1937



Wirthomyia Vargas 1973

C. stilobezzioides Foote and Pratt, 1954



Unplaced subgenus

***piliferus* species group Root and Hoffman**

C. alexanderi Wirth and Hubert, 1962



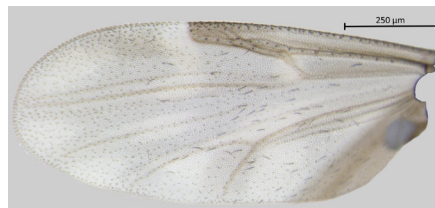
C. bickleyi Wirth and Hubert, 1962



C. denticulatus Wirth and Hubert, 1962



C. downesi Wirth and Hubert, 1962



C. franclemonti Cochrane, 1974



C. jamnbacki Wirth and Hubert, 1962



C. parapiliferus Wirth and Blanton, 1974



C. piliferus Root and Hoffman, 1937



C. snowi Wirth and Jones, 1956



C. testudinalis Wirth and Hubert, 1962

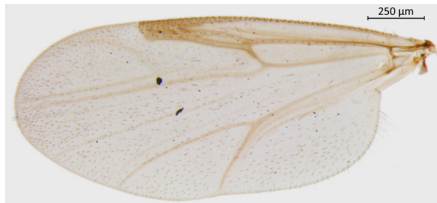


C. utowana Jamnback, 1965



saundersi species group

C. atchleyi Wirth and Blanton, 1969

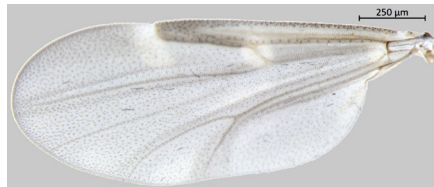


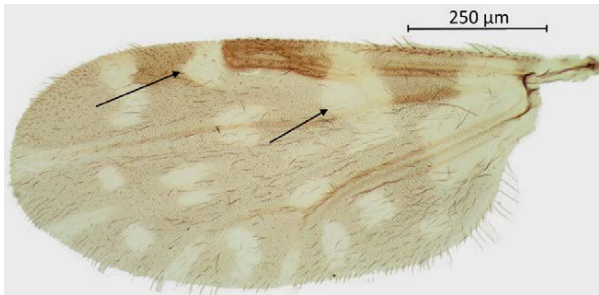
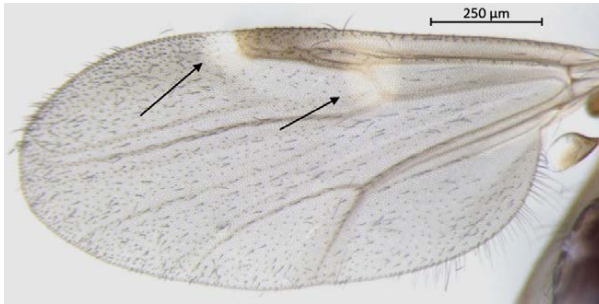
Unplaced species group/Misc. species

C. nanus Root and Hoffman, 1937



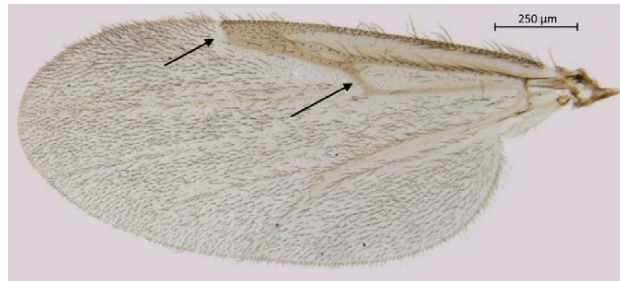
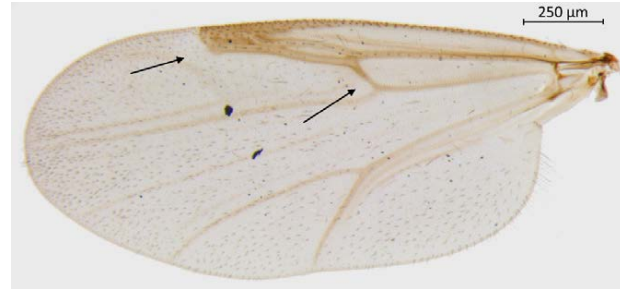
C. travisi Vargas, 1949





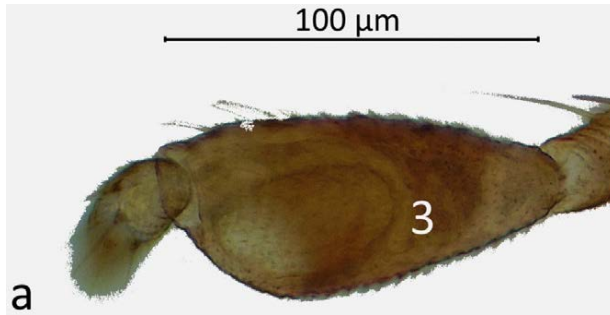
1) Wing with two pale spots visible, which may be faint or well-defined: the post-stigmatic pale spot and the *r-m* crossvein pale spot. Additional pale spots may also be present.

5



1') Wing mostly uniform with no visible pale spots. Vein pigmentation may vary.

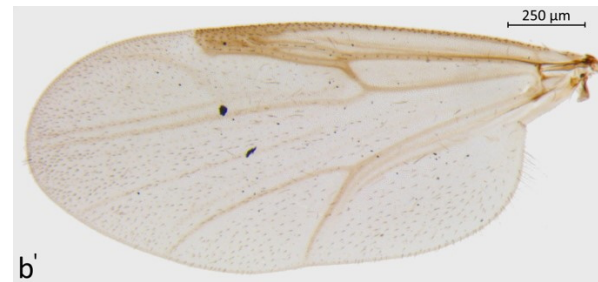
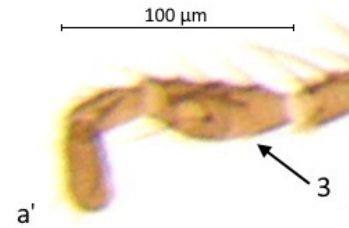
2



2) (a) 3rd palpal segment (3) swollen, large and globular with a distinct deep sensory pit. (b) Wing entirely covered with very dense macrotrichia. Wing veins not darkly pigmented.

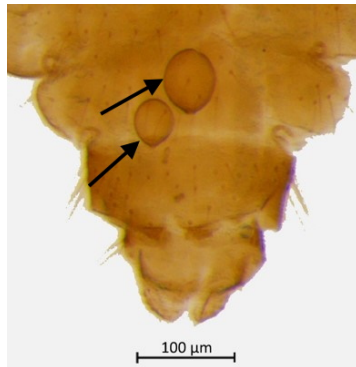
(Return to: [1](#))

[Culicoides stilobezzioides](#) Foote and Pratt



2') (a') 3rd palpal segment (3) smaller, and slender to moderately swollen. Round or irregular palpal pit may be visible but not distinctly deep. (b') Wing macrotrichia sparse, especially basally. Wing veins usually darkly pigmented.

[3](#)

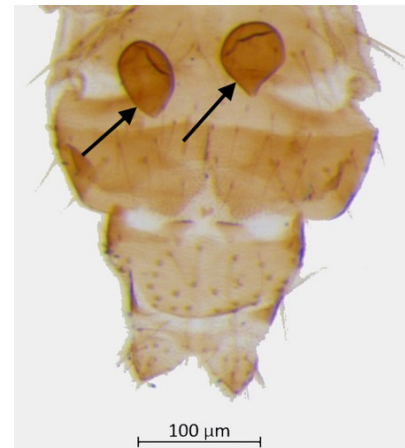


3) Two spermathecae rounded and unequal in size.

Note: Spermathecae are often difficult to distinguish as they are usually lightly pigmented

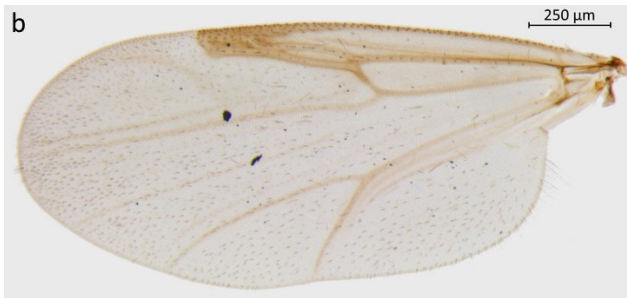
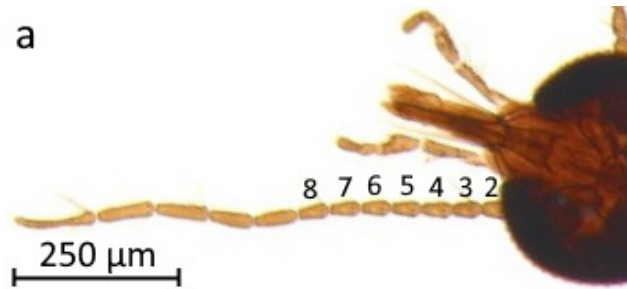
(Return to: [2](#))

[Culicoides utowana](#) Jamnback (in part)



3') Two spermathecae rounded and equal in size.

[4](#)

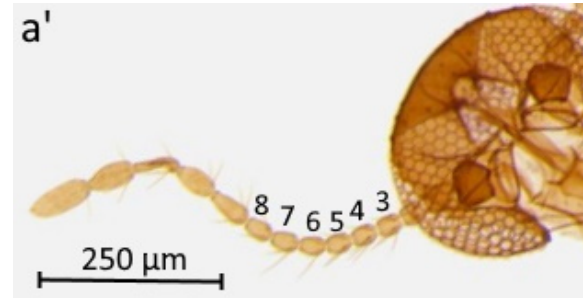


4) (a) Proximal 8 flagellomeres barrel shaped*.
(b) Large species; average wing length of 1.95 mm.

*note: flagellomere 1 not visible in image.

(Return to: [3](#))

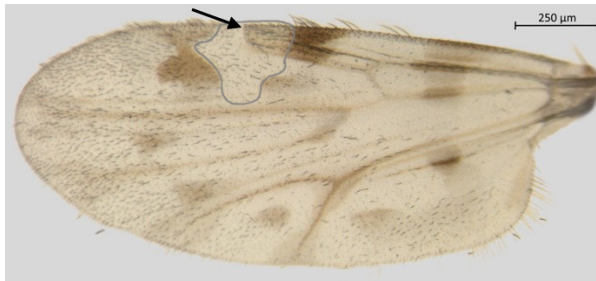
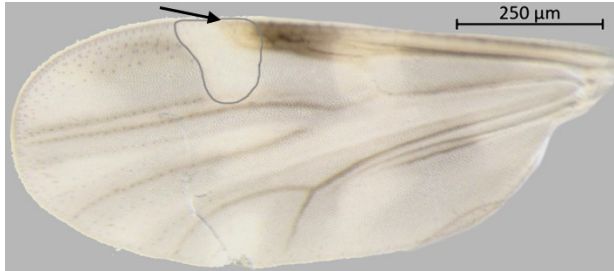
[Culicoides atchleyi](#) Wirth and Blanton



4') (a') Proximal 8 flagellomeres round shaped*.
(b') Small species; average wing length of 1.19 mm.

*note: flagellomeres 1 & 2 missing from image.

[Culicoides franclemonti](#) Cochrane (in part)

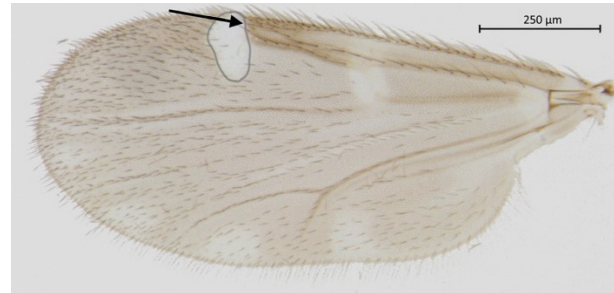


5) Post-stigmatic pale spot extends into the R_{4+5} vein and into the r_{2+3} cell.

*post-stigmatic pale spot outlined for clarity

(Return to: [1](#))

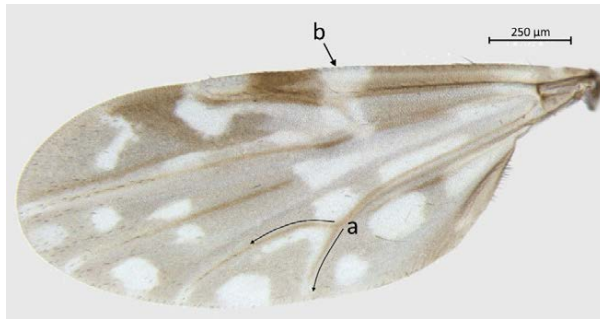
[6](#)



5') Post-stigmatic pale spot usually does not extend into the R_{4+5} vein, and does not extend into the r_{2+3} cell.

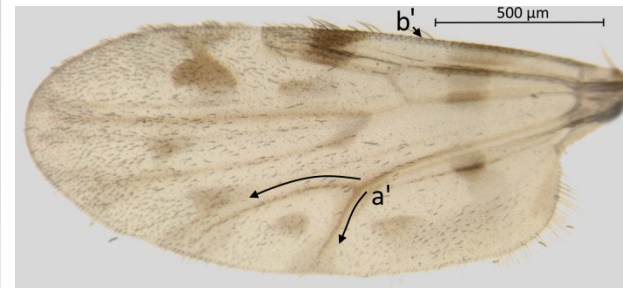
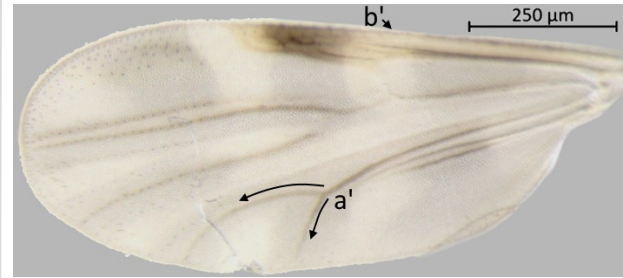
*post-stigmatic pale spot outlined for clarity

[13](#)



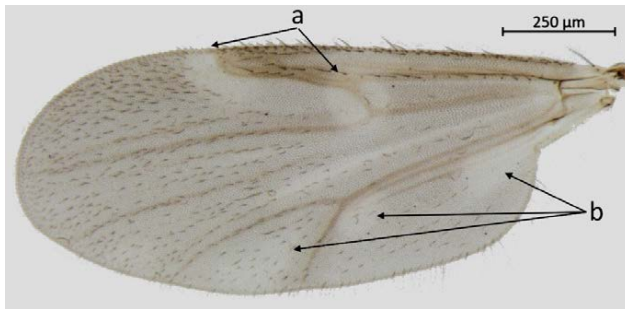
6) Combination of all of these characteristics:
 (a) *cu* cell with pale V-shaped spot extending from the Medio-cubital fork along *CuA*₁ and *CuA*₂ veins. (b) *r-m* crossvein contained within a narrow, irregular pale spot that extends to anterior margin of wing. (c) Wing with a highly contrasting pattern of distinct pale spots on a dark background. (Return to: [5](#))

Culicoides venustus Hoffman



6') Either a, b, c from couplet 6 can be present but not a combination of all characteristics.

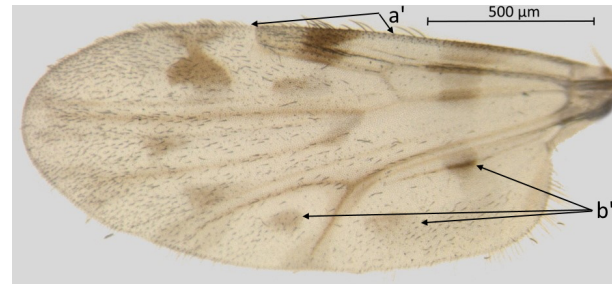
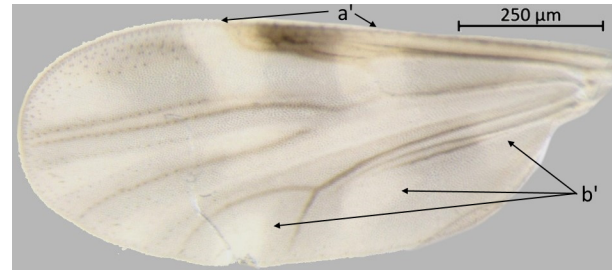
[7](#)



7) Wing pattern diffuse with only (a) the post-stigmatic pale spot and *r-m* crossvein pale spot prominent. (b) Other indistinct pale spots may be present in *m*, *cu*, and/or *a* cells. Macrotrichia moderately distributed throughout apical two thirds of wing, sparsely on basal third of wing.

(Return to: [6](#))

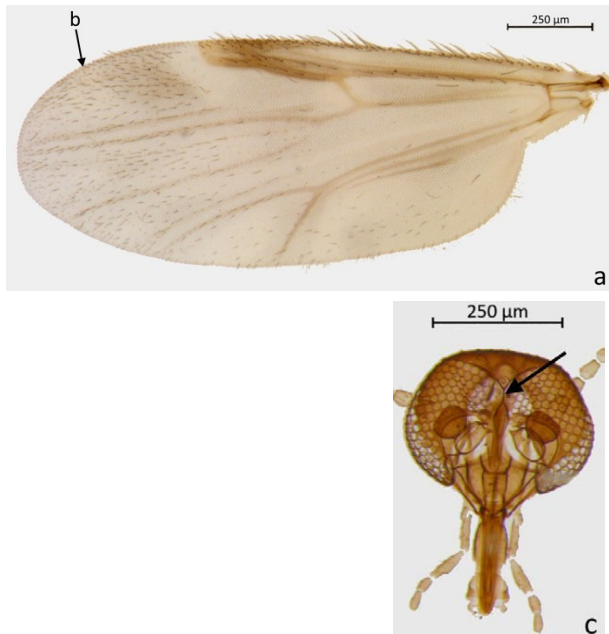
[8](#)



7') Wing with extensive pattern, either mostly dark with prominent pale spots or mostly pale with prominent dark spots. (a') Post-stigmatic and *r-m* crossvein pale spot prominent and large (b') Prominent pale or dark spots in *m*, *a*, and/or *cu* cells.

Or, If wing pattern is more diffuse as described in couplet 7, then macrotrichia sparse and only present on the apical 1/3 of the wing.

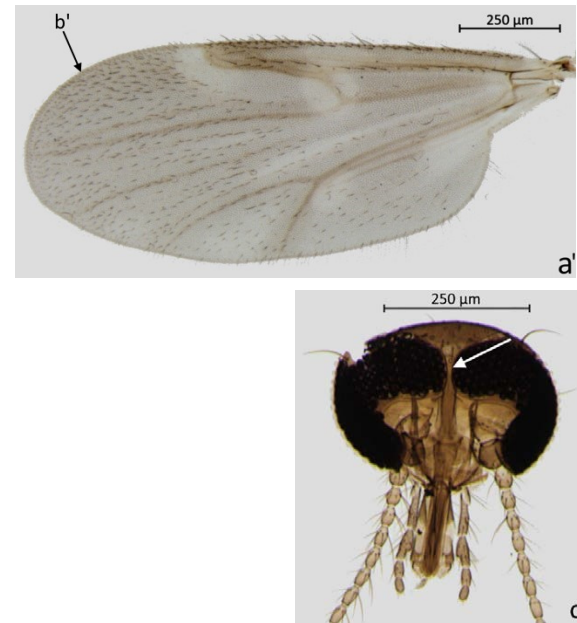
[9](#)



8) (a) A larger species (Average wing length 1.61 mm). (b) Wing with diffuse pale area in apical portion of r_5 extending to wing margin. (c) Eyes contiguous or touching at a point.

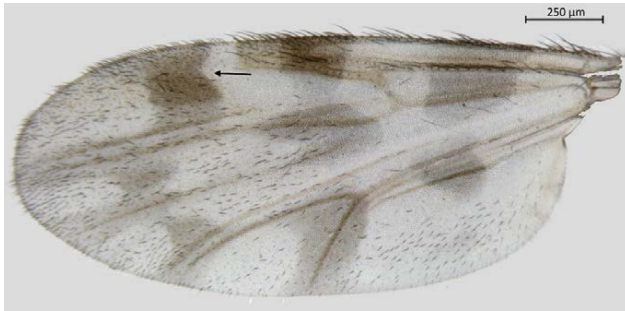
(Return to: [7](#))

[Culicoides frohnei](#) Wirth and Blanton (in part)



8') (a') Generally a smaller species (Average wing length 0.9 mm). (b') Wing with r_5 dark, no visible pale area near wing margin. (c') Eyes separated.

[Culicoides spinosus](#) Root and Hoffman (in part)



9) r_5 cell with prominent dark spot in the middle of cell, which is often hourglass-shaped.

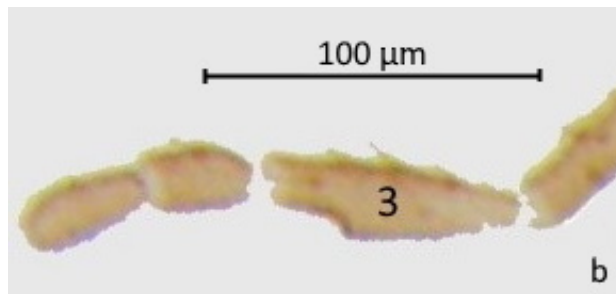
(Return to: [7](#))

[11](#)



9') r_5 cell uniformly light brown on apical half or with at most, poorly contrasting, diffuse, median dark spot.

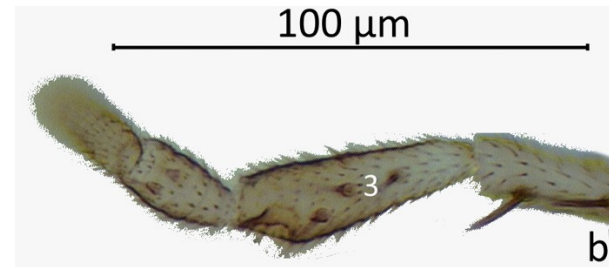
[10](#)



10) A large species (average wing length 1.61 mm) (a) Pale spots on wings are small, diffuse and poorly defined. (b) 3rd palpal segment large and narrow.

(Return to: [9](#))

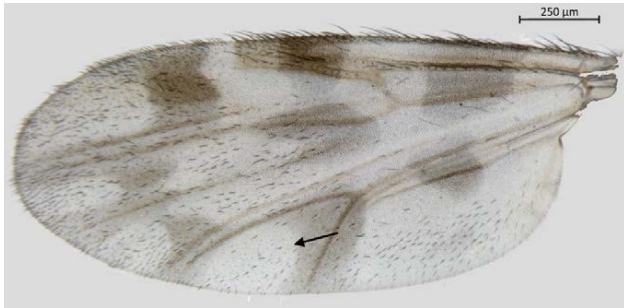
[Culicoides frohnei](#) Wirth and Blanton (in part)



10') Generally a small species (Average wing length 1.13 mm). (a') Pale spots on wings are large and well defined (b') 3rd palpal segment small, can be of variable width.

In Ontario, includes: *C. chiopterus* (Meigen), *C. obsoletus* (Meigen), and *C. sanguisuga* (Coquillett).

[Subgenus Avaritia](#) Fox



11) Wing with *cu* cell with a large pale area, but dark central spot is absent.

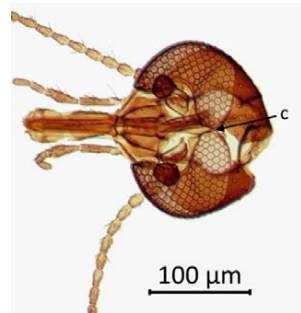
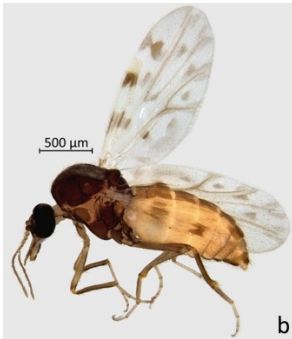
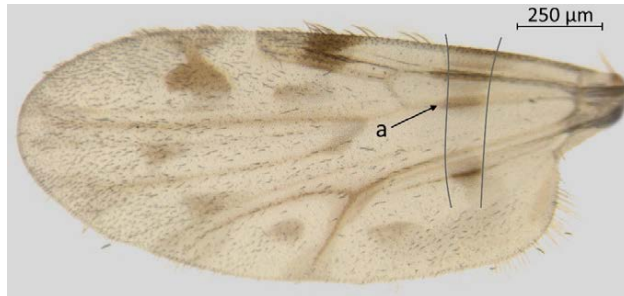
(Return to: [9](#))

[Culicoides cockerellii](#) (Coquillett)



11') Wing with *cu* cell with dark spot centered in a large pale area.

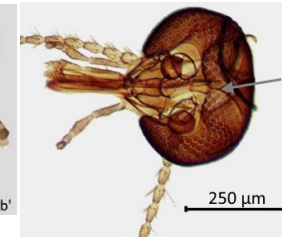
[12](#)



12) (a) Wing with small, dark spots aligned laterally that occupy approximately 1/4 of cell *br*. (b) A large species with an average wing length of 1.97 mm. (c) Eyes touching at a single point.

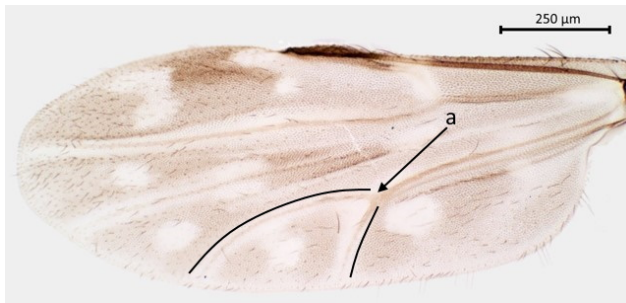
(Return to: [11](#))

[*Culicoides yukonensis*](#) Hoffman



12') (a') Wing with large, diffuse, dark spots aligned laterally that occupy over 1/3 of cell *br*. (b') A moderately large species with average wing length of 1.52 mm. (c') Eyes touching for a short distance.

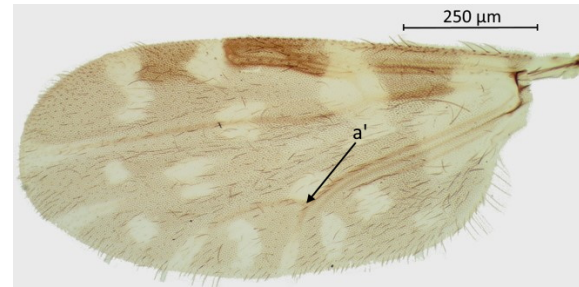
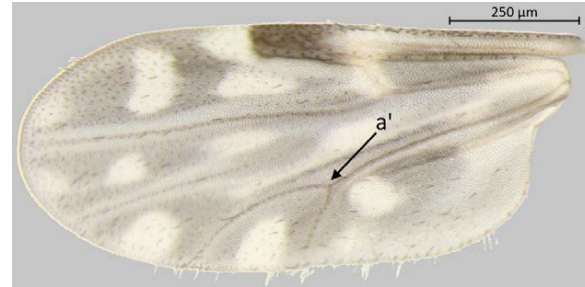
[*Culicoides paraimpunctatus*](#) Borkent



13) (a) *cu* cell with pale V-shaped spot extending from the Medio-cubital fork along the *CuA*₁ and *CuA*₂ veins; pale spot may or may not reach the wing margin.

(Return to: [5](#))

[14](#)



13') (a') *cu* cell dark from the Medio-cubital fork and along some portion of *CuA*₁ and *CuA*₂. Pale spots may or may not be present along *CuA*₁ and *CuA*₂ near the wing margin.

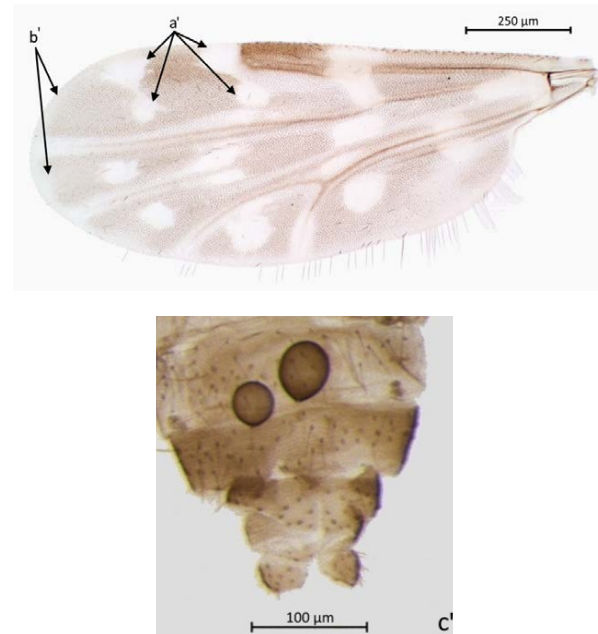
[17](#)



14) a) Wing with r_5 variable; 3–5 pale or dark spots distributed distally and medially, but never arranged in two pairs of pale spots. b) r_5 and m_1 with apical or preapical pale spot or area. c) Spermatheca single and C-shaped.

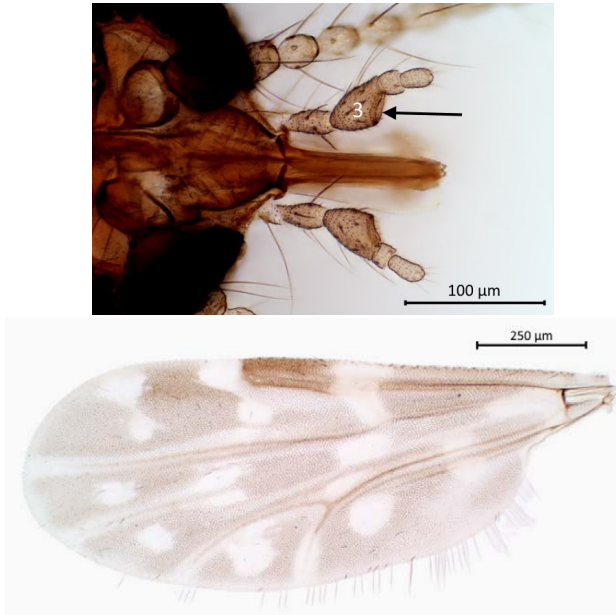
(Return to: [13](#))

Subgenus *Monoculicoides* Khalaf - [16](#)



14') a) Wing with r_5 with two pairs of distinct pale spots in the distal portion: a post-stigmatic pale spot and a central pale spot, each of which often consist of two small, connected spots. b) r_5 and m_1 dark apically c) Spermathecae paired and rounded.

[15](#)



15) 3rd palpal segment short and moderately swollen, triangular with shallow palpal pit.

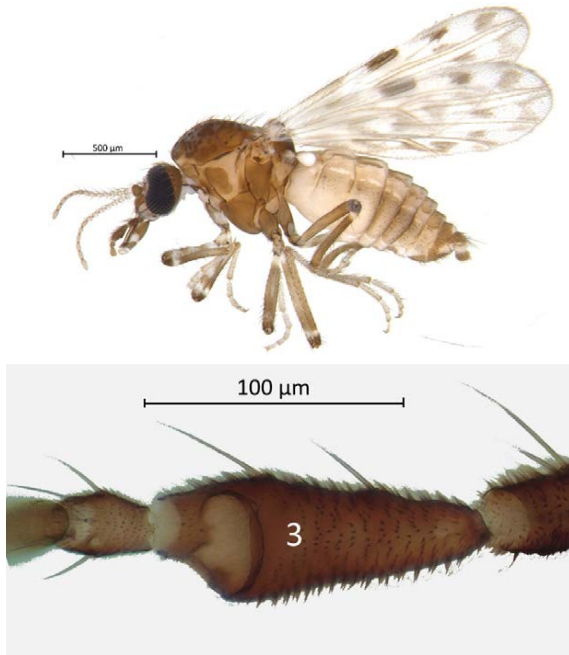
(Return to: [14](#))

[Culicoides baueri](#) Hoffman



15') 3rd palpal segment large, greatly swollen, globular or triangular with deep palpal pit.

[Culicoides bergi](#) Cochrane



16) 3rd palpal segment moderately to greatly swollen and triangular with a wide, well-defined sensory pit that may be partially bifurcated.

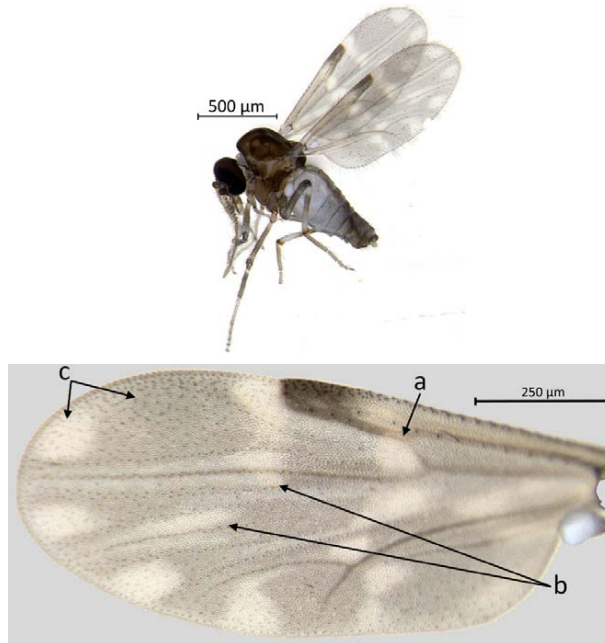
(Return to: [14](#))

[*Culicoides albertensis*](#) Wirth and Jones



16') 3rd palpal segment slender or slightly swollen with a small, round sensory pit.

[*Culicoides variipennis*](#) (Coquillett)



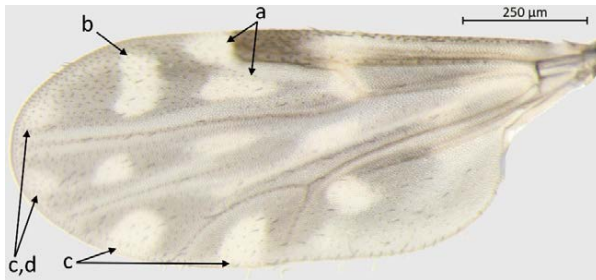
17) All wing traits must be present:
 (a) *r-m* crossvein pale spot off-center from vein, located at base of r_5 cell. (b) Two elongated pale spots intersected by M_1 and M_2 veins. (c) r_5 with a grey central area between the post-stigmatic pale spot and apical pale spot in r_5 .
 (Return to: [13](#))

[Culicoides haematopotus](#) Malloch



17') Wing pattern varies, but does not include all of the wing characteristics described for *C. haematopotus*.

[18](#)



- 18)** Wing with prominent, highly contrasting pattern including (all must be present):
- (a) Post-stigmatic pale spot with two distinct sections.
 - (b) Large, definite pale spot in the middle of r_5 , often irregularly shaped.
 - (c) Pale spots at the apical margin of r_5 and m_1 , and posterior margin of m_2 and cu .
 - (d) Apical pale spots in the r_5 and m_1 cells, often less distinct than other pale spots.

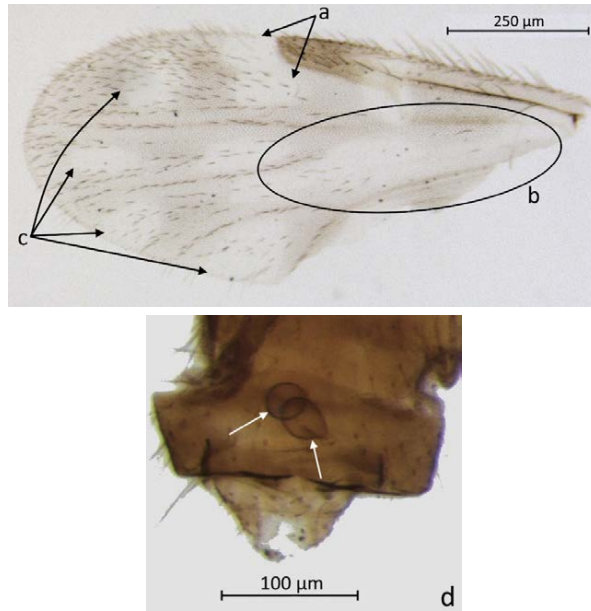
(Return to: [17](#))

[*Culicoides stellifer*](#) (Coquillett)



- 18')** Wing pattern varies, but does not include all of the wing characteristics described for *C. stellifer*.

[19](#)



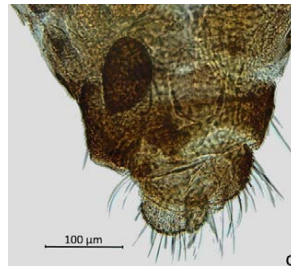
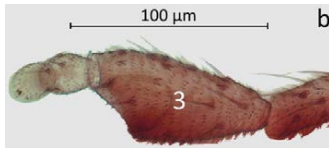
19) Grayish wing with pattern of mostly diffuse pale spots, (all must be present): (a) Large post-stigmatic pale spot with two distinct sections. (b) Large, diffuse pale area filling the basal half of cell m_2 . (c) r_5 and m_1 with preapical pale spot; m_2 and cu with apical spot. (d) Two rounded spermathecae, similar in size.
(Return to: [18](#))

Culicoides furenoides Williams



19') Wing colour and pattern varies, but does not include all of the wing characteristics described for *C. furenoides*. One or two rounded or oval spermathecae.

[20](#)

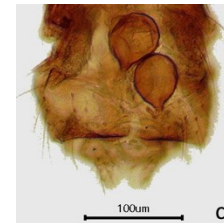
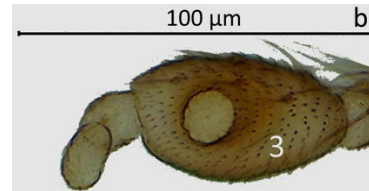
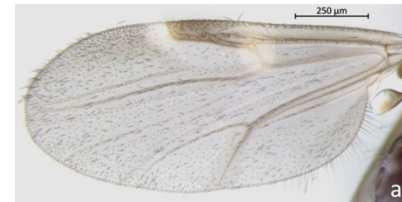


20) All of these traits must be present:

(a) Wing with rounded, well-defined pale spots contained within cells and not intersected by veins (except *r-m* pale spot) arranged in three lateral lines of 3, 4, and 3 spots. (b) 3rd palpal segment swollen and triangular with a deep sensory pit. (c) A single, oval spermatheca.

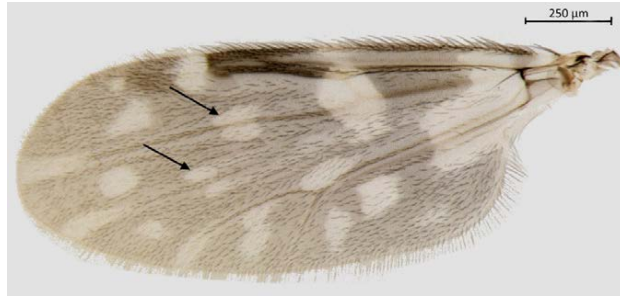
(Return to: [19](#))

Culicoides crepuscularis Malloch (in part)



20') Wing pattern, 3rd palpal segment, and spermathecae vary, but do not include all of the characteristics described for *C. crepuscularis*.

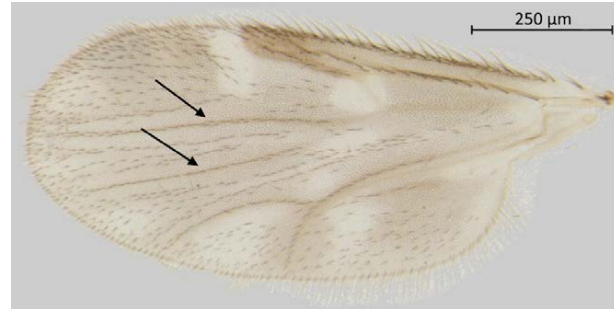
[21](#)



21) Wing with two pale spots that are intersected by M_1 and M_2 veins.

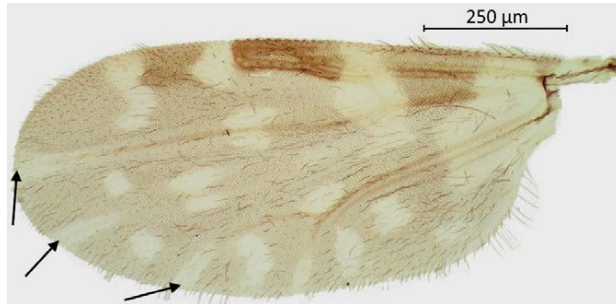
(Return to: [20](#))

[22](#)



21') Wing with area surrounding M_1 and M_2 veins uniform; no pale spots intersected by M_1 and M_2 .

[26](#)



22) Wing with numerous small, well-defined pale spots. M_1 , M_2 and CuA_1 veins with pale spots on the apical wing margin.

(Return to: [21](#))

[23](#)



22') Wing with several large pale spots, some of which may be diffuse or faint. M_1 , M_2 , and CuA_1 veins dark at the wing margin.

[25](#)



23) *r-m* crossvein with small pale spot that does not extend, or barely extends posteriorly past the M_1 vein.

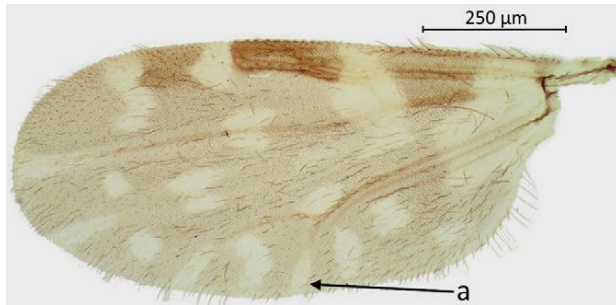
(Return to: [22](#))

[Culicoides villosipennis](#) Root and Hoffman



23') *r-m* crossvein pale spot large that extends posteriorly past the M_1 vein into cell m_2 .

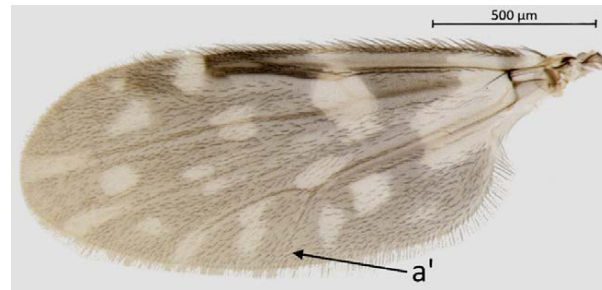
[24](#)



24) (a) CuA_2 vein with small pale spot at the posterior wing margin.

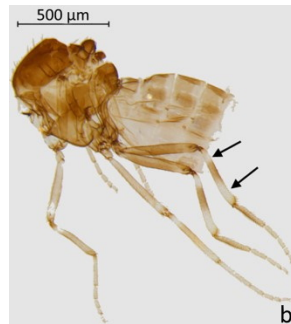
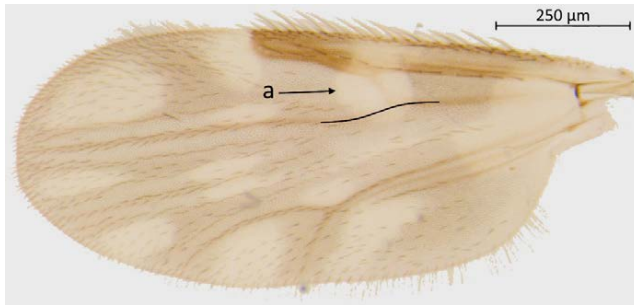
(Return to: [23](#))

[Culicoides arboricola](#) Root and Hoffman



24') (a') CuA_2 vein dark at the posterior wing margin.

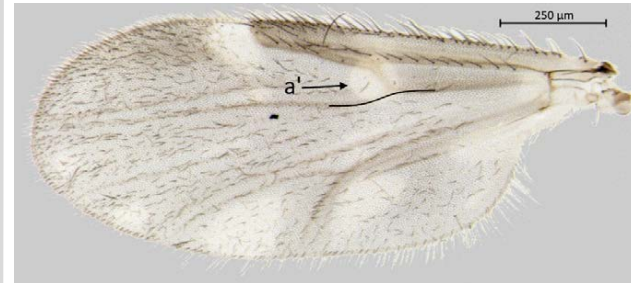
[Culicoides guttipennis](#) (Coquillett)



25) Wing with large and prominent pale spots. (a) *r-m* crossvein pale spot large, extends from anterior wing margin, crossing M_1 vein into the m_2 cell. (b) Hind tibiae with distinct basal and apical pale bands.

(Return to: [22](#))

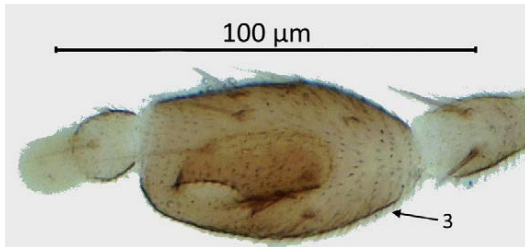
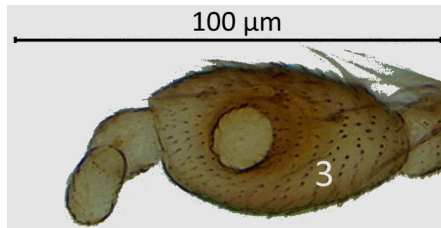
[Culicoides flukei](#) Jones



25') Wing with variable pale spots that can be large and prominent, or small and faint. (a') *r-m* crossvein pale spot small and circular, usually not extending to the anterior wing margin, nor posteriorly past vein M_1 . (b') Hind tibiae without light banding.

Includes *C. alexanderi* Wirth and Hubert, *C. bickleyi* Wirth and Hubert, or *C. denticulatus* Wirth and Hubert, *C. downesi* Wirth and Hubert, *C. jamnbacki* Wirth and Hubert, *C. parapiliferus* Wirth and Blanton, *C. piliferus* Root and Hoffman, and *C. testudinalis* Wirth and Hubert.

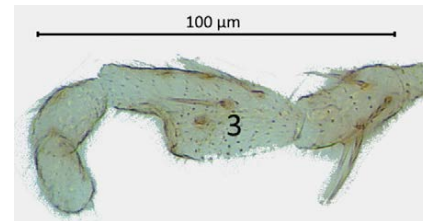
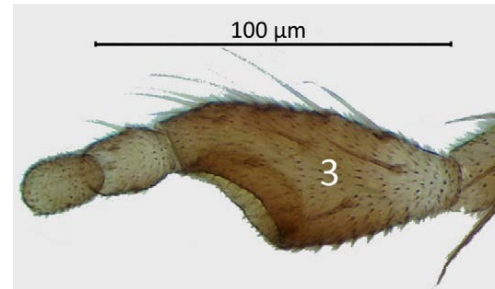
[piliferus species group](#) Root and Hoffman (in part)



26) 3rd palpal segment globular, rounded, and greatly swollen.

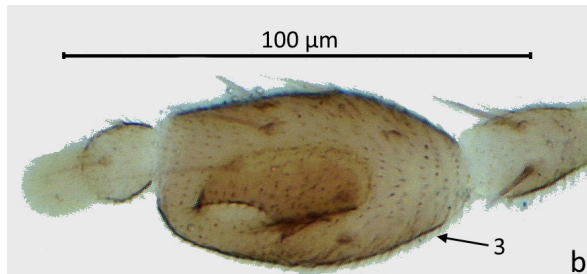
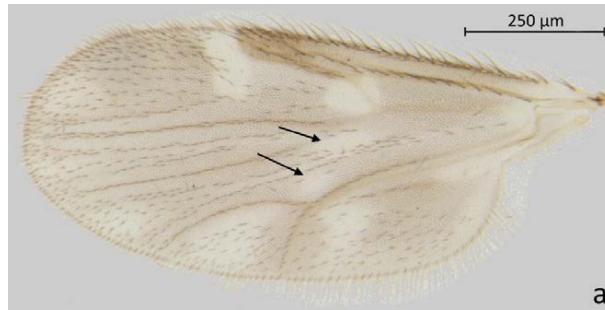
(Return to: [21](#))

[27](#)



26') 3rd palpal segment triangular, irregular or elongate.

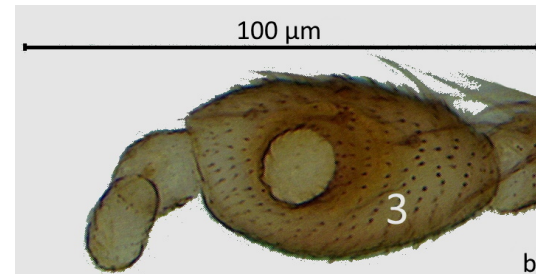
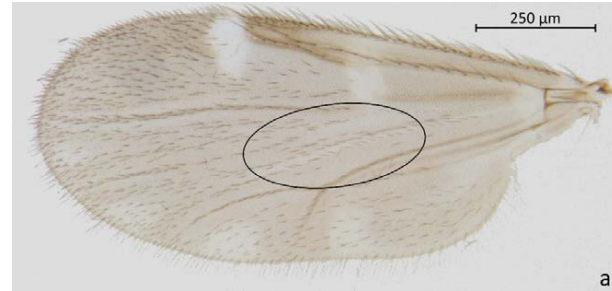
[28](#)



27) (a) Wing with two pale spots in cell m_2 , between the $r-m$ crossvein and the medio-cubital fork. (b) 3rd palpal segment greatly swollen and globular with a distinctive deep sensory pit.

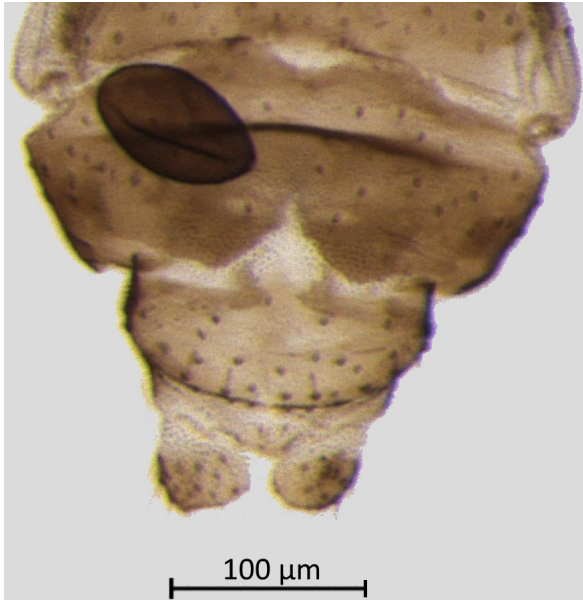
(Return to: [26](#))

[Culicoides footei](#) Wirth and Jones



27') (a') Wing uniformly dark in cell m_2 between the $r-m$ crossvein and the medio-cubital fork. (b') 3rd palpal segment greatly swollen and globular with a shallow sensory pit.

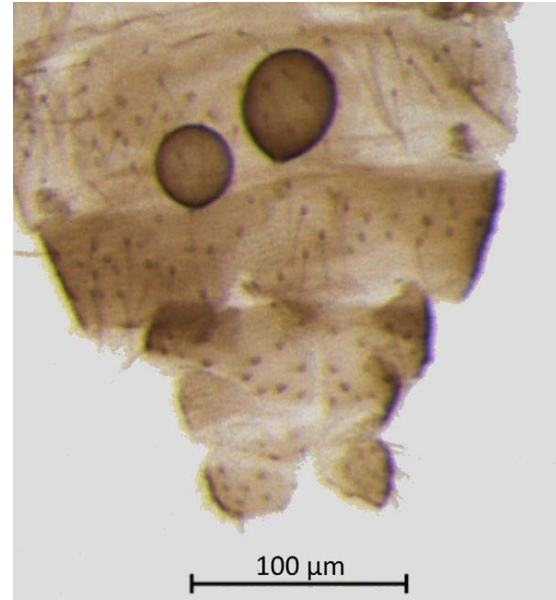
[Culicoides nanus](#) Root and Hoffman



28) One distinct spermatheca, usually oval and large.

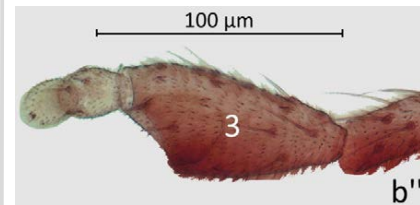
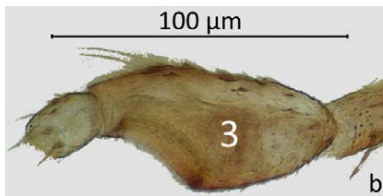
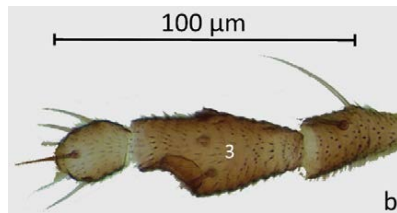
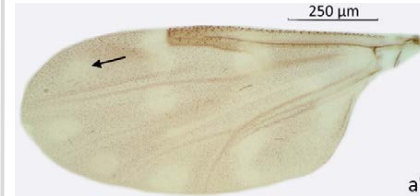
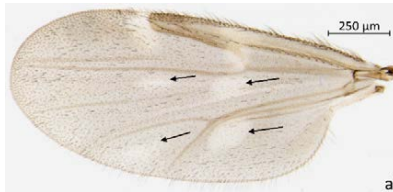
(Return to: [26](#))

[29](#)- Subgenus *Beltranmyia* Vargas



28') Two or more distinct spermathecae, which can be rounded or oval.

[30](#)



29) (a) Wing mostly uniform, generally with only two spots: the post-stigmatic pale spot and the *r-m* crossvein pale spot. (b) 3rd palpal segment short, moderately swollen, and irregular with a shallow sensory pit with a small opening. (Return to: [28](#))

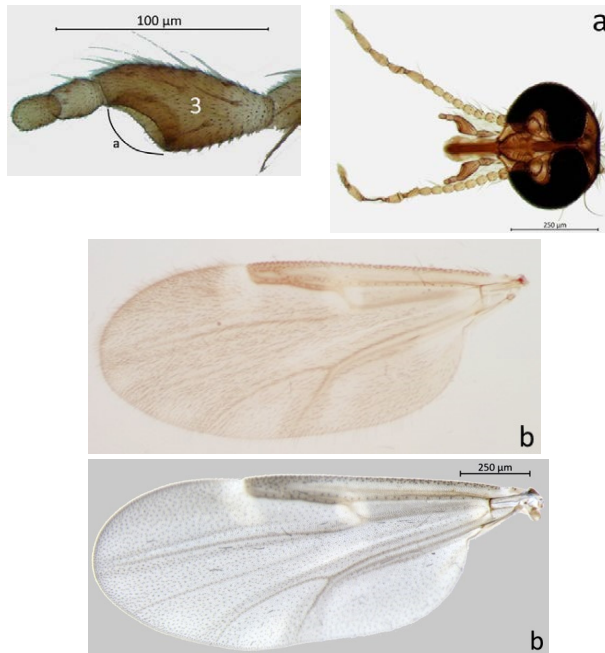
[*Culicoides wisconsinensis*](#) Jones

29') (a') Wing mostly uniform with more than two spots located in *m*₂ cell, *cu* cell, and *a* cell. (b') 3rd palpal segment long, very swollen, and triangular with a shallow sensory pit with a large opening.

[*Culicoides sphagnumensis*](#) Williams

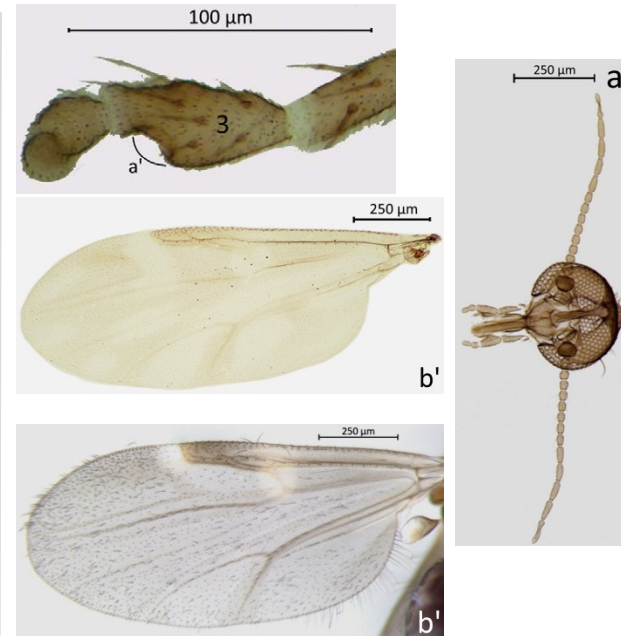
29'') (a'') Wing faintly patterned with more than two spots, always including a spot in the apical area of the *r*₅ cell. (b'') 3rd palpal segment long, very swollen, globular or triangular with deep sensory pit with a large opening.

[*Culicoides crepuscularis*](#) Malloch (in part)



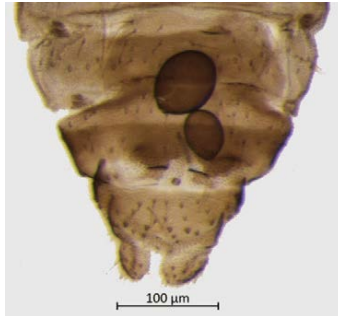
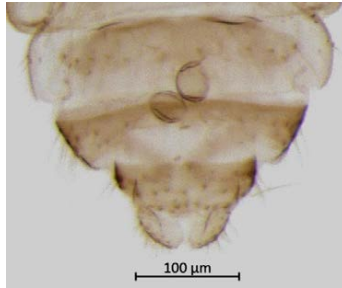
30) All these traits must be present:
 (a) 3rd palpal segment very large, triangular, and very swollen with a wide, definite, shallow sensory pit.
 (b) Wing with definite post-stigmatic and *r-m* crossvein pale spots, as well as variable diffuse pale areas along the wing margin in *r₅*, *m₁*, *m₂*, *cu*, and *a* cells, and the central portion of *m₂*.
 (Return to: [28](#))

Culicoides travisj Vargas



30') (a') 3rd palpal segment slightly to moderately swollen and triangular with a small to medium-sized palpal pit.
 (b') Wing pattern varies, but if as described in (b), then does not have the characteristic of (a).

[31](#)

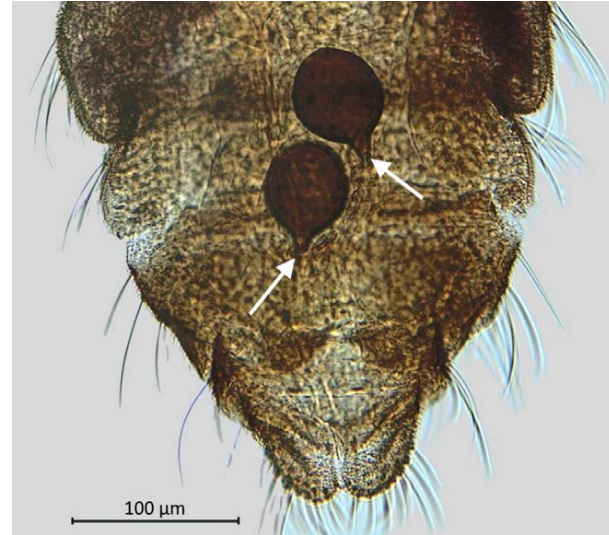


31) Spermathecae rounded, without necks.

In Ontario, includes: *C. alexanderi* Wirth and Blanton, *C. jamnbacki* Wirth and Hubert, *C. piliferus* Root and Hoffman, *C. snowi* Wirth and Jones, *C. testudinalis* Wirth and Hubert, and/or *C. utowana* Jamnback.

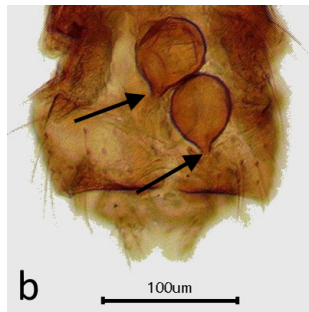
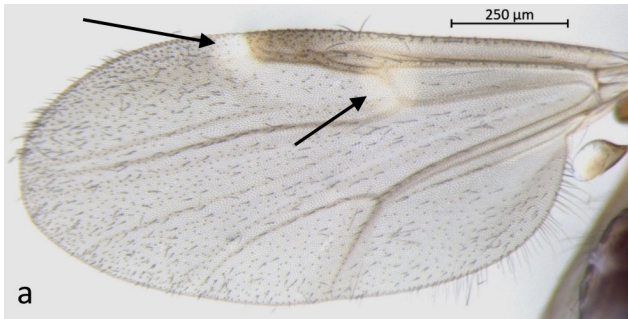
(Return to: [30](#))

[piliferus species group](#) Root and Hoffman (in part)



31') Spermathecae rounded with slender necks.

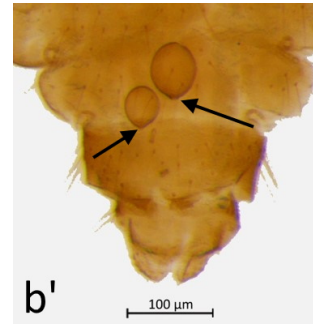
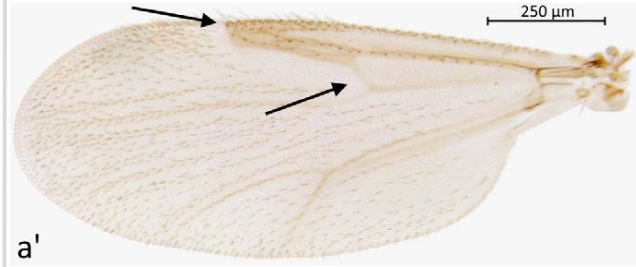
[32](#)



32) (a) *r-m* crossvein pale spot and post-stigmatic pale spot both prominent and well-defined. (b) Spermathecae with very distinct and long necks.

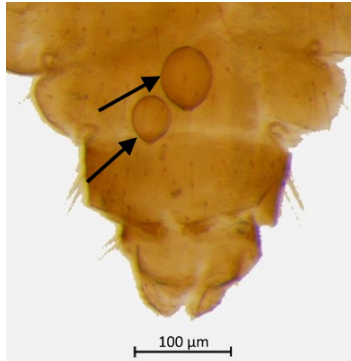
(Return to: [31](#))

[34](#)



32') (a') *r-m* crossvein pale spot and post-stigmatic pale spot faint and/or poorly defined. (b') Spermathecae with very short necks.

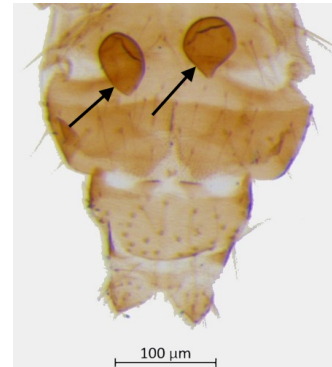
[33](#)



33) Spermathecae rounded and visibly unequal.

(Return to: [32](#))

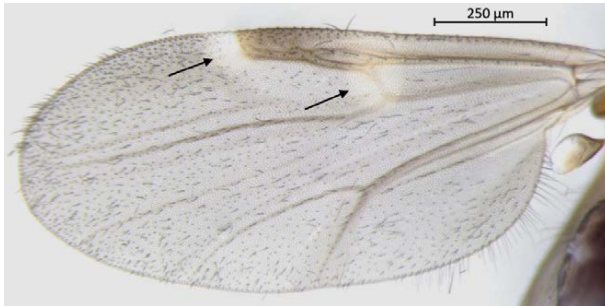
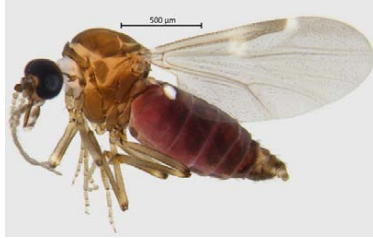
[C. utowana](#) Jamnback (in part)



33') Spermathecae rounded and visibly equal.*

*Spermathecae are collapsed in figure

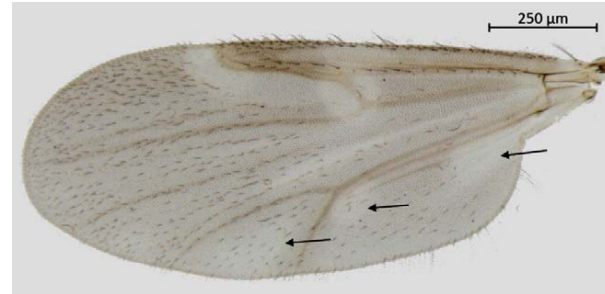
[C. franclemonti](#) Cochrane (in part)



34) Wing dark, only with small and highly-contrasting post-stigmatic pale spot and *r-m* crossvein pale spot.

(Return to: [32](#))

[Culicoides biguttatus](#) (Coquillett)



34') Wing dark with variably diffuse but prominent post-stigmatic pale spot and *r-m* crossvein pale spot. Other indistinct pale spots may be present near the wing margin in m_1 , m_2 , *cu*, and/or *a* cells, and basally in m_1 and m_2 .

[Culicoides spinosus](#) Root and Hoffman (in part)

piliferus Species Group Root and Hoffman

The *piliferus* species group is a complex that shares many diagnostic similarities with each other, most notably by the pale spots straddling the mid-positions of the M_1 and M_2 veins, the post-stigmatic pale spot not encroaching on the r_{2+3} cell, two rounded spermathecae without necks, and cell r_5 having an elongate, large apical pale spot (Wirth and Hubert 1962). Although some species have plain, non-patterned wings, they are described in the same group from other characteristics such as spermathecae, and features of the male genitalia.

Due to the ambiguity of this group and the high degree of apparent intraspecific variation (including wing pattern), the species in this complex cannot be soundly identified using this key for morphology in Ontario. Here we link the species pages of all Ontarian members of the *piliferus* species group for further examination and research:

[Plain wing](#)

[Patterned wing](#)



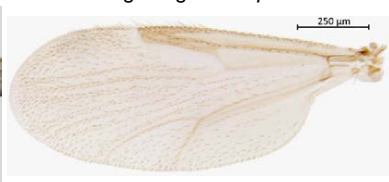
Wing image of *C. snowi*



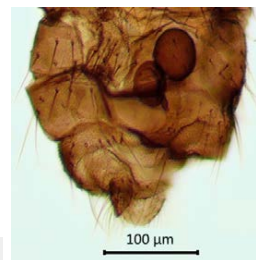
Wing image of *C. piliferus*



Wing image of *C. bickleyi*



Wing image of *C. utowana*



Spermatheca image of *C. downesi*



Head image of *C. jamnbacki*



Lateral image of *C. denticulatus*

Plain wing *piliferus* Species Group Root and Hoffman

The *piliferus* species group is a complex that shares many diagnostic similarities with each other, most notably by the pale spots straddling the mid-portion of the M_1 and M_2 veins, the post-stigmatic pale spot not encroaching on the r_{2+3} cell, two oval/ovoid spermathecae without necks, and cell r_5 having an elongate, large apical pale spot (Wirth and Hubert 1962). Although some species have plain non-patterned wings, they are described in the same group from other characteristics such as spermathecae, and features of the male genitalia.

Due to the ambiguity of this group and the high degree of apparent intraspecific variation, the species in this complex cannot be soundly identified using this key for morphology in Ontario. Here we link the species pages of all Ontarian members of the *piliferus* species group for further examination and research:

- [Culicoides alexanderi](#)
- [Culicoides franclemonti](#)
- [Culicoides jamnbacki](#)
- [Culicoides snowi](#)
- [Culicoides testudinalis](#)
- [Culicoides utowana](#)

[Back to *piliferus* species group page](#)



Wing image of *C. utowana*



Wing image of *C. franclemonti*



Spermatheca image of *C. utowana*



Lateral image of *C. franclemonti*



Wing image of *C. jamnbacki*



Head image of *C. testudinalis*

Patterned wing *piliferus* Species Group Root and Hoffman

The *piliferus* species group is a complex that shares many diagnostic similarities with each other, most notably by the pale spots straddling the mid-portion of the M_1 and M_2 veins, the post-stigmatic pale spot not encroaching on the r_{2+3} cell, two oval/ovoid spermathecae without necks, and cell r_5 having an elongate, large apical pale spot (Wirth and Hubert 1962). Although some have plain non-patterned wings, they are described in the same group from other characteristics such as spermathecae, and features of the male genitalia.

Due to the ambiguity of this group and the high degree of apparent intraspecific variation, the species in this complex cannot be soundly identified using this key for morphology in Ontario. Here we link the species pages of all Ontarian members of the *piliferus* species group for further examination and research:

- [Culicoides alexanderi](#)
- [Culicoides bickleyi](#)
- [Culicoides denticulatus](#)
- [Culicoides downesi](#)
- [Culicoides jamnbacki](#)
- [Culicoides parapiliferus](#)
- [Culicoides piliferus](#)
- [Culicoides testudinalis](#)

[Back to *piliferus* species group page](#)



Wing image of *C. bickleyi*



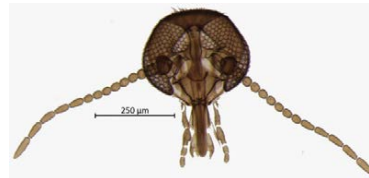
Wing image of *C. piliferus*



Wing image of *C. downesi*



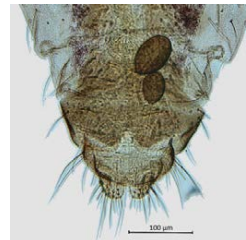
Wing image of *C. testudinalis*



Wing image of *C. testudinalis*



Lateral image of *C. downesi*



Spermatheca image
of *C. bickleyi*

Subgenus *Avaritia* Fox 1955

The subgenus *Avaritia* is a group that comprises of three different species in Ontario that are often regarded as being pests (Jamnback and Wirth 1963). They share many diagnostic characteristics including: the comparatively small size of females for the genus *Culicoides*, the apical wing macrotrichia, the post-stigmatic pale spot which encroaches into the r_{2+3} cell, other pale wing spots that are often diffuse including the preapical pale spot in the r_5 , and two nearly equal, rounded spermathecae with necks (Jamnback and Wirth 1963).

Due to the ambiguous separation of these species in this subgenus, these three species cannot be soundly identified using this key for morphology in Ontario. Here we link the species pages of all Ontarian members of the subgenus *Avaritia* for further examination and research:

[Culicoides chiopterus](#)

[Culicoides obsoletus](#)

[Culicoides sanguisuga](#)



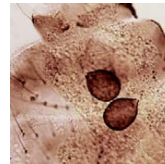
Wing image of *C. chiopterus*



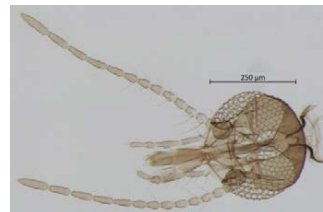
Wing image of *C. obsoletus*



Wing image of *C. sanguisuga*



Spermatheca image of
C. obsoletus



Head image of *C. chiopterus*



Lateral image of *C. sanguisuga*

Culicoides (Monoculicoides) albertensis Wirth and Jones, 1957

Differential diagnosis: The subgenus *Monoculicoides* can be distinguished from all other Ontarian *Culicoides* by the single, C-shaped spermatheca; *C. (M.) albertensis* is distinguished by its moderate-to-greatly swollen 3rd palpal segment with a wide rounded pit, which is sometimes partially bifurcated (Holbrook et al. 2000). The similar species, *C. (M.) variipennis*, has a longer and only slightly swollen 3rd palpal segment, with a small round pit. *Culicoides (M.) albertensis* can be more variable in size and colour than *C. (M.) variipennis* (Pers. Comm. Vigil, 2022).

Diagnosis: Thorax brown. Eyes bare, separated. 3rd palpal segment moderately or greatly swollen and triangular, with large, shallow sensory pit, which is sometimes partially bifurcated (Wirth and Jones 1957). Proximal 8 flagellomeres barrel-shaped and covered with sensoria, distal 5 flagellomeres elongate, though nearly barrel shaped. Hind tibia brown with well-defined basal pale band. Single spermatheca C-shaped (Wirth and Jones 1957). Haltere whitish, base dark (Wirth and Jones 1957).

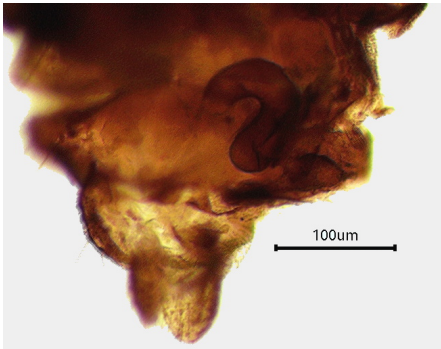
Wing diagnosis: Average wing length 1.4 mm (Wirth and Jones 1957). Wing with sparse macrotrichia that is whitish in pale areas (Wirth and Jones 1957). Wing dark grey with highly contrasting, mostly coalesced pale spots as follows: post-stigmatic pale spot large, does not extend into r_{2+3} , coalesced with pale spots in m_1 and m_2 ; $r-m$ pale spot large, extends to anterior wing margin and coalesces with pale spot in m_2 ; r_s , m_1 and m_2 almost entirely pale except for irregular, dark, preapical and median spots; cu mostly pale except for dark funnel shape on posterior CuA_2 vein; a with pair of small distal spots and large basal spot. Wing dark brown at apex of C , with well-defined stigma.

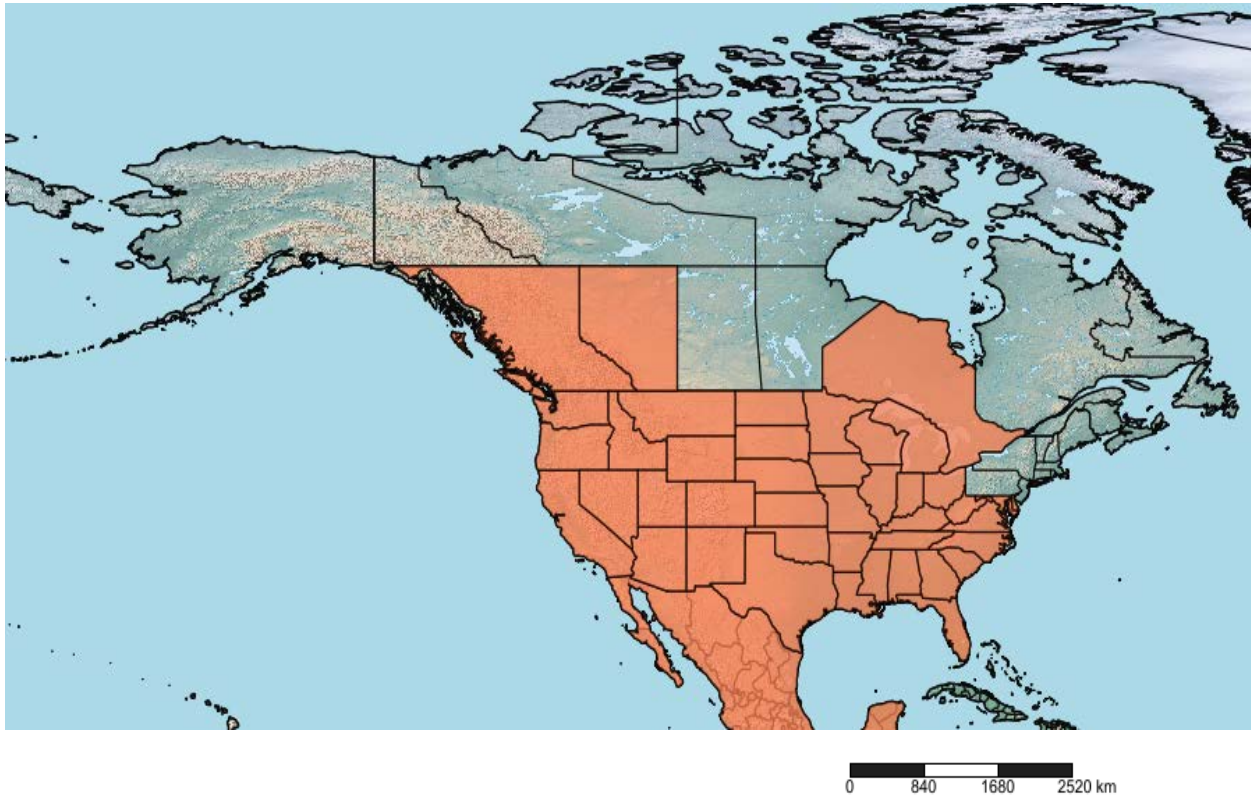
Habitat: This species has been found in mud close to ponds and slow streams, where there is pollution from sheep and cow manure (Wirth and Jones 1957). It is found in the highest density where there is manure pollution (Wirth and Jones 1957).

Distribution: After elevating *C. albertensis* to species status, Shults et al. (2022a, 2022b) lists the current distribution as the Midwest U.S. and Ontario. The holotype of this species comes from Lethbridge, Alberta and the original distribution from Wirth and Jones (1957) includes the Midwest U.S and Alberta.

Remarks: Ontarian records of *C. (M.) albertensis* were previously thought to be specimens of *C. sonorensis*, under the assumption that this typically midwestern species experienced a range shift into the northeast, including Ontario (Jewiss-Gaines et al. 2017). More recently, *Culicoides (M.) albertensis* was raised to species status after Shults et al. (2022a, 2022b) found significant molecular differences between North American populations of *Culicoides* in the *C. varriipennis* species complex. Although *C. albertensis* is sympatric with the principal vector of BTV and EHDV in North America (*C. sonorensis*), *C. albertensis* itself is not a confirmed vector of these diseases. See remarks under *C. (M.) variipennis* for species treatment of the *C. variipennis* species complex, which includes *C. (M.) variipennis*, *C. (M.) albertensis*, *C. (M.) sonorensis* and *C. (M.) occidentalis* (Shults et al. 2022a, 2022b).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides albertensis* could occur in North America in orange, based on distribution data from the literature (Wirth and Jones 1957; Wirth et al. 1985; Borkent and Grogan 2009; Jewiss-Gaines et al. 2017).

Culicoides alexanderi Wirth and Hubert, 1962

Culicoides pseudopiliferus Wirth & Hubert, 1962.

Differential diagnosis: *Culicoides alexanderi* belongs to the [piliferus species group](#) and resembles other species in that group, particularly [C. parapiliferus](#) and [C. testudinalis](#) in having wings with poorly contrasting, diffuse pale spots. *Culicoides alexanderi* cannot be soundly identified to species using the current key due to close resemblance and intraspecific variation within the *piliferus* species group; we suggest close comparison of wing and 3rd palpal segment figures to delineate these species.

Diagnosis: Thorax dark brown. Eyes separated. 3rd palpal segment short, rounded and slightly swollen, with a small and round sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded; distal 5 flagellomeres elongate. Hind tibia dark brown, slightly paler basally but without well-defined pale bands. Pair of spermathecae rounded, very unequal, without necks (Wirth and Hubert 1962). Haltere pale brown.

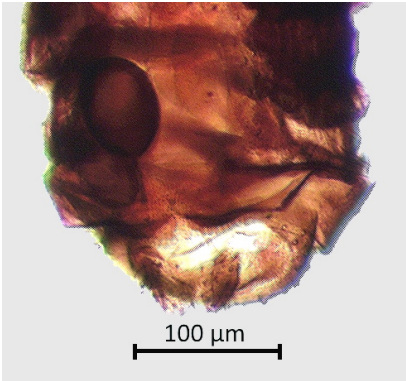
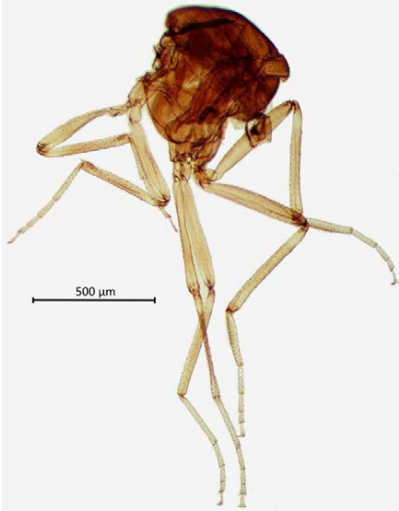
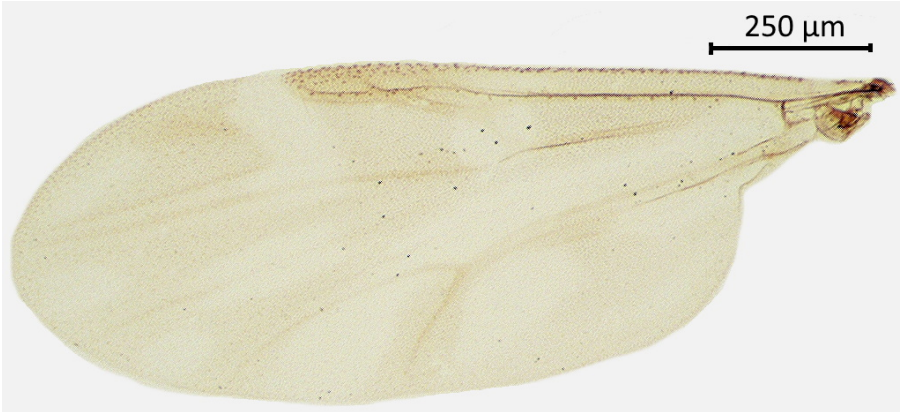
Wing diagnosis. Average wing length 1.13 mm (Wirth and Hubert 1962). Wing with long and numerous macrotrichia (not visible in Fig.) (Wirth and Hubert 1962). Wing light brown with very poorly contrasting and diffuse pale spots as follows: M_1 and M_2 with elongate spots sitting on veins on same plane as post-stigmatic pale spot; post-stigmatic pale spot large, not encroaching into r_{2+3} ; $r-m$ pale spot relatively large, sits on $r-m$ but does not extend to anterior margin of wing; r_5 and m_1 with small subapical spots; m_2 with small subapical spot and very poorly defined discal spot; cu almost entirely occupied by large distal spot; a with spot on distal half. Wing uniformly brown at apex of C , without dark stigma.

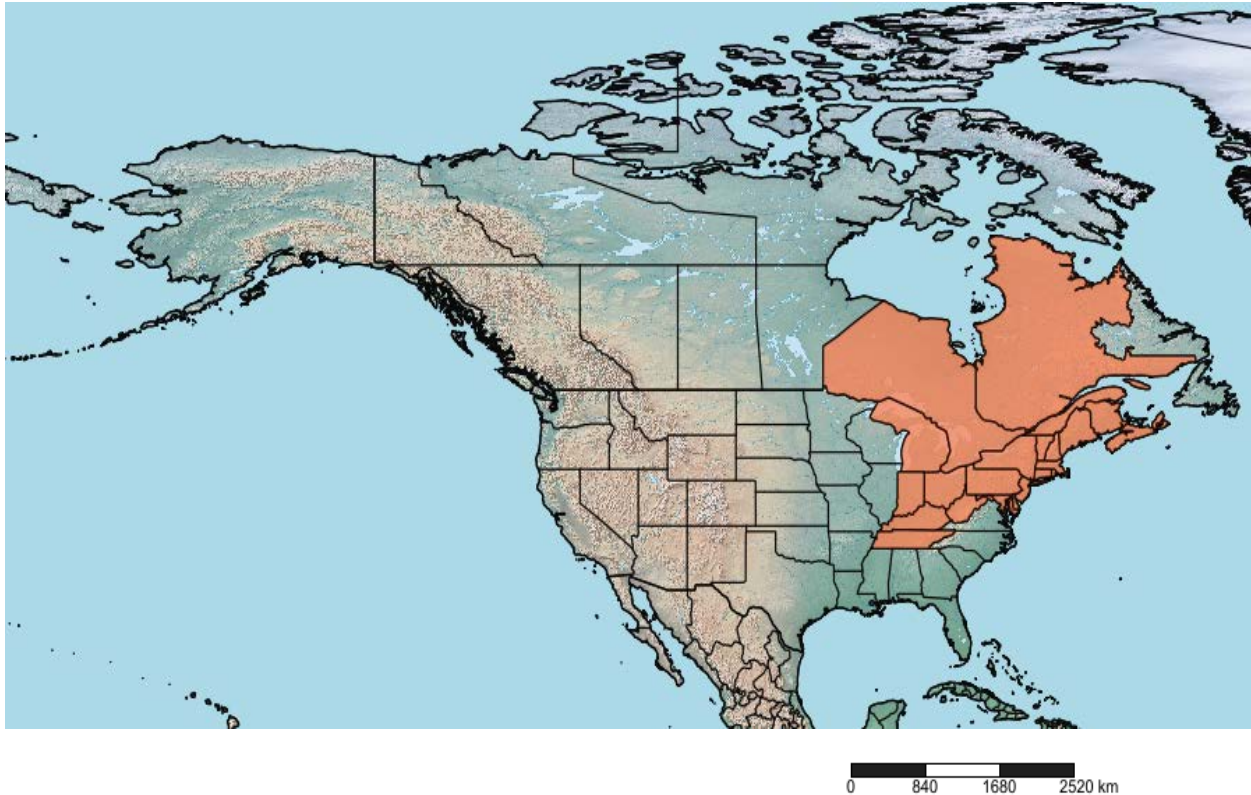
Habitat: From label data in Jamnback (1965): *C. alexanderi* has been collected at a stream margin, grassy puddle, and near a lake.

Distribution: Eastern North America from Michigan east to Nova Scotia in the north, extending south to Tennessee and Maryland (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: There is only a single record of this species biting a human, otherwise its feeding habits are largely unknown (Jamnback 1965). *Culicoides alexanderi* has been recorded as active from May to July, with a peak occurring in early June in Virginia (Tanner 1971). Wirth and Hubert (1962) record a peak for this species in May in Connecticut. This species was not attracted to traps baited with goats (Tanner 1971).

[Images](#)
[Distribution Map](#)
[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides alexanderi* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Amossovia) arboricola Root and Hoffman, 1937

Differential diagnosis: *Culicoides (Am.) arboricola* resembles other species in subgenus *Amossovia* in having a similar distribution of numerous small, highly contrasting pale spots on the wing. It is most similar to [C. \(Am.\) guttipennis](#) in having similar wing length (1.19 and 1.3 mm, respectively) and a large *r-m* pale spot which extends into m_2 , but it differs by having a pale spot on CuA_2 at the wing margin (Root and Hoffman 1937). The large *r-m* pale spot of *C. (Am.) arboricola* differs from the more restricted *r-m* pale spot of [C. \(Am.\) villosipennis](#), which does not extend into m_2 (Blanton and Wirth 1979).

Diagnosis: Thorax dark brown. Eyes narrowly separated. 3rd palpal segment triangular, slightly to moderately swollen (Wirth and Blanton 1967). Proximal 8 flagellomeres barrel-shaped, short and nearly rounded; distal 5 flagellomeres elongate. Hind tibia dark brown with well-defined apical and basal pale bands. Pair of spermathecae equal or subequal, rounded with small, slender necks (Wirth and Blanton 1967). Haltere pale brown.

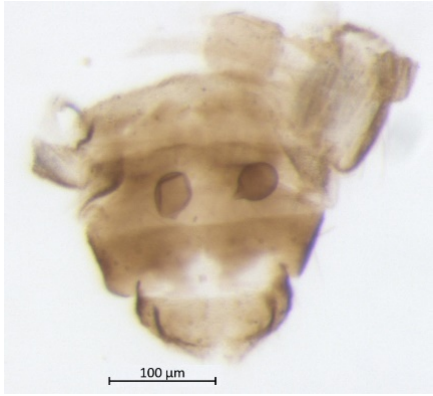
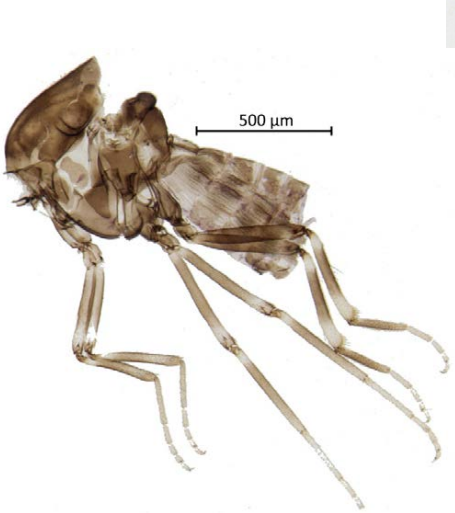
Wing diagnosis: Average wing length 1.19 mm (Wirth and Blanton 1967). Wing with long and numerous macrotrichia. Wing dark brown with highly contrasting, well-defined pale spots as follows: M_1 and M_2 pale apically, with pairs of small spots straddling veins on same plane as post-stigmatic pale spot; post-stigmatic pale spot small or large, not encroaching into r_{2+3} , but can drop below R_{4+5} and R_{2+3} to join *r-m* pale spot (Wirth and Blanton 1967); *r-m* pale spot large, extends into m_2 and sometimes to the anterior margin of wing; r_5 with two small distal spots, upper spot touching anterior margin of wing; m_1 with small subapical spot; m_2 with small subapical spot and discal spot at fork between CuA_1 and CuP ; cu with small elongate spot touching CuA_1 and two very small indistinct spots at the posterior wing margins of CuA_1 and CuA_2 veins; a with three to four small spots. Base of wing pale. Wing dark brown at apex of C , with stigma.

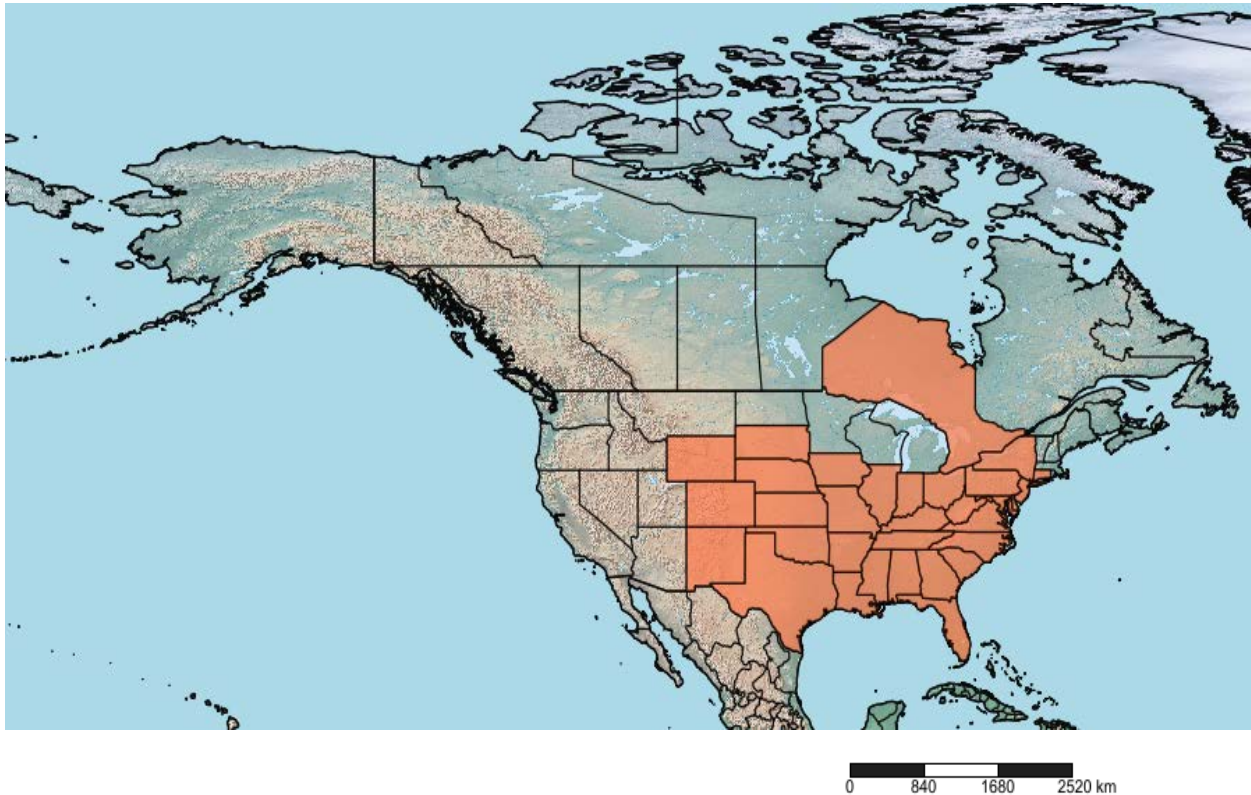
Habitat: *Culicoides (Am.) arboricola* has been reared from moist or wet tree or stump holes (Wirth and Blanton 1967).

Distribution: Wyoming and Texas east to Connecticut and Florida (Wirth and Blanton 1967; Wirth et al. 1985). In Canada, it has been recorded in Ontario (Borkent and Grogan 2009).

Remarks: Blanton and Wirth (1979) provide a summary of feeding habits of *C. (Am.) arboricola*: primarily ornithophilic and feeds on chickens, rabbits, and seldom if at all on humans (Wirth and Blanton 1967; Snow et al. 1957; Messersmith 1965; Smith and Varnell 1967; Childers and Wingo 1968; Turner 1968; Humphreys and Turner 1973).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides arboricola* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009)

Culicoides atchleyi Wirth and Blanton, 1969

Differential diagnosis: *Culicoides atchleyi* resembles other Ontarian *Culicoides* with relatively plain wings but have extremely reduced or absent pale spots, like [C. \(*Wirthomyia*\) *stilobezzioides*](#), but can be distinguished by the sparse wing macrotrichia and the slender 3rd palpal segment. *Culicoides atchleyi* also resembles the western species *C. saundersi* Wirth and Blanton (Alaska, s. to California & Montana, (Borkent and Grogan 2009)) in having a relatively plain wing, but differs by the loss of mandibular teeth, the narrower eye separation and shorter 3rd palpal segment (Wirth and Blanton 1969b).

Diagnosis: Thorax dark brown. Eyes hairy, separated. 3rd palpal segment triangular, slender, and short. Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres elongate. Hind tibia dark brown, paler basally but without well-defined pale band. Pair of spermathecae small, rounded, with slender necks (Wirth and Blanton 1969b). Haltere pale brown.

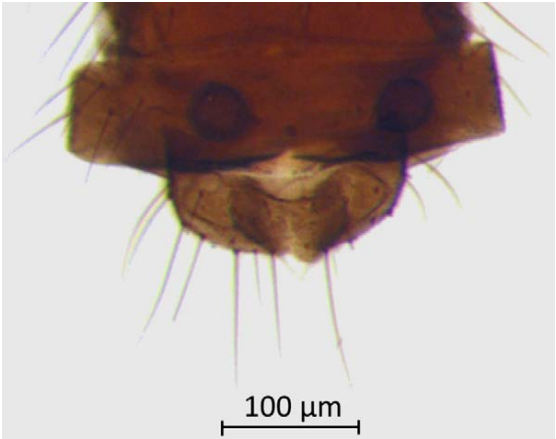
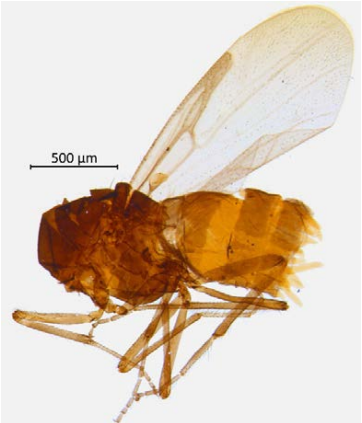
Wing diagnosis: Average wing length 1.95 mm (Wirth and Blanton 1969b). Wing with short macrotrichia, sparser basally and absent in *c* (Wirth and Blanton 1969b). Wing light brown and plain or with very faint, poorly contrasting, diffuse spots if any. *r-m* and post-stigmatic pale spot very faint if present (Wirth and Blanton 1969b). Wing dark brown at apex of *C*, with obvious stigma.

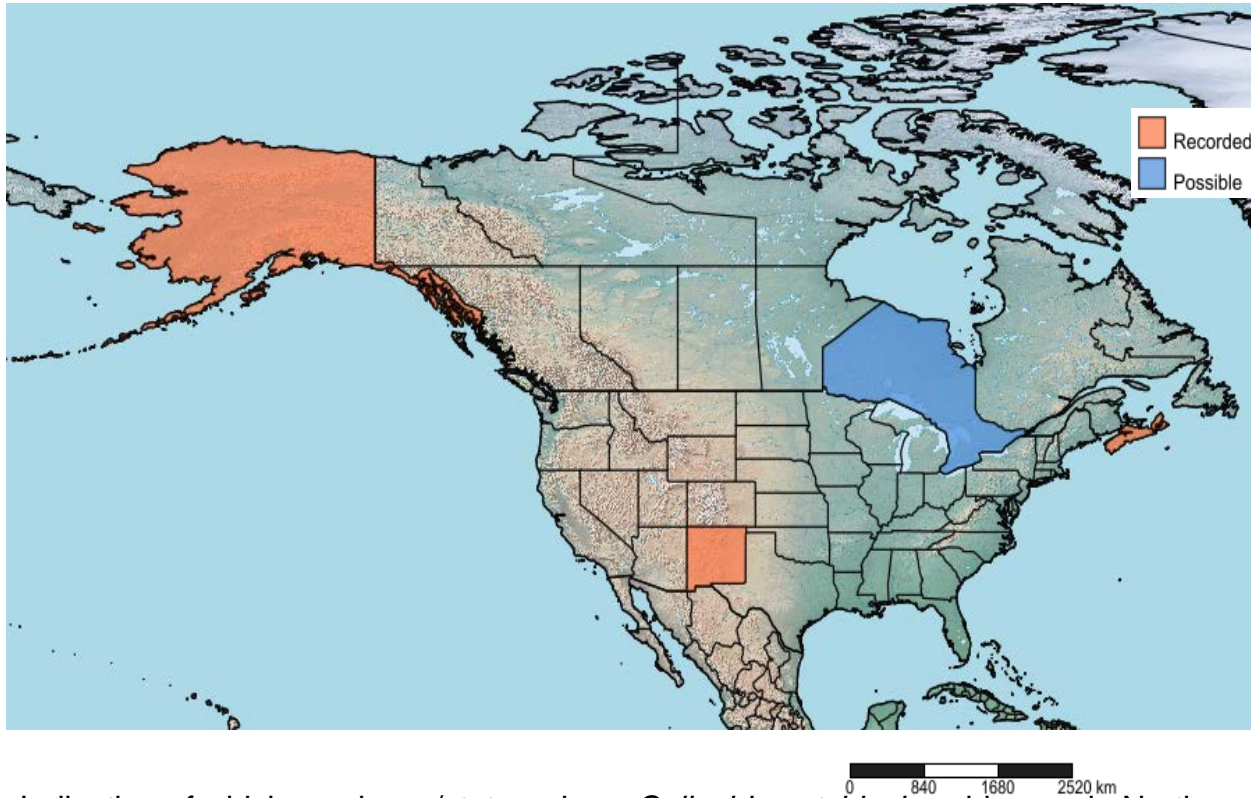
Habitat: Unknown.

Distribution: Found in Alaska and New Mexico (Wirth and Blanton 1969b). Wirth et al. (1985) also notes a collection in Nova Scotia. Although there are no known records of this species collected from Ontario, this species has been identified from widely distributed locations across North America and is possible to be within range of Ontario.

Remarks. The feeding habits of *C. atchleyi* are unknown, but the species lacks mandibular teeth (Wirth and Blanton 1969b) suggesting it is not hematophagous.

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides atchleyi* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1969b; Wirth et al. 1985). Possible distribution is in blue.

Culicoides (Diphaomyia) baueri Hoffman, 1925

Differential diagnosis: *Culicoides (Di.) baueri* closely resembles [C. \(Di.\) bergi](#) in having a wing pattern with a pair of distinct or coalesced preapical spots in r_s , and the post-stigmatic pale spot split into two, but can be differentiated by the smaller third palpal segment with a shallow pit and the lighter basal hind tibial band. *Culicoides (Di.) baueri* also resembles [C. \(Amossovia\) arboricola](#) and others in the *guttipennis* species group in having a pair of preapical spots in r_s , but *C. (Di.) baueri* can be recognized by the 1–2 spots in the *a* cell (Blanton and Wirth 1979).

Diagnosis: Body length 1.4 mm (Hoffman 1925). Thorax dark brown. Eyes bare, separated. Third palpal segment short, triangular, with a shallow sensory pit (Allen et al. 2022). Proximal 8 flagellomeres round, distal 5 flagellomeres elongate. Hind tibia with well-defined apical and wide basal pale bands. Pair of spermathecae small, rounded, unequal, with slender necks (Blanton and Wirth 1979). Haltere pale brown.

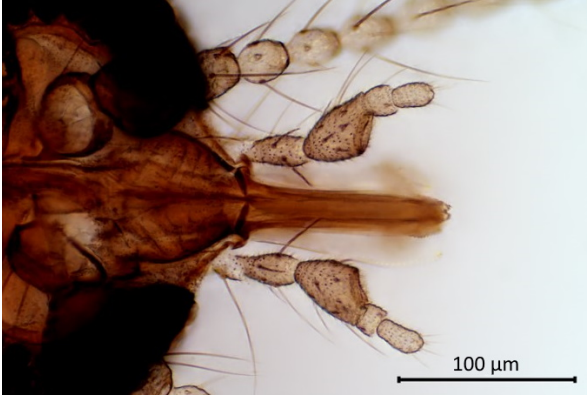
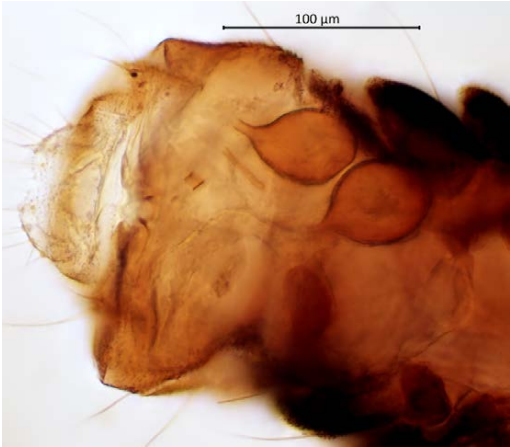
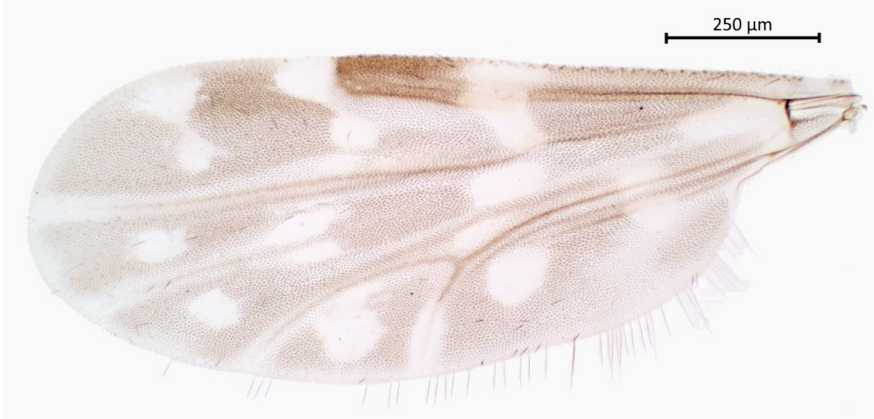
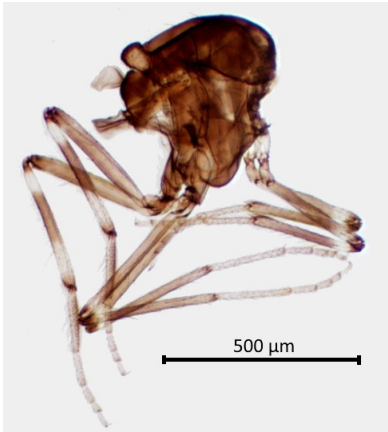
Wing diagnosis: Wing length 1.03 mm (Blanton and Wirth 1979). Macrotrichia on apical third of wing, denser anteriorly (Hoffman 1925). Wing grey or brown with highly contrasting, well-defined pale spots as follows: M_1 and M_2 with pale highlight extending to apical wing margin; post-stigmatic pale spot not encroaching into r_{2+3} , split into two well-defined or coalesced spots; *r-m* pale spot large, sits on *r-m* vein, extending to anterior margin of wing and posteriorly into m_1 ; r_s with pair of distinct or diffuse subapical spots; m_1 and m_2 with small distal spot; CuA_1 and CuP with pale highlight; *cu* with large median spot that touches CuA_1 ; *a* with distal, well-defined spot and proximal faded spot. Wing dark brown at apex of *C*, well-defined stigma.

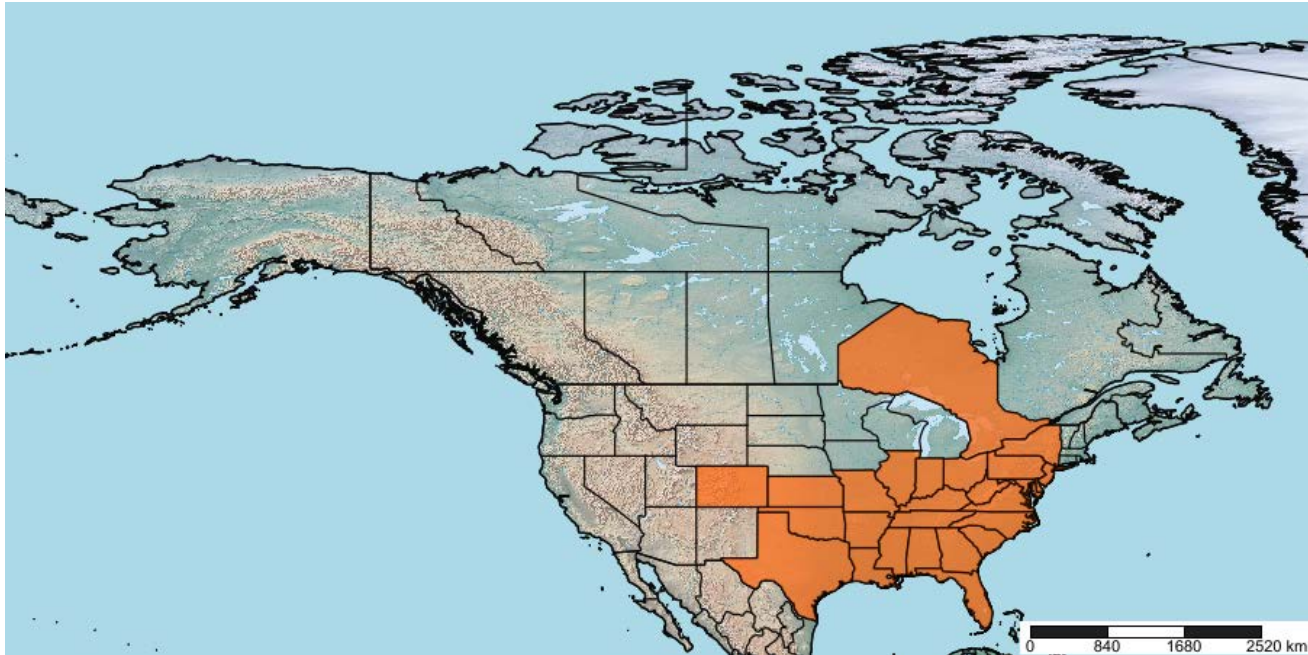
Habitat: *Culicoides (Di.) baueri* has been reared from spring and stream margins, marshes, pools and from dead leaves and mud (Childers and Wingo 1968; Gazeau and Messersmith 1970). In Ontario, this species has been collected from sheep-focused livestock habitat traps, and forested/wetland area traps (Allen et al. 2022).

Distribution: Because it was misidentified for many years, the true distribution of *C. (Di.) baueri* is not well established, but most conclusive records are from southeastern and eastern USA (Allen et al. 2022). Allen et al. (2022) recorded this species for the first time in Ontario. Other sources list the distribution as Colorado, New Jersey, Maryland and Tennessee south to Louisiana and Florida (DasGupta and Hansens 1965; Blanton and Wirth 1979; Borkent and Grogan 2009).

Remarks. This species has seldomly been recorded biting man (Blanton and Wirth 1979). *Culicoides (Di.) baueri* is implicated as a potential vector of the avian blood parasite, *Haemoproteus lophortx* (Mullens et al. 2006). *Culicoides (Di.) baueri* is suggested to be primarily ornithophilic in some studies, while other studies point to it being opportunistic, although these observations are in question due to *C. (Di.) baueri* being historically misidentified (Allen et al. 2022). *Culicoides (Di.) baueri* has been observed at sheep, but not cattle farms (Allen et al. 2022).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides baueri* could occur in North America in orange, based on distribution data from the literature (DasGupta and Hansens 1965; Blanton and Wirth 1979; Borkent and Grogan 2009; Allen et al. 2022).

Culicoides (Diphaomyia) bergi Cochrane, 1973

Misidentification: *Culicoides baueri* in Jamnback (1965) (Cochrane 1973)

Differential diagnosis: *Culicoides (Di.) bergi* closely resembles [C. \(Di.\) baueri](#) in having a wing pattern with a pair of distinct or coalesced preapical spots in r_5 and the post-stigmatic pale spot split into two, but can be most easily recognized by the large, swollen third palpal segment and larger body size (Wing length 1.07–1.26mm). *Culicoides (Di.) bergi* also resembles [C. \(Amosovia\) arboricola](#) and others in the *guttipennis* species group in having a pair of distal spots in r_5 , but *C. (Di.) bergi* can be recognized by the 1–2 spots in the *a* cell.

Diagnosis: Thorax dark brown. Eyes bare, narrowly separated. Third palpal segment long, very swollen, triangular or globular, with a deep sensory pit. Proximal 8 flagellomeres round, distal 5 flagellomeres elongate. Hind tibia dark brown, with well-defined apical and wide basal pale bands; basal band darker and more diffuse than apical band (Allen et al. 2022). Pair of spermathecae small, rounded, slightly unequal, with slender long necks (Cochrane 1973). Haltere pale brown (Cochrane 1973).

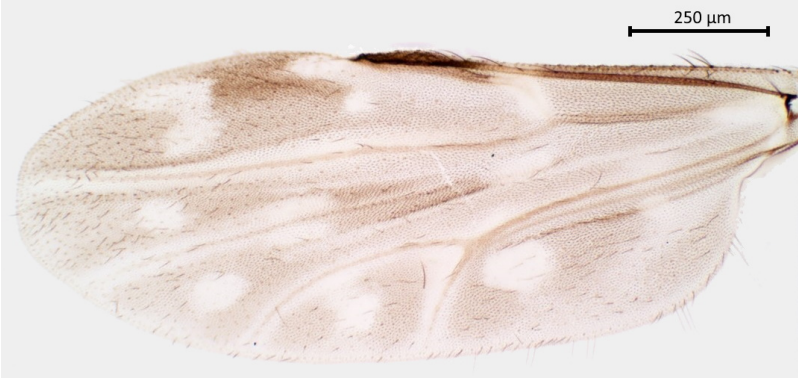
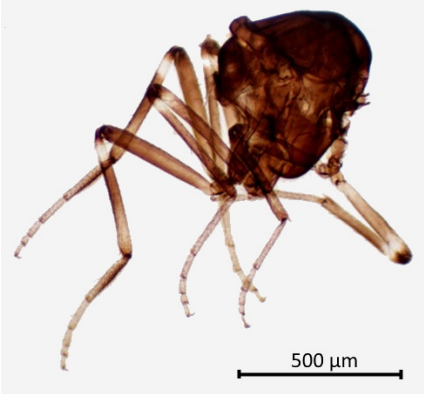
Wing diagnosis: Average wing length 1.20 mm (Cochrane 1973). Macrotrichia abundant, sparser basally (Cochrane, 1973). Wing grey or brown with highly contrasting, well-defined pale spots as follows: M_1 and M_2 with pale highlight extending to apical wing margin; post-stigmatic pale spot not encroaching into r_{2+3} (not visible in Fig.), split into two well defined or coalesces spots; *r-m* pale spot large, sits on *r-m* vein, extending to anterior margin of wing and posteriorly into m_1 ; r_5 with pair of distinct or diffuse subapical spots; m_1 and m_2 with small distal spot; CuA_1 and CuP with pale highlight; *cu* with large median spot that touches CuA_1 ; *a* with distal, well-defined spot and proximal faded spot. Wing dark brown at apex of *C*, well-defined stigma.

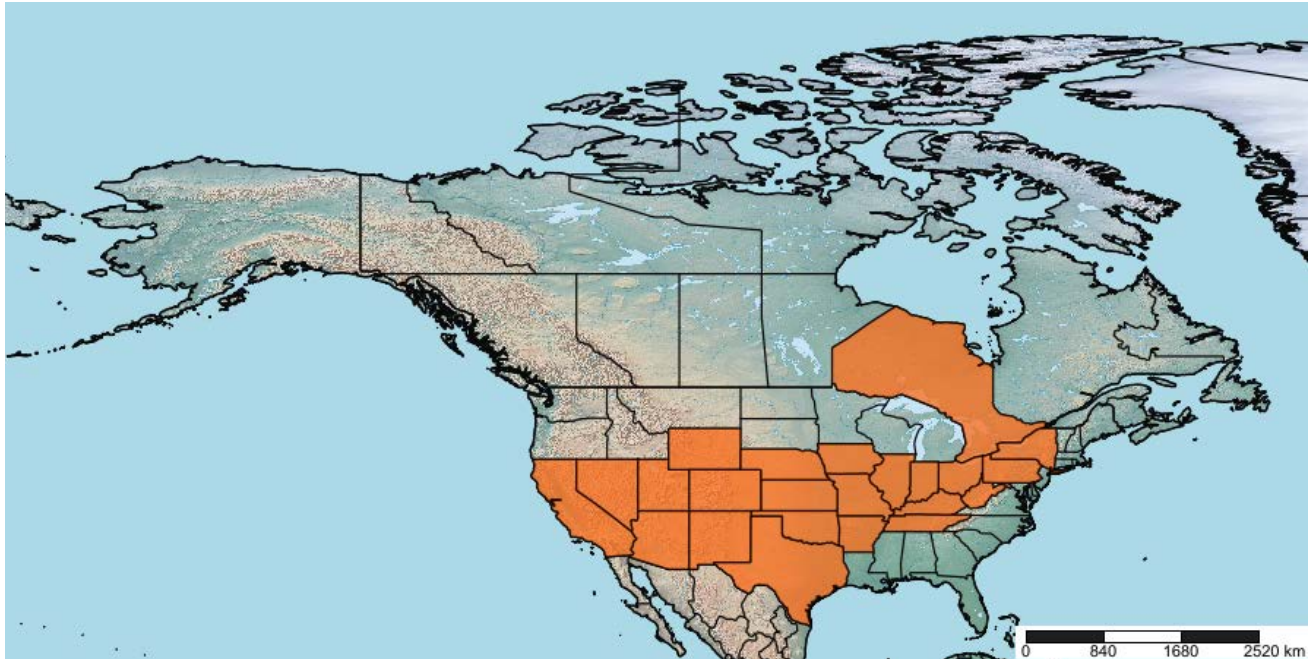
Habitat: Allen et al. (2022) collected this species in Ontario from light traps placed in natural areas adjacent to farms but not from light traps placed near livestock.

Distribution: California, Wyoming to New York, south to Arizona, Texas, Virginia (Borkent and Grogan 2009). Allen et al. 2022 detected this species in Ontario for the first time.

Remarks. *Culicoides (Di.) bergi* is implicated as a potential vector of the avian blood parasite, *Haemoproteus lophortx* (Mullens et al. 2006; Allen et al. 2022).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides bergi* could occur in North America in orange, based on distribution data from the literature (Borkent and Grogan 2009; Allen et al. 2022).

Culicoides bickleyi Wirth and Hubert, 1962

Differential diagnosis: *Culicoides bickleyi* belongs to the [piliferus species group](#) and closely resembles *C. piliferus* in having a similar distribution of pale spots on the wing and spermathecae without necks but differs by the slender 3rd palpal segment and the greatly unequal spermathecae (Wirth and Hubert 1962). *Culicoides bickleyi* also resembles *C. jamnbacki* in sometimes having sensoria on some or all of the flagellomeres (especially in populations from Ontario) but is distinguished by the numerous pale spots on the wing (Wirth and Hubert 1962).

Diagnosis: Thorax dark brown. Eyes contiguous to narrowly separated (Wirth and Hubert 1962). 3rd palpal segment small, triangular, slightly swollen. Proximal 8 flagellomeres round, distal 5 flagellomeres elongate. Hind tibia dark brown, paler basally but without well-defined pale band. Pair of spermathecae rounded, unequal, without necks (Wirth and Hubert 1962). Halteres pale grey or brown (Wirth and Hubert 1962).

Wing diagnosis. Average wing length 1.07 mm (Wirth and Hubert 1962). Wing with numerous macrotrichia, sparser basally (not visible in Fig.) (Wirth and Hubert 1962). Wing grey with highly contrasting, well-defined or diffuse pale spots as follows: M_1 and M_2 with elongate spots sitting on veins at same plane as post-stigmatic pale spot; post-stigmatic pale spot not encroaching into r_{2+3} , but may encroach on R_{4+5} ; $r-m$ pale spot large, sits on $r-m$ vein, can extend to anterior margin of wing; r_5 with large diffuse subapical spot; m_1 with small diffuse apical spot; m_2 with small diffuse apical spot and large, elongate spot from fork between CuA_1 to CuP to base of wing; cu with large distal spot that reaches posterior margin of wing; a with small spots on apical half and basal corner. Wing slightly dark brown at apex of C , without well-defined stigma.

Habitat: Blanton and Wirth (1979) provide a summary of larval habitats for *C. bickleyi*: reared from *Sphagnum* from a swamp (Wirth and Hubert 1962), soft mud from a small woodland stream and mixtures of rotting hay, grass roots, and humus from swamps and thick *Sphagnum* (Jamnback 1965).

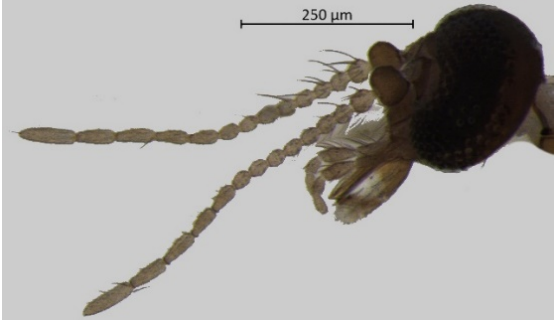
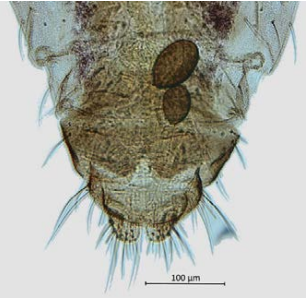
Distribution: From Wisconsin east to New Brunswick, and south to Florida and Louisiana (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

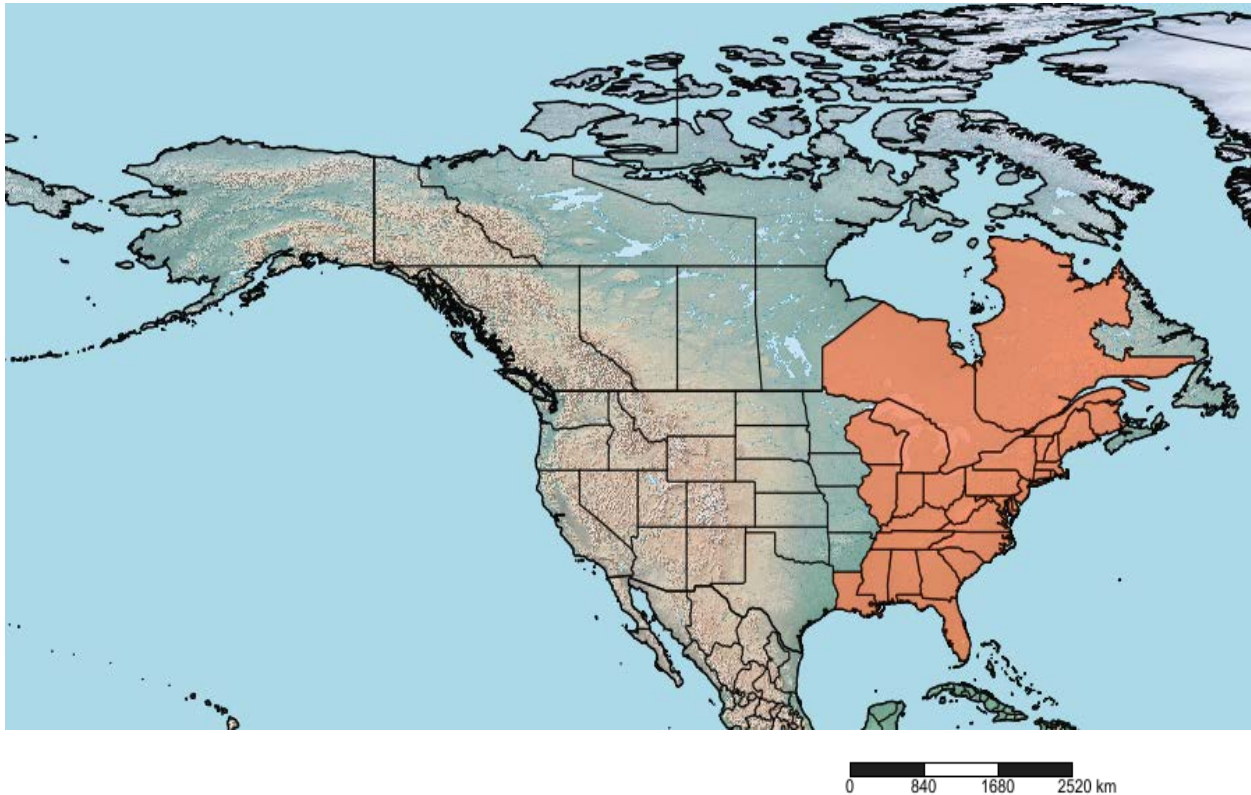
Remarks. Summarized from Blanton and Wirth (1979): This species has been recorded to bite humans (Wirth and Hubert 1962), and Battle and Turner (1971) suggests a preference for mammals. Humphreys and Turner (1973) collected this species from goats and turkey.

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides bickleyi* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert, 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Silvaticulicoides) biguttatus (Coquillett, 1901)

Ceratopogon biguttatus Coquillett, 1901.

Differential diagnosis: *Culicoides (S.) biguttatus* resembles other species of Ontarian *Culicoides* that have relatively plain wings with only the post-stigmatic and *r-m* pale spot visible, such as [C. trivisi](#) and [C. \(Beltranmyia\) wisconsinensis](#), but differs by the small, triangular 3rd palpal segment and the rounded, necked pair of spermathecae. In contrast to similar species, *C. (S.) biguttatus* tends to have only a highly contrasting post-stigmatic and *r-m* pale spot on a moderately dark wing, and no other pale spots on the wing.

Diagnosis: Thorax brown, mesonotum with a dark median longitudinal stripe (may be lost if the specimen is stored in alcohol). Eyes separated. 3rd palpal segment small, triangular, and swollen. Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres elongate. Hind tibia dark brown, pale brown basally. Pair of spermathecae rounded, equal or subequal, with necks. Halteres yellowish or whitish, basal part of knob brown.

Wing diagnosis: Average wing length 1.25 mm (Hoffman 1925). Wing with long macrotrichia, sparser basally (Foote and Pratt 1954; Hoffman 1925). Wing mostly uniformly grey or brown with highly contrasting, small post-stigmatic spot that does not extend into *r*₂₊₃ and large *r-m* pale spot that can extend to anterior margin of wing. Wing dark brown at apex of C, with stigma.

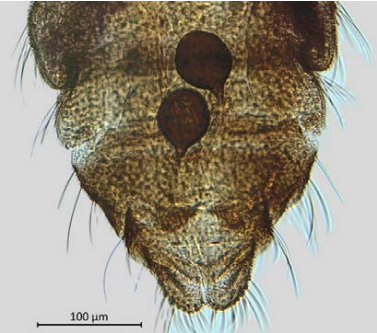
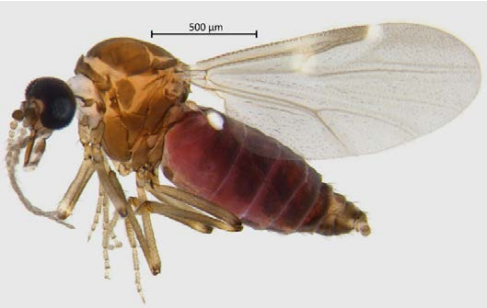
Habitat: Blanton and Wirth (1979) provide a summary for larval habitats of *C. (S.) biguttatus*: reared or collected from the margins of lakes, pools, streams, moist leaf depressions, cedar bogs, grassy marshes, bottomlands, humus and clay soil (Wirth 1951; Williams 1955; Murray 1957; Snow et al. 1957; Jamnback 1965; Hair et al. 1966; Gazeau and Messersmith 1970).

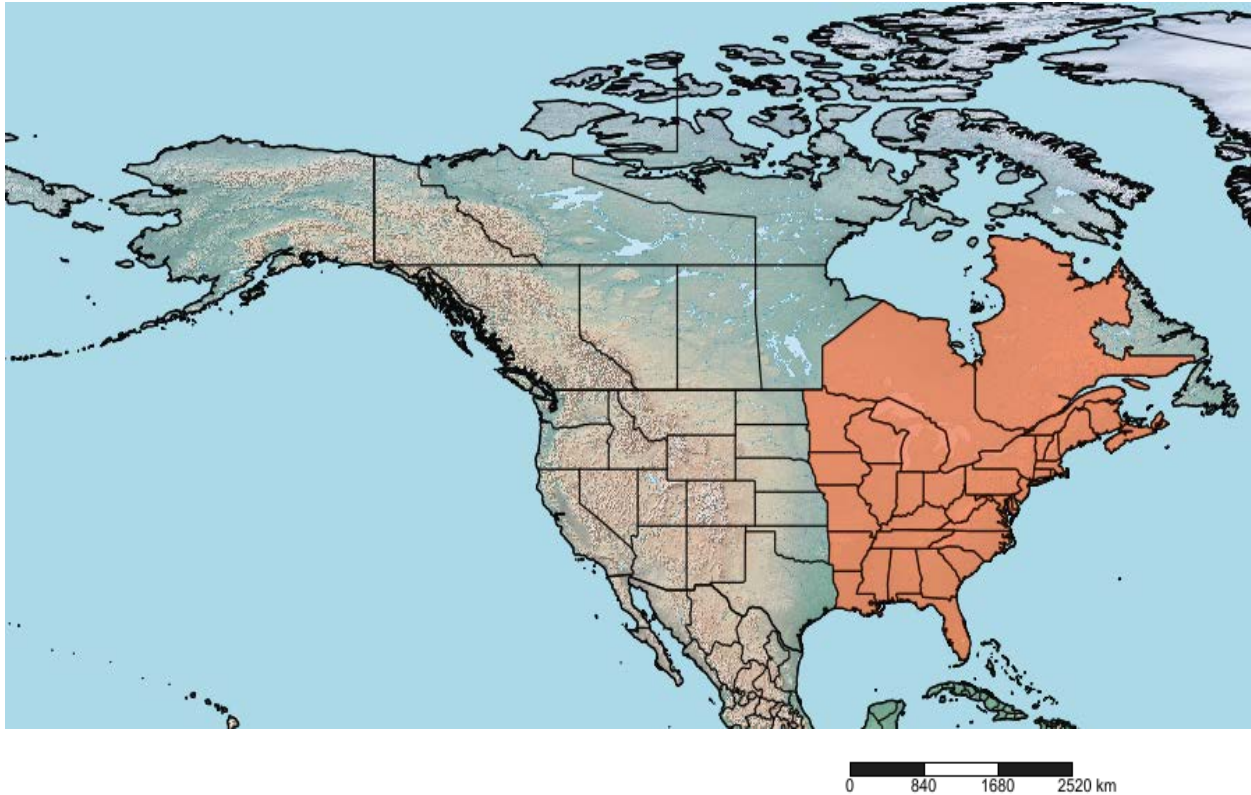
Distribution: Wisconsin to Nova Scotia in the north and Louisiana to Florida in the south (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (S.) biguttatus* is the most common *Culicoides* species that we found in Guelph, Ontario in our summer 2019 collections (Milián-García et al. 2021). Blanton and Wirth (1979) summarize the feeding habits of *C. (S.) biguttatus*: rarely bites humans (Murray 1957; Snow and Pickard 1958; Jamnback 1965; Childers and Wingo 1968); feeds on cows, horses, chickens, birds, and is regarded as a general feeder (Hoffman 1925; Pickard and Snow 1955; Downes 1958; Jellison and Philip 1933; Judd 1959; Hair and Turner 1968).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides biguttatus* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Avaritia) chiopterus (Meigen, 1830)

Ceratopogon amoenus Winnertz, 1852.

Differential diagnosis: *Culicoides (Av.) chiopterus* resembles other Ontarian species in *Avaritia* (*C. (Av.) sanguisuga*, *C. (Av.) obsoletus*) but generally exhibits a plainer wing with poorly contrasting pale spots and a shorter, more swollen 3rd palpal segment (1.2X as long as the 5th palpal segment) (Jamnback and Wirth 1963). Two non-Ontarian species occurring in close range (*C. (Av.) juddi* Cochrane and *C. (Av.) pechumani* Cochrane (New York (Borkent and Grogan 2009)) resemble *C. (Av.) chiopterus*, though they are smaller species. All of the North American *Avaritia* species are similar and can be difficult to differentiate.

Diagnosis: Thorax dark brown. Eyes contiguous (Jamnback 1965) or touching at a point. Small species, ranging from 1–1.5 mm in length (Jamnback and Wirth 1963). 3rd palpal segment short, swollen, and triangular. Proximal 8 flagellomeres barrel-shaped, and distal 5 flagellomeres elongate. Hind tibia dark brown, slightly paler basally. Two rounded spermathecae, equal or subequal with short necks (Jamnback and Wirth 1963). Haltere pale brown basally with whitish knob.

Wing diagnosis: Average wing length 1.05 mm (Jamnback and Wirth 1963). Wing with few distal macrotrichia. Wing mostly plain, grey, with poorly contrasting, faint pale spots. Post-stigmatic pale spot large, encroaches into r_{2+3} . $r-m$ pale spot moderately large, can reach anterior margin of wing. cu and a with diffuse pale spots only seen in a certain light/angle. Wing dark brown at apex of C , with well-defined stigma.

Habitat: Larvae and pupae of *Culicoides* in *Avaritia* are widespread and are found in many places (Jamnback and Wirth 1963), including tree hole debris, clay soil, manure piles, decaying cornstalk and leaves, rotting logs, sandy banks of streams, running water, decaying fungi, cow and sheep dung, *Sphagnum* bogs, marshes, swamps and bare mud (Jamnback and Wirth 1963). Specifically, *C. (Av.) chiopterus* larvae and pupae are frequently found in cow dung and have been reared from soil polluted with chicken or horse manure (Jamnback and Wirth 1963).

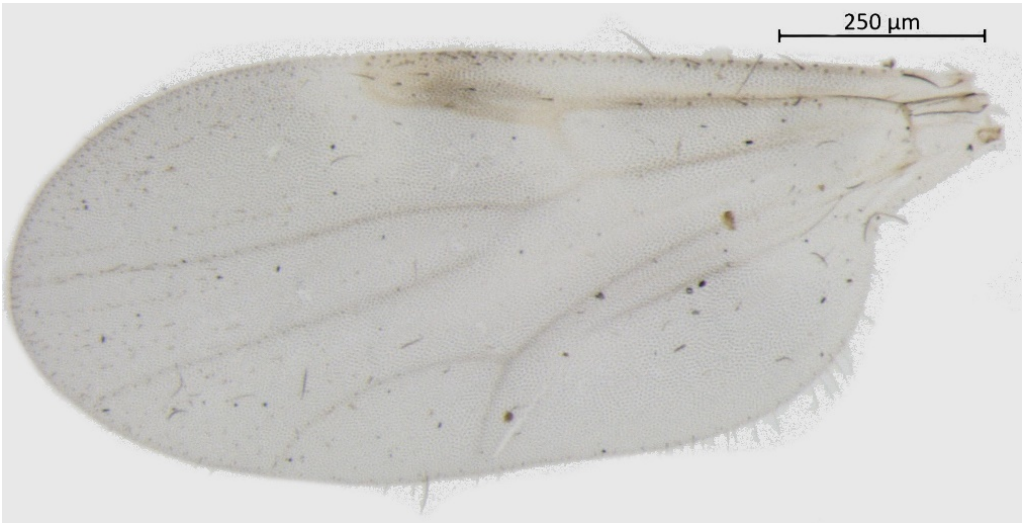
Distribution: Found throughout the entirety of North America and Eurasia (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: Unlike the other two Ontarian species in *Avaritia* (*C. (Av.) sanguisuga* and *C. (Av.) obsoletus*), this species is not known to bite humans in North America (Wirth and Jamnback 1963). Blanton and Wirth (1979) summarize adult feeding habits: reported to feed on man in Estonia (Remm 1956) and on poultry (Messersmith 1965) and birds (Humphreys and Turner 1973).

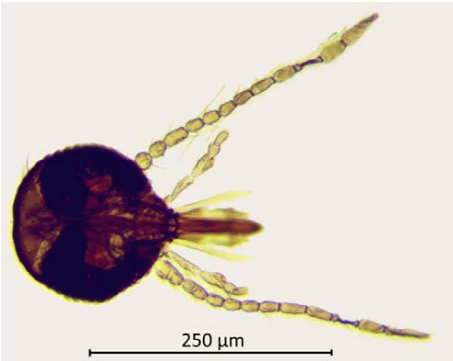
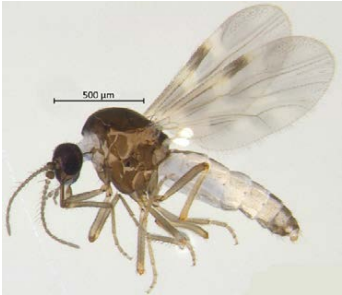
[Images](#)

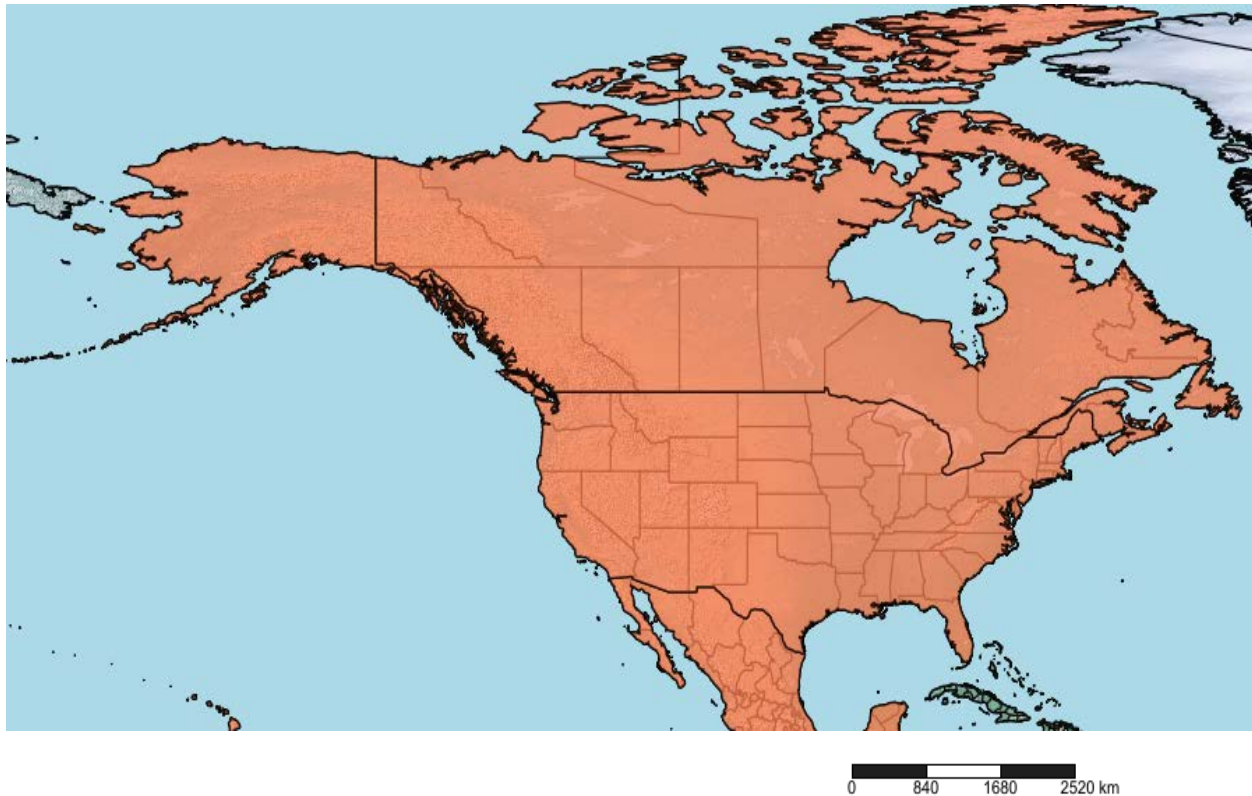
[Distribution Map](#)

[Back to Subgenus *Avaritia* page](#)



*please see lateral image for a better picture of the patterned wing.





Indication of which provinces/states where *Culicoides chiopterus* could occur in North America in orange, based on distribution data from the literature (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Culicoides) cockerellii (Coquillett, 1901)

Differential diagnosis: *Culicoides (C.) cockerellii* is easily distinguished from other Ontarian species in the *pulicaris* species group (*C. (C.) yukonensis*, *C. (C.) paraimpunctatus*) by the large pale spot in *cu* and the dark spot in r_5 that reaches the anterior wing margin (Wirth and Blanton 1969a). *Culicoides (C.) cockerellii* is also generally larger than other species in the *pulicaris* species group (Wirth and Blanton 1969a). *Culicoides denticulatus* has a similar arrangement of pale spots on the wing, but *C. (C.) cockerellii* has a much darker wing with highly contrasting spots.

Diagnosis: Thorax dark brown. Eyes meeting at a single point. 3rd palpal segment moderately slender and elongate. Proximal 8 flagellomeres barrel shaped, distal 5 flagellomeres elongate. Hind tibia dark brown, very slightly paler basally. Pair of spermathecae subequal, rounded, with slender necks. Haltere pale brown with dark brown or pale brown knob (Wirth and Blanton 1969a).

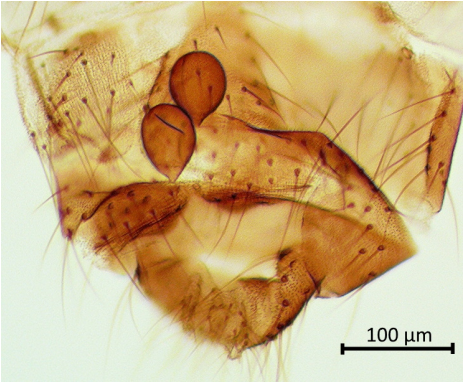
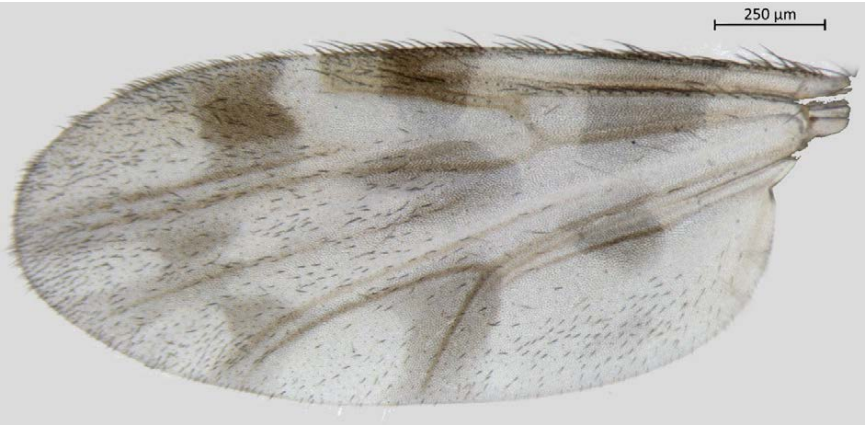
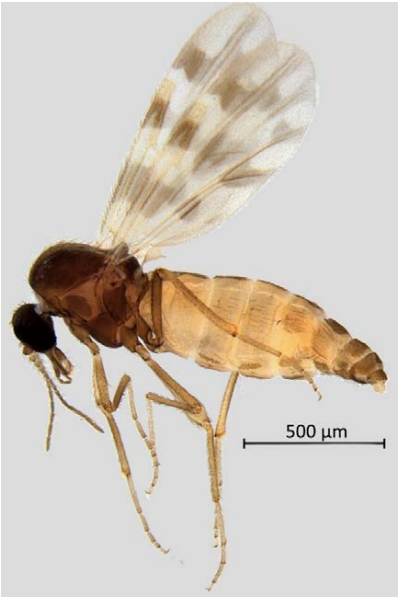
Wing diagnosis: Average wing length 1.86 mm (Wirth and Blanton 1969a). Wing with fine, long, abundant macrotrichia, sparser basally. Wing dark grey or brown with highly contrasting, well-defined pale spots as follows: post-stigmatic pale spot large, encroaching into r_{2+3} , joins spots in m_1 , m_2 , and *cu* to form large, irregular pale area; *r-m* pale spot large, sits on *r-m* vein and reaches anterior margin of wing (Wirth and Blanton 1969a), joins spots in m_2 and *a* to form large, irregular pale area interrupted by dark spots in the middle of *CuP* and *c*; r_5 , m_1 and m_2 with large apical pale spots. Base of wing pale. Wing dark brown at apex of *C*, with well-defined stigma interrupted by the post-stigmatic pale spot.

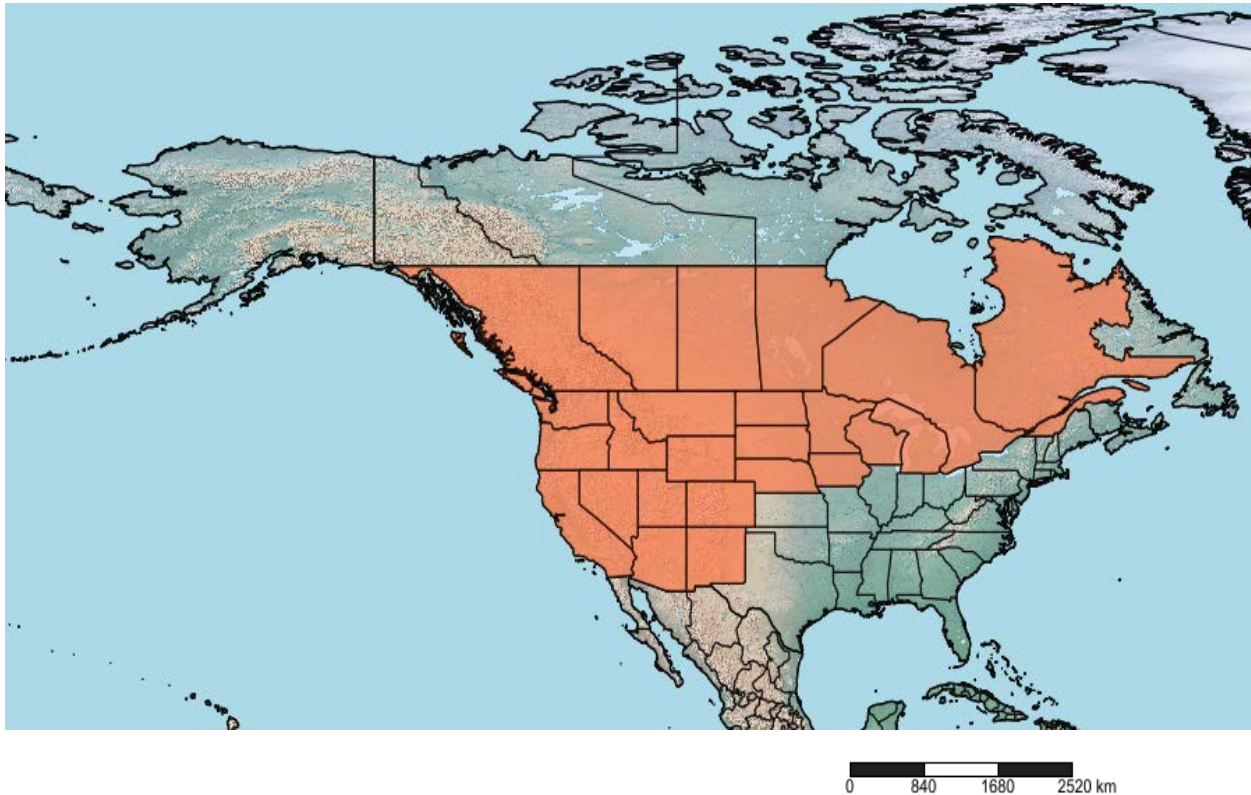
Habitat: Unknown.

Distribution: Found west from British Columbia and California east to New Mexico and Quebec (Wirth and Blanton 1969a; Borkent and Grogan 2009).

Remarks: Species in the *C. (C.) cockerellii* complex feed on large mammals (Jones and Luedke 1969). Bluetongue virus has been isolated from this species (Kramer et al. 1990). *Culicoides (C.) cockerellii* has the broadest distribution of species in the *pulicaris* species group (Wirth and Blanton 1969a).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides cockerellii* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Beltranmyia) crepuscularis Malloch, 1915

Differential diagnosis: Like other species in the subgenus *Beltranmyia*, *C. (B.) crepuscularis* has only a single large, oval spermatheca, though this characteristic may require dissection and slide-mounting to fully observe. It can also be distinguished from other species of Ontarian *Culicoides* by the wing pattern with numerous, highly contrasting pale spots and the swollen 3rd palpal segment.

Diagnosis: Thorax dark brown. Eyes widely separated. 3rd palpal segment swollen and triangular, with large sensory pit. Proximal 8 flagellomeres round, distal 5 flagellomeres elongate. Hind tibia dark brown, paler basally but without well-defined pale band. Single spermatheca large, oval, with neck. Haltere pale grey, knob sometimes yellow (Hoffman 1925).

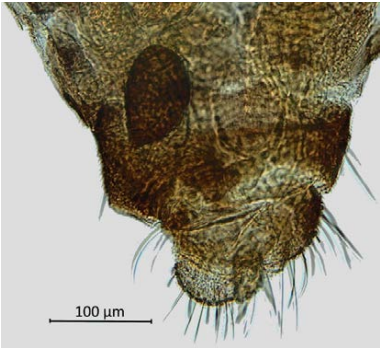
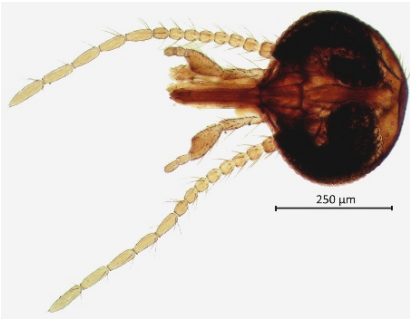
Wing diagnosis: Note: *Culicoides (B.) crepuscularis* exhibits significant wing pattern variability; while the general pattern is consistent and is described as follows, the size and shape of pale spots can vary dramatically between individuals. Average wing length 1.17 mm (Hoffman 1925). Wing with uniform macrotrichia. Wing dark grey or brown with highly contrasting, well-defined pale spots as follows: post-stigmatic pale spot large, may be elongate and oblique; *r-m* pale spot large, sits on *r-m* and extends to anterior margin of wing; *r*₅ with large subapical spot; *m*₁ with small subapical and median spots; *m*₂ with small apical, median and basal spots; *cu* with large apical spot reaching posterior margin of wing; *a* with large spot in apical half and small spot in basal corner. Wing dark brown at apex of *C*, with well-defined stigma.

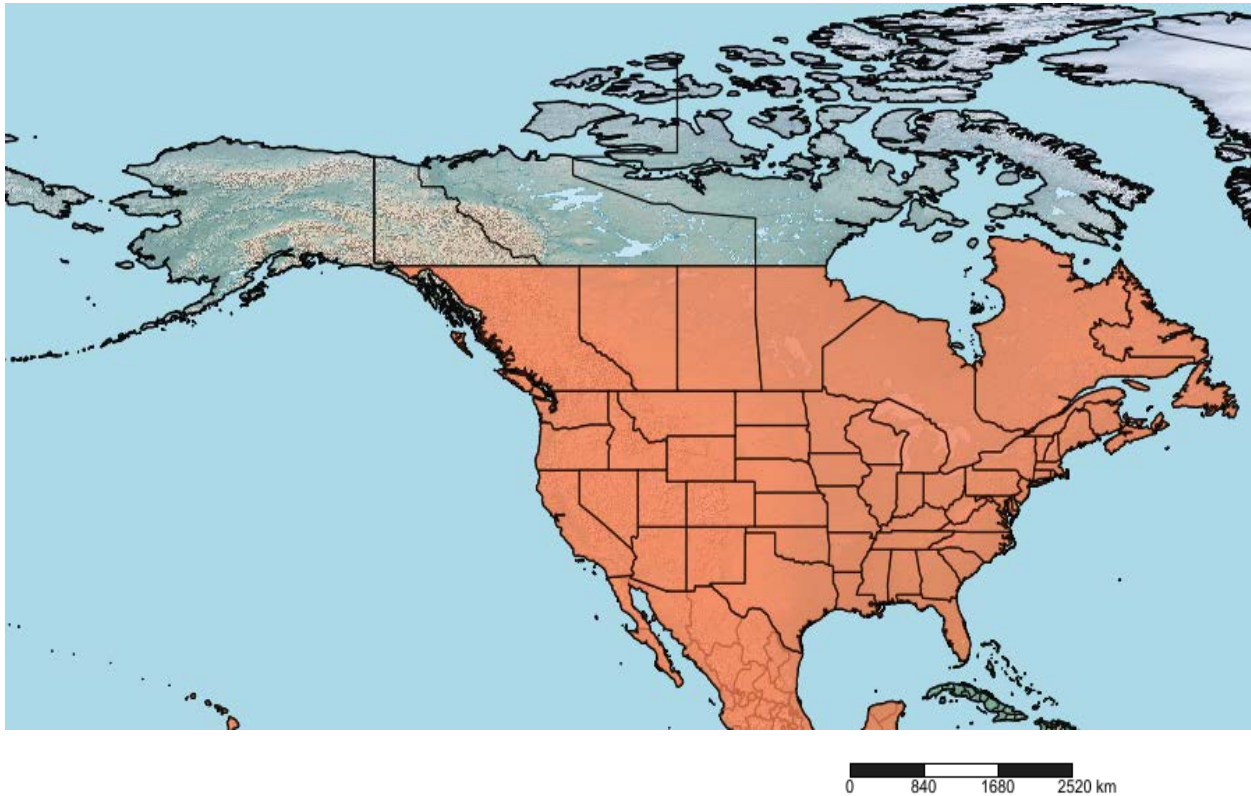
Habitat: Blanton and Wirth (1979) summarize larval habitat of *C. (B.) crepuscularis*: reared from most freshwater soil habitats as well as mud, pond margins, puddles, septic effluents, marshes with wide ranges of salinity, and rainwater ditches and springs (Wirth and Bottimer 1956; Williams 1956, 1957; Snow et al. 1957; Jones 1959; Jones 1961; Jamnback 1965; Hair et al. 1966; Childers and Wingo 1968; Battle and Turner 1970; Kardatzke and Rowley 1971).

Distribution: From British Columbia east to Nova Scotia and south to Costa Rica (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: Blanton and Wirth (1979) summarize the feeding habits of adults of *C. (B.) crepuscularis*: recorded as ornithophilic and has been noted to attack poultry and a variety of Ontarian birds (Bennett 1960; Fallis and Bennett 1961; Hair and Turner 1968; Hoffman 1925); recorded to bite man in Nebraska and Tennessee, but rarely, if at all, elsewhere (Snow et al. 1957; Downes 1958; Edmunds and Keener 1954; Pickard and Snow 1955; Jamnback 1965). It is a hypothesized vector of *Haemoproteus* parasites and filarial worms to various birds (Bennett 1960; Fallis and Bennett 1961; Robinson 1961).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides crepuscularis* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides denticulatus Wirth and Hubert, 1962

Misidentification: *Culicoides unicolor* (Coquillet) (Jones, 1956).

Differential diagnosis: *Culicoides denticulatus* belongs to the [piliferus species group](#) and resembles [C. downesi](#). It is similar to the western American species *C. unicolor* Coquillet (British Columbia to California and Colorado (Borkent and Grogan 2009)) in having a similar pattern of the antennal sensoriae, rounded spermathecae with tapered necks, and five tibial spines (Wirth and Hubert 1962), but it can be distinguished by the more pronounced wing pigmentation with large, pale, poorly defined pale spots. The distribution of pale spots on the wing is similar to that of [C. \(Culicoides\) cockerellii](#), but the wing is lighter and has a less contrasting pattern.

Diagnosis: Thorax dull and medium-brown. Eyes broadly contiguous to narrowly separated (Wirth and Hubert 1962). 3rd palpal segment relatively slender and triangular, with a small, shallow, irregularly-shaped sensory pit. Proximal 8 flagellomeres rounded, but may appear slightly barrel-shaped, distal 5 flagellomeres elongate. Hind tibia brown, slightly paler apically and basally but without well-defined pale bands. Pair of spermathecae equal, rounded, with short necks of equal length (Wirth and Hubert 1962). Haltere pale brown (Wirth and Hubert 1962).

Wing diagnosis: Average wing length 1.41 mm (Wirth and Hubert 1962). Wing with short and numerous macrotrichia on entire surface (not visible in Fig.) (Wirth and Hubert 1962). Wing dark grey with poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot very large, does not encroach into r_{2+3r} , extends posteriorly to join with spot on M_2 ; $r-m$ pale spot very large, reaches anterior margin of wing and extends posteriorly to join with spots in m_2 and a , forming irregular band that reaches posterior margin of wing; r_s , m_1 , and m_2 with large apical spots; cu with large spot occupying most of cell. Base of wing pale. Wing slightly dark brown at apex of C, no well-defined stigma.

Habitat: Collected from freshwater habitats including pool margins, swamps, marshes, leaf depressions, and from substrates including mud and decayed leaves, *Sphagnum*, and sand (Jamnback 1965).

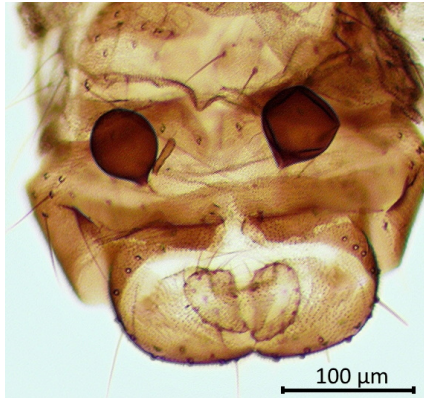
Distribution: From British Columbia to Newfoundland and Nova Scotia in the north and from Nebraska to Maryland in the south (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

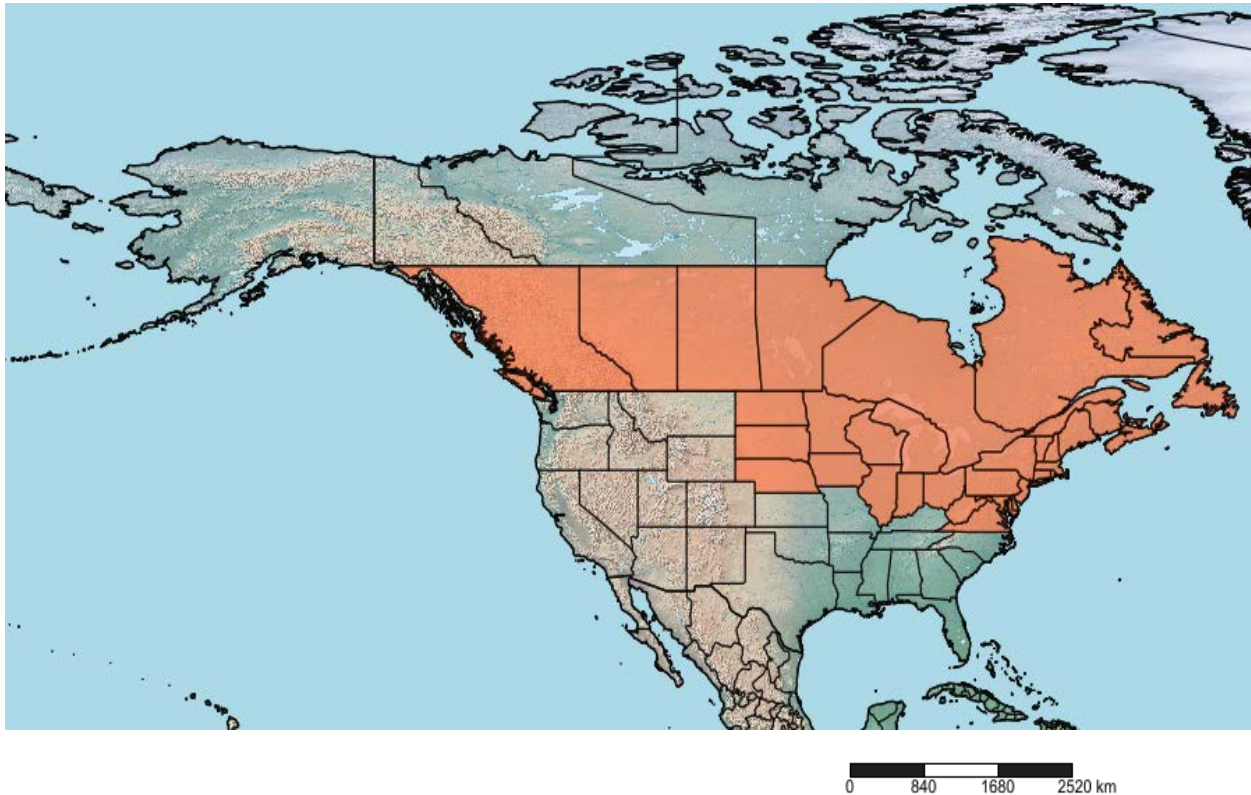
Remarks: *Culicoides denticulatus* has remarkably reduced mandibular teeth (hence the name *denticulatus* from the Latin word for “teeth”), this reduction (seen in several other species of *Culicoides*) is thought to be associated with a change from blood-feeding to flower-feeding (Wirth and Hubert 1962). Specimens from a more northern range tend to have more plain, poorly marked wings compared to their southern counterparts (Wirth and Hubert 1962).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides denticulatus* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides downesi Wirth and Hubert, 1962

Differential diagnosis: *Culicoides downesi* belongs to the [piliferus species group](#) and resembles [C. denticulatus](#) in having large wings (1.45–1.72 mm) and a larger body size than other species in the group (Wirth and Hubert 1962), but differs by the smaller, mostly uncoalesced pale spots on the wing. *Culicoides downesi* resembles [C. piliferus](#) in having similar flagellomere length, but differs by the moderately swollen 3rd palpal segment, and the poorly contrasting, pale wing markings (Wirth and Hubert 1962). *Culicoides downesi* also resembles [C. bickleyi](#) in having a similar arrangement of pale spots on the wings, but differs by the moderately swollen 3rd palpal segment, the distinctly irregular sensory pit, and the slightly unequal spermathecae (Wirth and Hubert 1962). *Culicoides downesi* generally has smaller pale spots on the wing than others with patterned wings in the *piliferus* species group.

Diagnosis: Thorax dark brown. Eyes narrowly separated. 3rd palpal segment moderately swollen, with a large, shallow irregular sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Hind tibia dark brown, slightly paler basally and apically but without well-defined pale bands. Pair of spermathecae unequal or sub-equal, rounded, without necks (Wirth and Hubert 1962), or with necks. Haltere brown at base, knob whitish.

Wing diagnosis: Average wing length 1.58 mm (Wirth and Hubert 1962). Wing with long and numerous macrotrichia on entire wing surface (not visible in Fig.) (Wirth and Hubert 1962). Wing dark grey with mostly poorly contrasting, diffuse pale spots as follows: M_1 and M_2 with small, elongate spots sitting on veins at the same plane as post-stigmatic pale spot; post-stigmatic pale spot elongate, does not encroach into r_{2+3} ; $r-m$ pale spot very small, round, sits on $r-m$ vein, does not extend to anterior margin of wing; r_5 and m_1 with large apical spots; m_2 with apical spot and median spot at fork between CuA_1 and CuP ; cu with large, distal spot; a with large apical and basal spots. Base of wing pale. Wing slightly dark brown at apex of C , no well-defined stigma.

Habitat: This species has been reared from a bog in Michigan (Wirth and Hubert 1962) and collected from a chicken house (Jamnback 1965).

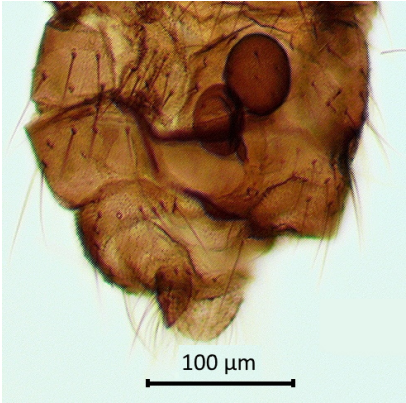
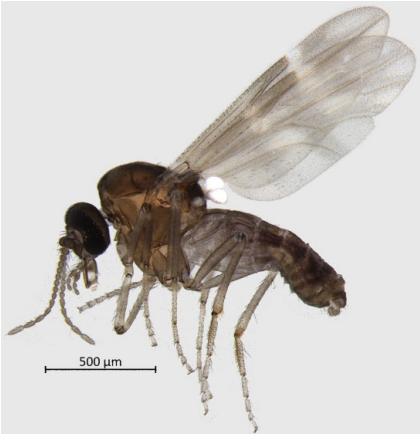
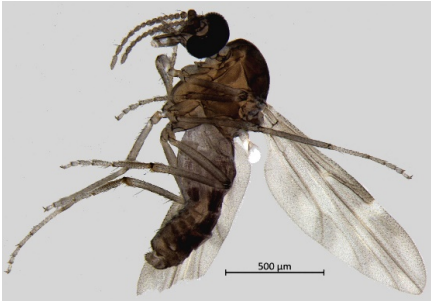
Distribution: From British Columbia east to Nova Scotia in the north and south to Michigan and New York (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

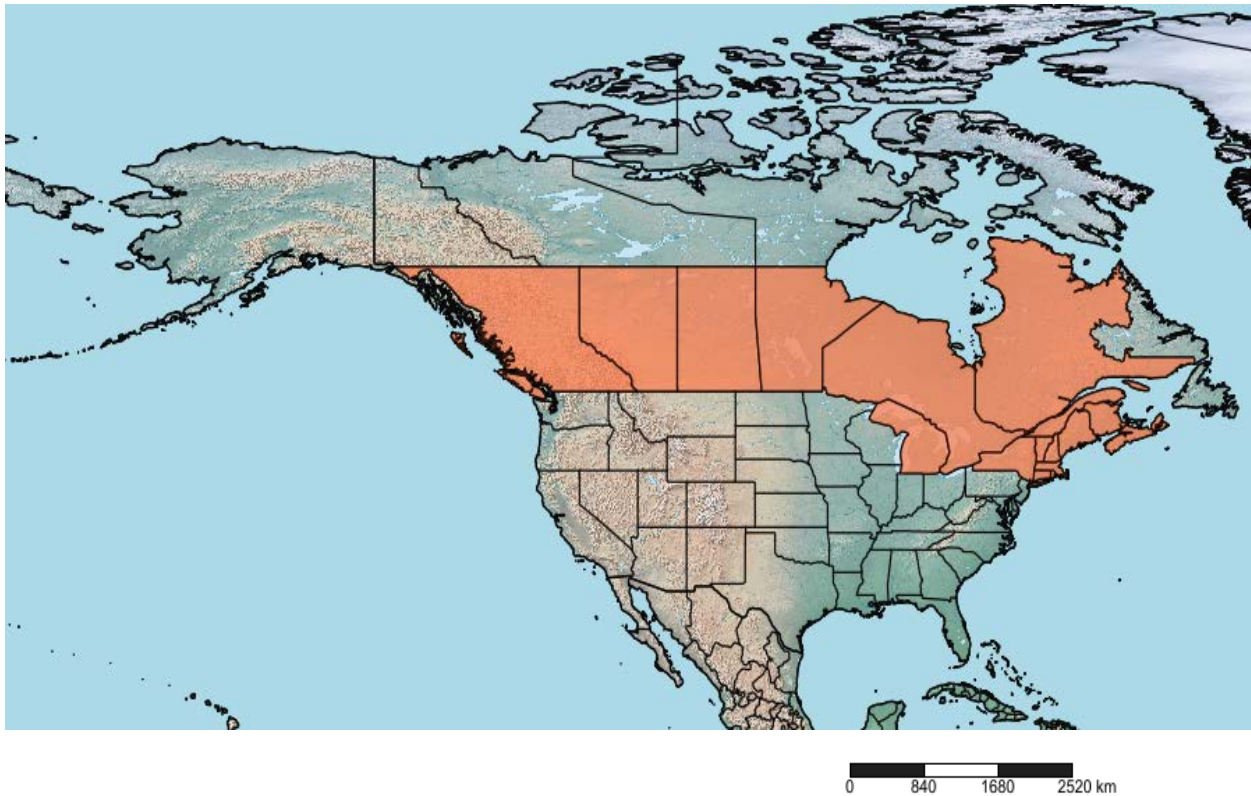
Remarks: *Culicoides downesi* is ornithophilic and feeds on many species of birds; it has been noted to feed commonly on ducks and is a vector of *Haemoproteus nettionis* (Fallis and Wood 1957; Sibley and Werner 1984; Bennett 1960).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides downesi* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Amossovia) flukei Jones, 1956

Differential diagnosis: *Culicoides (Am.) flukei* is easily distinguished from other species in subgenus *Amossovia* by the atypical wing pattern which includes an elongate pale spot in r_5 , dark apices of M_1 , M_2 and CuA_1 , a single spot in a , and the sparser wing macrotrichia, especially near the wing base (Wirth and Blanton 1967).

Diagnosis: Thorax brown. Eyes bare, contiguous or only narrowly separated (Wirth and Blanton 1967). 3rd palpal segment moderately swollen, short. Proximal 8 flagellomeres barrel-shaped but nearly round, distal 5 flagellomeres elongate, with the 13th segment very elongate. Hind tibia with well-defined basal and apical pale bands. Pair of spermathecae equal or subequal and rounded, with inconspicuous necks (Wirth and Blanton 1967). Haltere pale brown.

Wing diagnosis: Average wing length 0.99 mm (Wirth and Blanton 1967). Wing with macrotrichia forming longitudinal rows on the distal half of the wing, sparser basally (Wirth and Blanton 1967). Wing dark brown or grey with highly contrasting pale spots as follows: M_1 with small, elongate spot and M_2 with two small spots straddling vein; both on same vertical plane as post-stigmatic pale spot; post-stigmatic pale spot small, does not encroach into r_{2+3} ; $r-m$ pale spot large, can extend to anterior wing margin; r_5 with large, subapical spot; m_1 and m_2 with small, elongate subapical spots; cu and a each with large distal spot. Base of wing pale. Wing slightly dark brown at apex of C , with well-defined stigma.

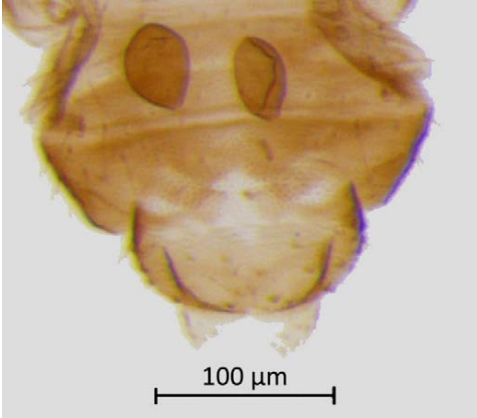
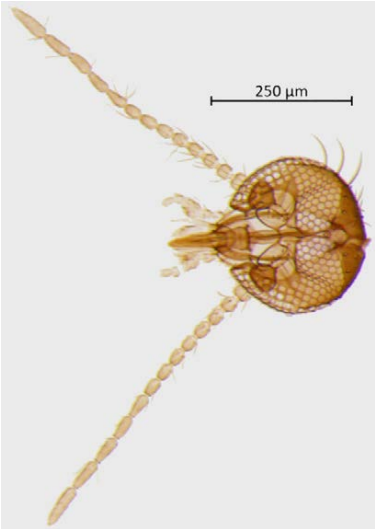
Habitat: Reared from moist or wet tree or stump holes and have also been reared from a *Sarracenia* pitcher plant (Jamnback 1965).

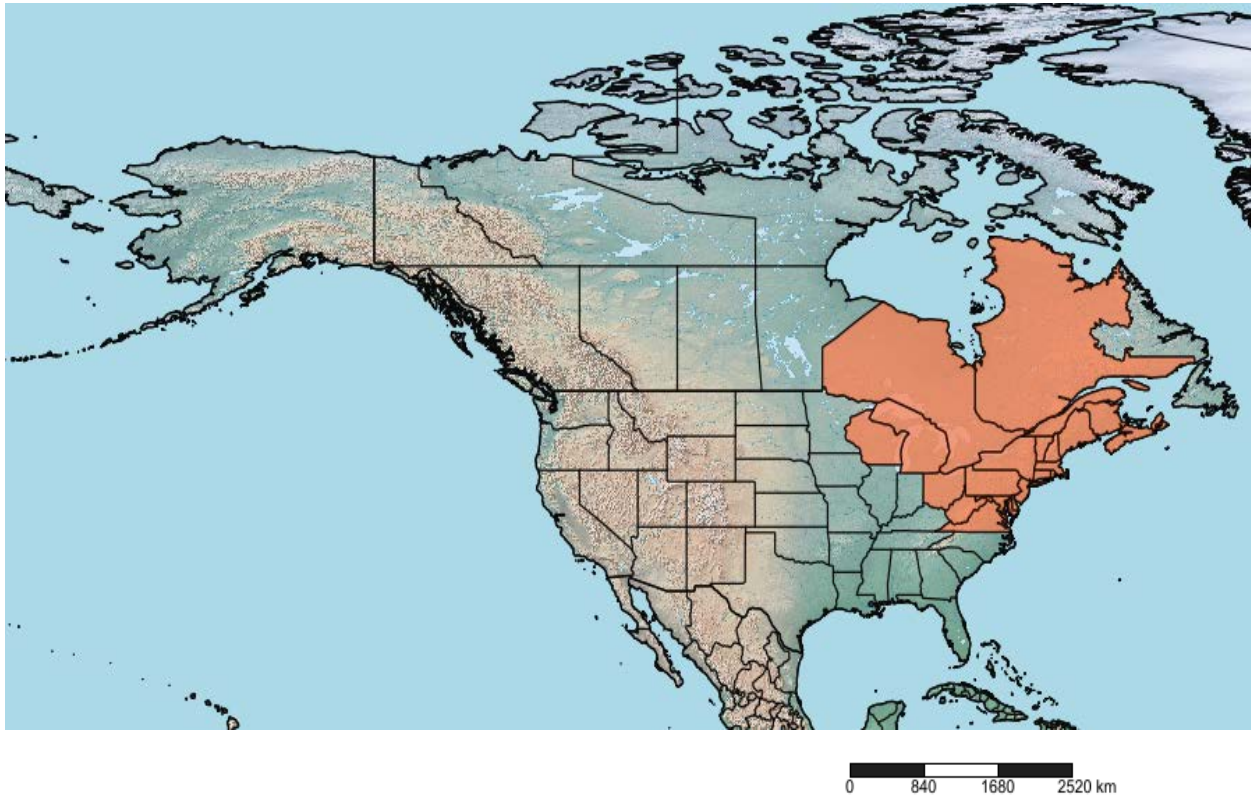
Distribution: Wisconsin east to Nova Scotia, and south to Virginia (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (Am.) flukei* is the only Ontarian species in the *guttipennis* species group that does not appear to feed on blood due to reduced mouthparts (Wirth and Blanton 1967).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides flukei* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Diphaomyia) footei Wirth and Jones, 1956

Differential diagnosis: *Culicoides (Di.) footei* resembles [C. nanus](#) and [C. travisi](#) in having similar colouration and arrangement of pale spots on the wing, but *C. (Di.) footei* also has two distal pale spots in m_2 , as well as large, globular 3rd palpal segments with distinctive, elongate sensory pits (Atchley and Wirth 1979). *Culicoides (Di.) footei* can also resemble [C. \(Di.\) haematopotus](#) in having a similar pattern of pale spots on the wings, though differs by the $r-m$ pale spot straddling the $r-m$ vein, rather than being adjacent to the $r-m$ vein.

Diagnosis: Thorax dark brown. Eyes bare, narrowly separated (Atchley and Wirth 1979). 3rd palpal segment greatly swollen and globular, with a deep sensory pit that has a visibly convoluted internal structure (Atchley and Wirth 1979). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Pair of spermathecae subequal, rounded, with slender necks (Atchley and Wirth 1979). Haltere pale brown (Atchley and Wirth 1979).

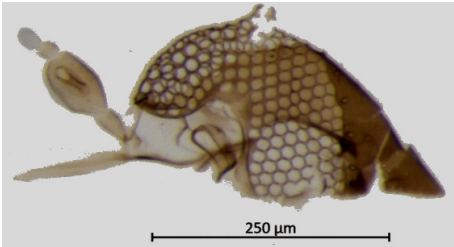
Wing diagnosis: Average wing length 0.9 mm (Atchley and Wirth 1979). Wing with scattered, sparse macrotrichia, forming longitudinal rows in m_1 and m_2 . Wing dark brown or grey with mostly poorly contrasting, diffuse pale spots as follows: Post-stigmatic pale spot either small or large, does not extend into r_{2+3} (Atchley and Wirth 1979); $r-m$ pale spot well-defined, small, round, not reaching anterior margin of wing; r_5 , m_1 and m_2 with very diffuse apical pale spots; cu with large distal pale spot; a with distal and basal spots. Base of wing pale. Wing slightly dark brown at apex of C , no well-defined stigma.

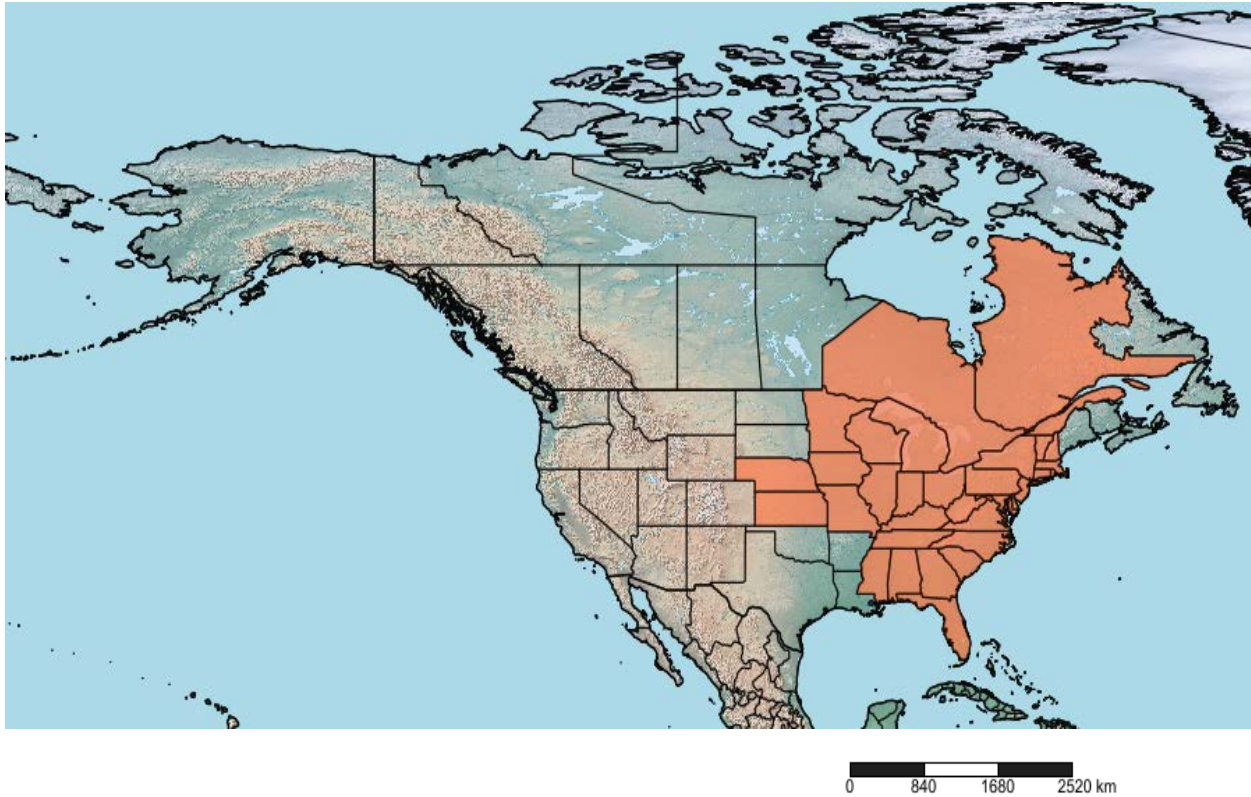
Habitat: *Culicoides (Di.) footei* has been reared from moist debris in tree holes (Atchley and Wirth 1979).

Distribution: Found in Ontario and Quebec in the north, southwest to Nebraska, and southeast to Mississippi and Florida (Atchley and Wirth 1979; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: The feeding habits of *C. (Di.) footei* are unknown.

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides footei* could occur in North America in orange, based on distribution data from the literature (Atchley and Wirth 1979; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides franclemonti Cochrane, 1974

Differential diagnosis: *Culicoides franclemonti* belongs to the [piliferus species group](#) and resembles *C. utowana* in having a relatively plain wing with few to no poorly contrasting pale spots but differs by the subequal spermathecae (Cochrane 1974). The proximal 8 flagellomeres of *C. franclemonti* are more barrel-shaped than other *piliferus* group species.

Diagnosis: Thorax medium brown. Eyes narrowly to moderately separated (Cochrane 1974). 3rd palpal segment slightly triangular and elongate, with a shallow sensory pit and irregular opening (Cochrane 1974). Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres elongate. Hind tibia uniformly brown. Pair of spermathecae subequal, rounded, and necked (Cochrane 1974). Haltere pale brown (Cochrane 1974).

Wing diagnosis: Average wing length 1.19 mm (Cochrane 1974). Wing with abundant macrotrichia across entire surface, scarcer in proximal areas of r_5 , m_2 , and a ; wing bare in c , r_1 , and r_{2+3} (Cochrane 1974). Wing mostly plain and light brown with very little to no pale spots. If present, post-stigmatic and $r-m$ pale spots are small, poorly contrasting, and diffuse. m_1 and/or m_2 sometimes with poorly contrasting, elongate pale spots (Cochrane 1974). Wing slightly dark brown at apex of C , with a faint stigma.

Habitat: Large numbers of *C. franclemonti* were collected using light traps in a bog, and specimens were reared from *Sphagnum* (Cochrane 1974).

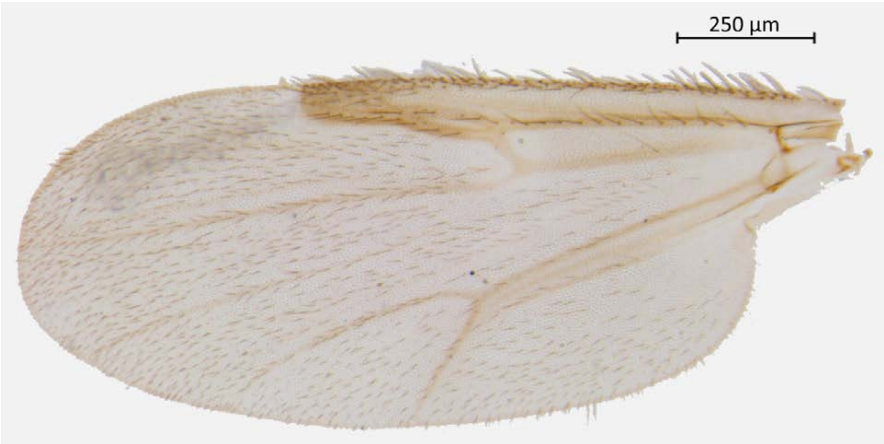
Distribution: An eastern species, found in Newfoundland south to New York and west to Ontario (Cochrane 1974; Wirth et al. 1985; Borkent and Grogan 2009).

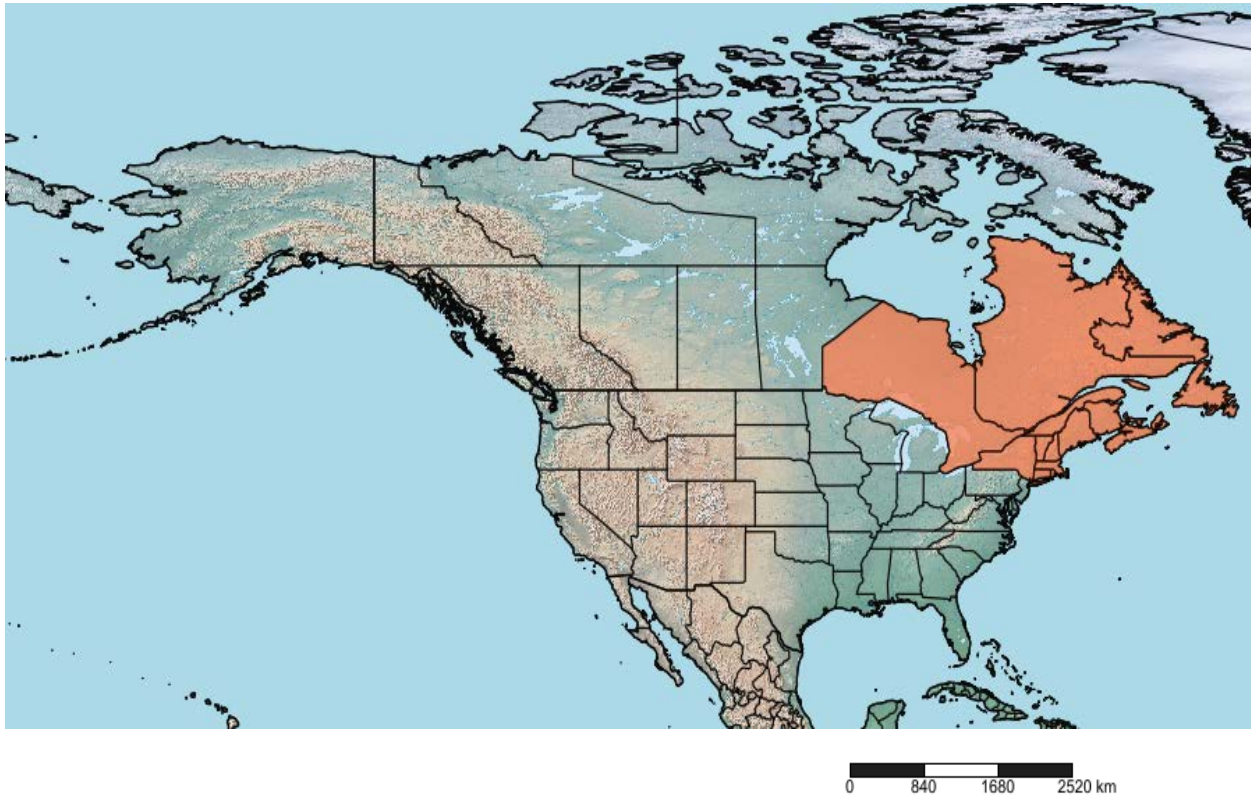
Remarks: Cochrane (1974) suggests this species is autogenous, meaning the species does not require a blood meal to produce viable eggs.

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides franclemonti* could occur in North America in orange, based on distribution data from the literature (Cochrane 1974; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Culicoides) frohnei Wirth and Blanton, 1969

Differential diagnosis: *Culicoides (C.) frohnei* most resembles [C. \(*Silvaticulicoides*\) spinosus](#) in having similar indistinct and diffuse pale spots on the wing, but differs mainly by its larger size (1.6mm, in contrast to ~1 mm in *C. (S.) spinosus*) (Wirth and Blanton 1969a; Root and Hoffman 1937).

Diagnosis: Thorax brown. Eyes contiguous for a short distance. 3rd palpal segment elongate and slightly triangular with a small sensory pit. Proximal 8 flagellomeres barrel-shaped but are tapered distally, proximal 5 flagellomeres elongate. Hind tibia uniformly brown. Pair of spermathecae subequal and rounded with short, slender necks. Haltere pale brown.

Wing diagnosis: Average wing length 1.61 mm (Wirth and Blanton 1969a). Wing with abundant macrotrichia on entire wing surface (not visible in Fig.) (Wirth and Blanton 1969a). Wing brown or grey with very poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot small, partially covering r_{2+3} ; $r-m$ pale spot moderately large, sits on $r-m$ vein, can extend to anterior margin of wing (Wirth and Blanton 1969a); r_5 , m_1 , and m_2 with very faint, diffuse subapical spots or without spots; cu with large, diffuse median spot; a with diffuse apical and basal spots. Wing dark brown at apex of C , with moderately defined stigma.

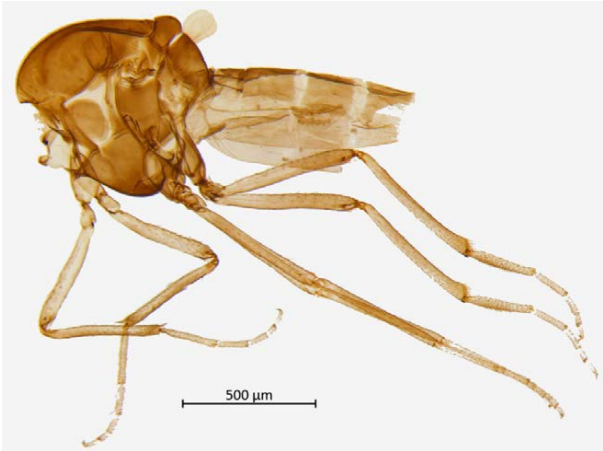
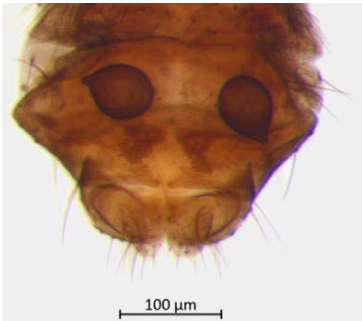
Habitat: Label data from Wirth and Blanton (1969) indicates a tendency to collect *C. (C.) frohnei* near lakes, creeks, and hot springs.

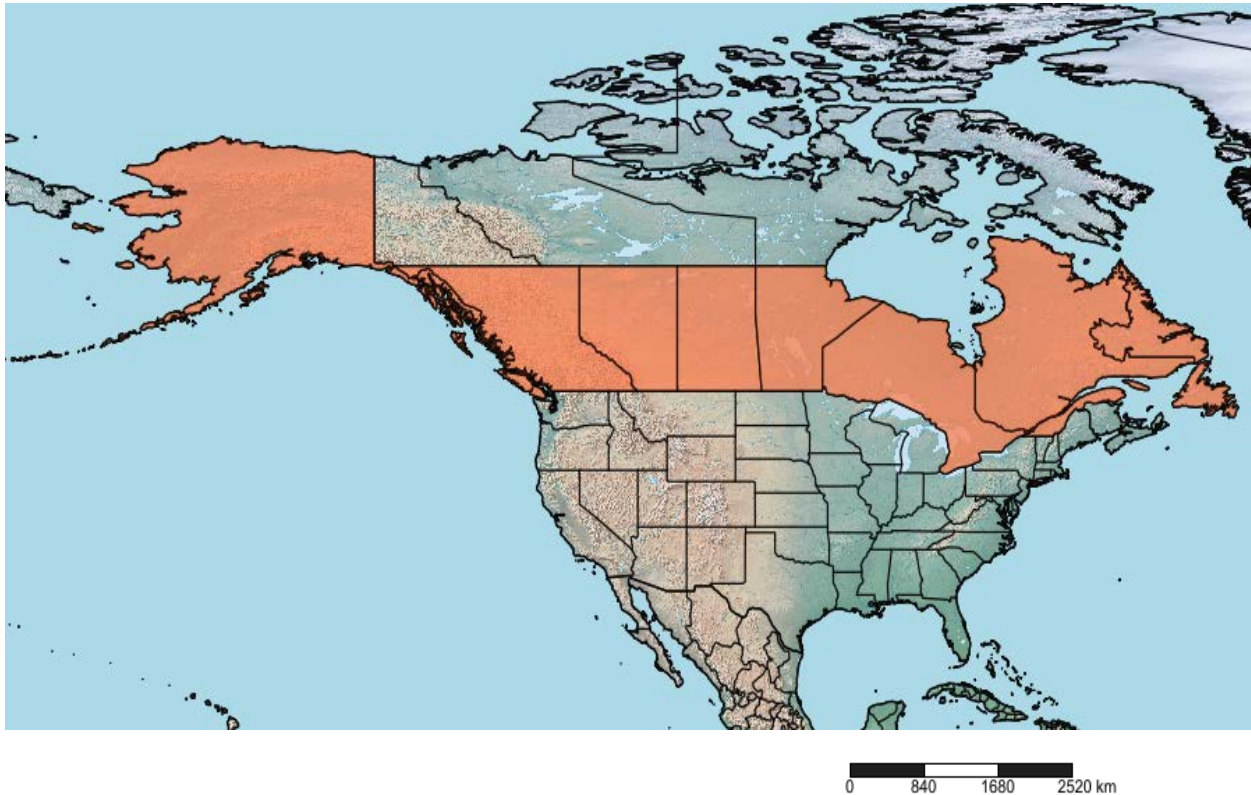
Distribution: Found from Alaska and British Columbia east to Newfoundland and Labrador (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (C.) frohnei* has been reported to feed on humans (Wirth and Blanton 1969a).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides frohnei* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Oecacta) furensoides Williams, 1955

Culicoides dickei Jones, 1956.

Differential diagnosis: *Culicoides (O.) furensoides* is in the subgenus *Oecacta* with [C. \(O.\) stellifer](#) and has a similar distribution of pale spots on the wing, however it is distinguished by the lack of apical pale spots in r_5 and m_{1+2} , as in *C. (O.) stellifer*. The wing spots in *C. (O.) furensoides* also tend to be more diffuse than those of *C. (O.) stellifer*. *Culicoides (O.) furensoides* also resembles a non-Ontarian but close-range species, *C. (Drymodesmyia) hinmani* Khalaf (New York, in part (Borkent and Grogan 2009)) in having a similar distribution of pale spots on the wing but differs by the light brown hind tibia with darkened proximal apex and no well-defined pale bands (Williams 1955; Blanton and Wirth 1979).

Diagnosis: Thorax dark brown. Eyes narrowly separated. 3rd palpal segment nearly triangular and slightly swollen, short, with a small sensory pit (Williams 1955). Proximal 8 and following distal 4 flagellomeres barrel-shaped, with distal 4 flagellomeres generally longer than proximal 8, and 13th segment elongate and slightly globular. Hind tibia light brown with the proximal apex having a slender dark band (Williams 1955). Pair of spermathecae rounded, subequal, with short necks (Williams 1955). Haltere pale brown.

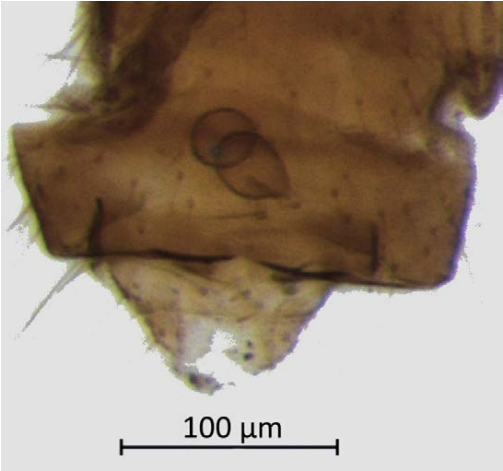
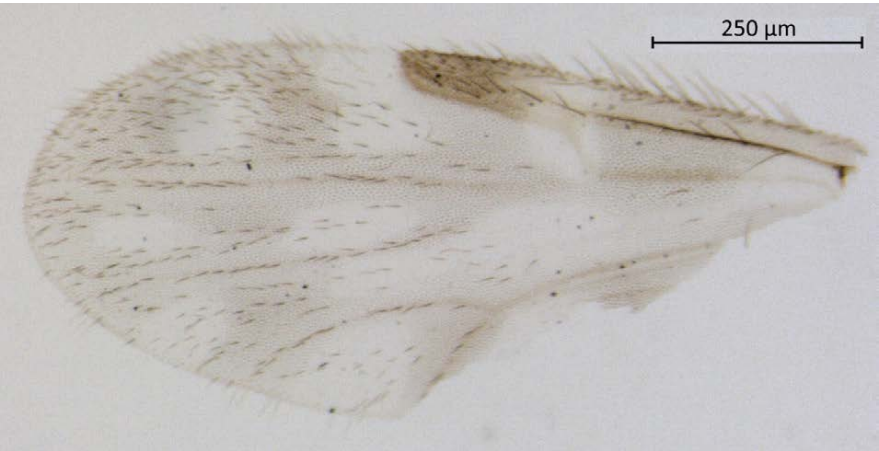
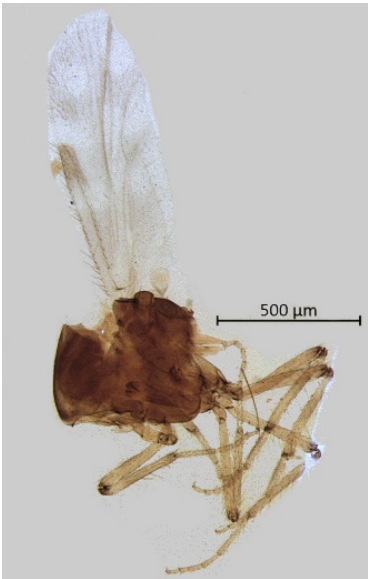
Wing diagnosis: Average wing length 1.03 mm (Williams 1955). Wing with abundant macrotrichia apically, little to no macrotrichia on basal half. Wing grey with poorly contrasting, diffuse pale spots as follows: M_1 with two elongate spots straddling vein; post-stigmatic spot large and irregular, not extending into r_{2+3} (Williams 1955); $r-m$ pale spot large, extending to anterior wing margin; r_5 and m_1 with small subapical spots; m_2 with small apical spot, and elongate basal spot; cu with large pale spot that reaches posterior margin; a cell with small irregular pale spot (not visible in Fig.) (Williams 1955). Wing dark brown at apex of C , with well-defined stigma.

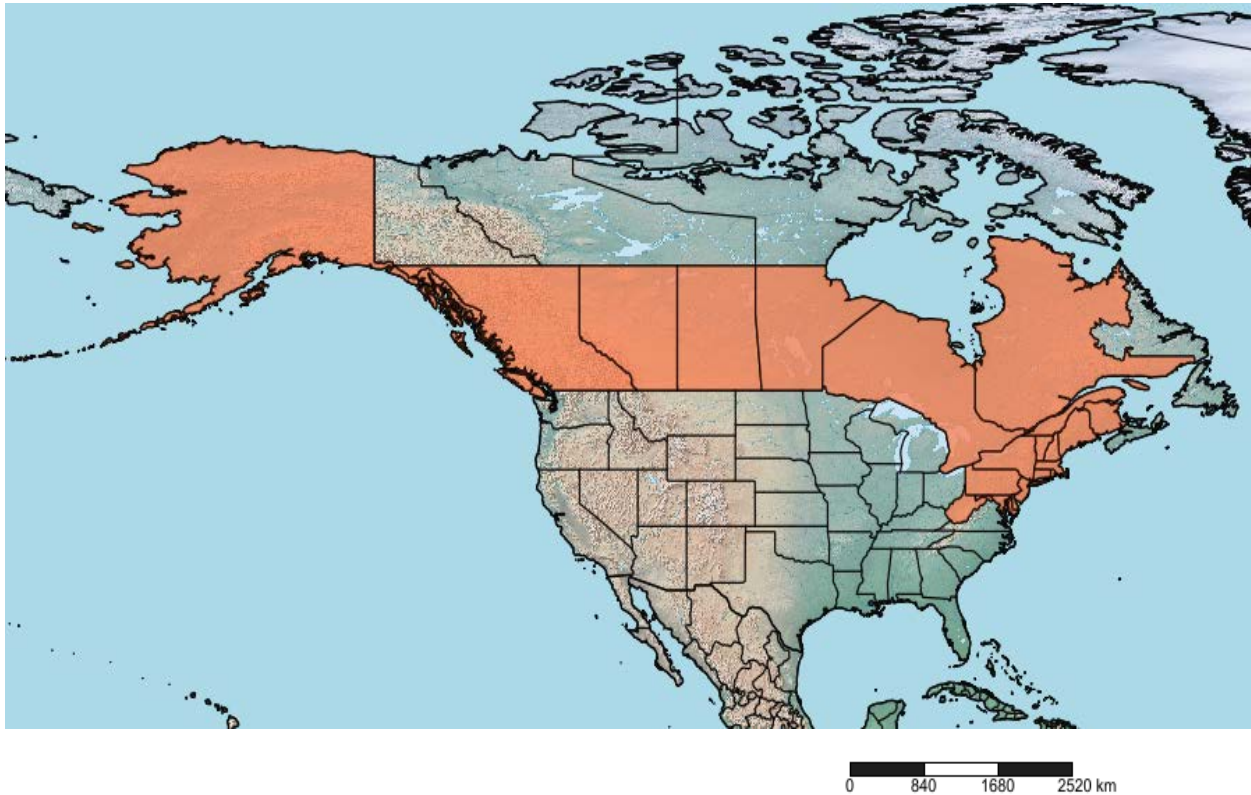
Habitat: Reared from *Sphagnum* moss from bogs (Williams 1955).

Distribution: Alaska east to New Brunswick and south to West Virginia (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: The feeding habits of *C. (O.) furensoides* are unknown, but mandibular dentition is reduced (Jamnback 1965), which suggests a shift away from hematophagy.

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides furenoides* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Amossovia) guttipennis (Coquillett, 1901)

Differential diagnosis: *Culicoides (Am.) guttipennis* belongs to the *guttipennis* species group and its wing pattern closely resembles that of [C. \(Am.\) arboricola](#) with a similar arrangement of numerous, highly-contrasting and well-defined pale spots on a darker wing. However, on *C. (Am.) guttipennis*, CuA_2 is dark along its entire length, from the CuP fork to the wing margin (no pale spot). *Culicoides (Am.) guttipennis* also differs from *C. (Am.) arboricola* by the heavily sclerotized, dark, pear-shaped spermathecae, whereas the latter has light, rounded spermathecae.

Diagnosis: Thorax dark brown. Eyes bare, narrowly separated. 3rd palpal segment nearly triangular, long, and slender (Wirth and Blanton 1967). Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres very elongate. Hind tibia dark brown, with well-defined basal and apical pale bands. Pair of spermathecae very dark, subequal and pear-shaped, with small, slender necks (Wirth and Blanton 1967). Haltere pale brown, knob whitish.

Wing diagnosis: Average wing length 1.32 mm (Wirth and Blanton 1967). Wing with numerous, long macrotrichia. Wing dark grey or brown with well-defined, highly contrasting pale spots as follows: M_1 and M_2 with apical elongate spots and small, ovoid spots straddling each vein on nearly same plane as post-stigmatic pale spot; post stigmatic pale spot small to large, round, not encroaching into r_{2+3} (Wirth and Blanton 1967); $r-m$ pale spot large, spilling into m_2 and sometimes extending to the anterior wing margin; r_5 with one small and one very small subapical spot; m_1 and m_2 with small subapical spots; fork between CuA_1 and CuP with elongate spot; cu with pair of small, joint spots touching mid- CuA_1 ; a with pair of apical spots and very small median spot. Anterior margin of wing with dark grey or brown spot (in r_{2+3}). Base of wing pale. Wing dark brown at apex of C , with well-defined stigma.

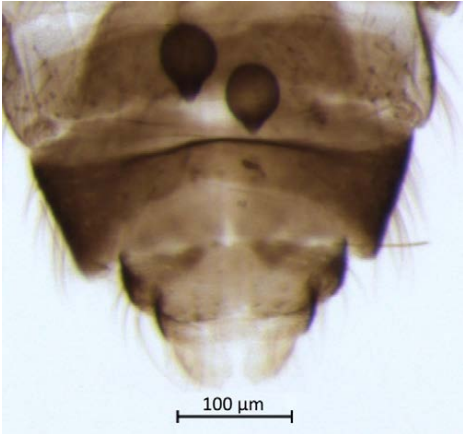
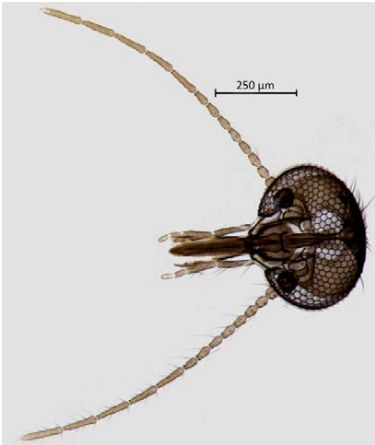
Habitat: *Culicoides (Am.) guttipennis* has been reared from immatures collected in moist or wet tree or stump holes and has also been reared from wet leaves from the margin of a small pond (Hair et al. 1966). It was the most common tree hole species collected in Virginia and was noted to survive a wide range of conditions including a temperature range of 2.7°C–30°C, a pH range of 5.0–8.2, and a dissolved oxygen range of 7.0–10 ppm (Hair et al. 1966).

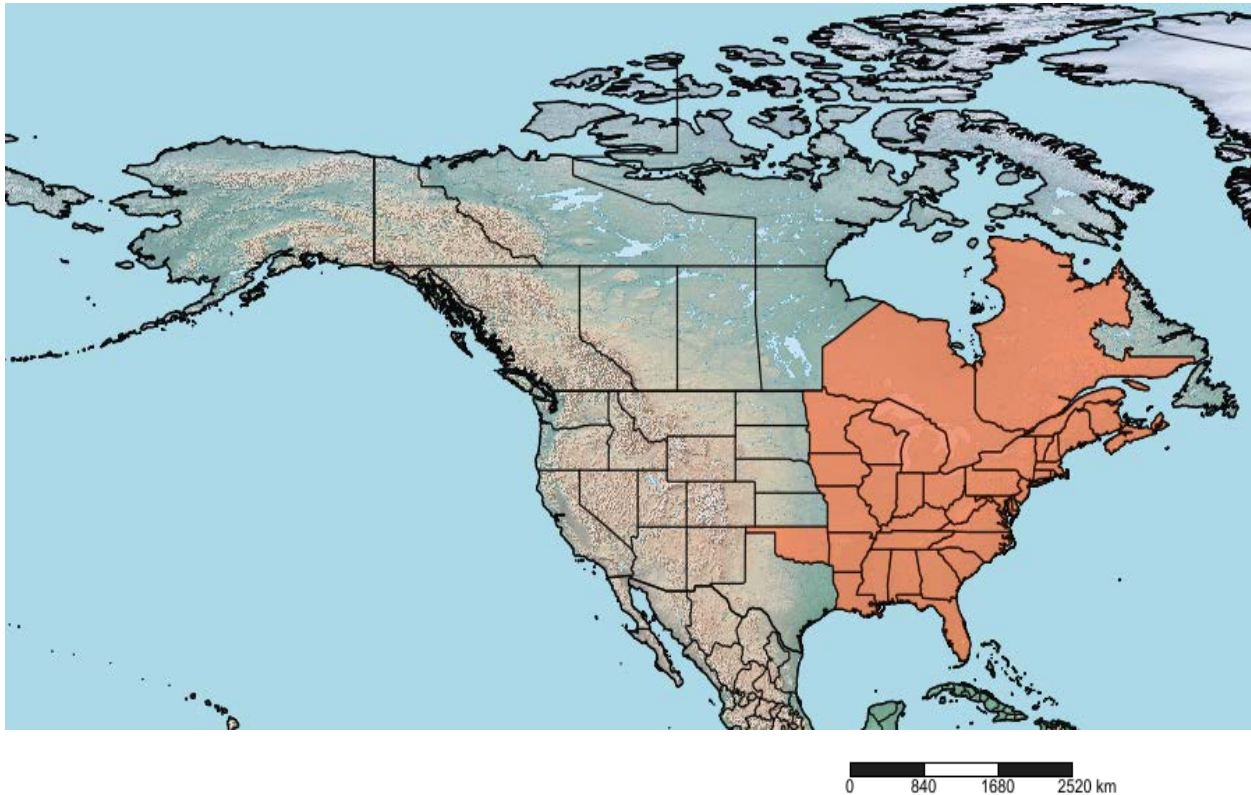
Distribution: Minnesota to Nova Scotia in the north through both New York and Ontario, and Oklahoma, Louisiana, and Florida in the south (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (Am.) guttipennis* is the most common species to be collected in the Ontarian *guttipennis* species group (group includes [C. \(Am.\) villosipennis](#), [C. \(Am.\) flukei](#), and *C. (Am.) guttipennis*), and has been easily reared in lab settings (Wirth and Blanton 1967). *C. (Am.) guttipennis* is commonly known to bite humans (Wirth and Blanton 1967) and feeds on goat, rabbit, turkey, chicken and horse (Malloch 1915; Turner 1973). Jambback (1965) suggests *C. (Am.) guttipennis* is primarily ornithophilic.

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides guttipennis* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Diphaomyia) haematopotus Malloch, 1915

Differential diagnosis: *Culicoides (Di.) haematopotus* resembles the Ontarian species [C. \(Beltranmyia\) crepuscularis](#) in having a wing pattern of well-defined, highly-contrasting pale spots, however *C. (Di.) haematopotus* has two spermathecae and a wing pattern with pale spots straddling the central portion of M_1 and M_2 , while *C. (B.) crepuscularis* has one spermatheca and a wing pattern with pale spots contained within cells and not straddling M_1 and M_2 . *Culicoides (Di.) haematopotus* can also resemble [C. \(Di.\) footei](#) in having a similar pattern of pale spots on the wings, through differs by the $r-m$ pale spot being adjacent to the $r-m$ vein rather than straddling the $r-m$ vein.

Diagnosis: Thorax dark brown. Eyes narrowly to moderately separated (Atchley and Wirth 1979). 3rd palpal segment slightly triangular or globular and swollen, with a shallow sensory pit (Atchley and Wirth 1979). Proximal 8 flagellomeres rounded, distal 5 flagellomeres very elongate. Hind tibia dark brown with well-defined apical and basal pale bands. Pair of spermathecae rounded and subequal, with long necks (difficult to see necks in figure) (Atchley and Wirth 1979). Haltere pale grey.

Wing diagnosis: Average wing length 1.11 mm (Atchley and Wirth 1979). Wing with moderate macrotrichia, especially distally (not visible in Fig.) (Atchley and Wirth 1979). Wing dark grey with well-defined, highly contrasting pale spots as follows: M_1 with small spots and M_2 with elongate spots straddling veins in slightly offset positions but on roughly same plane as post-stigmatic pale spot; post-stigmatic pale spot small, does not encroach into r_{2+3} (Atchley and Wirth 1979); $r-m$ pale spot small, elongate, adjacent to $r-m$ vein; r_5 , and m_1 with small apical spots; m_2 with apical spot, pale spot anterior of CuP at fork; cu with posterior spot; a with pair of small distal spots. Wing dark brown at apex of C , with well-defined stigma.

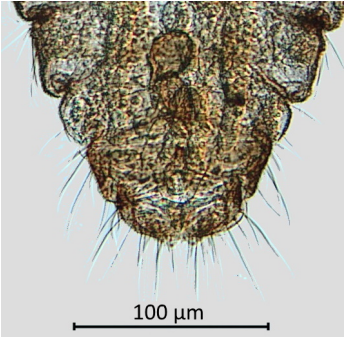
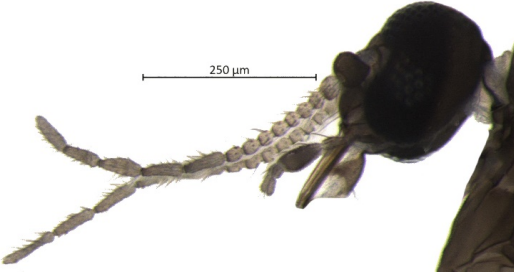
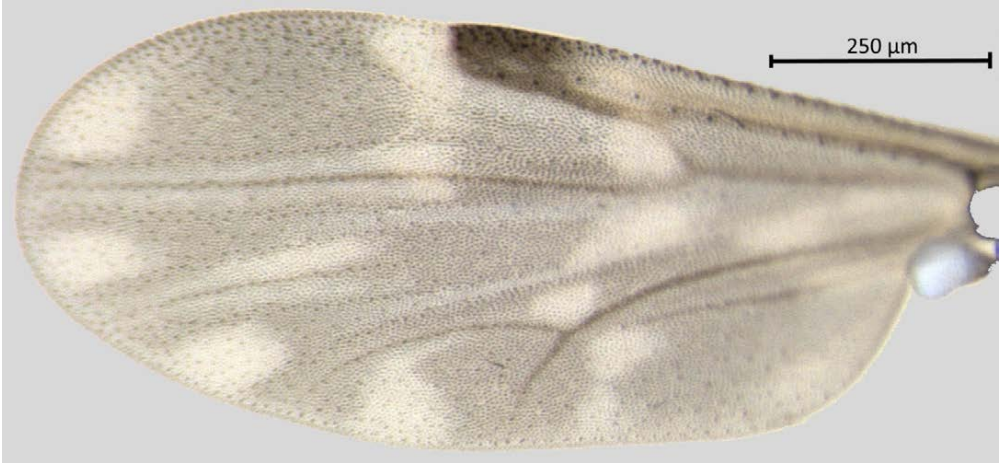
Habitat: Habitats of the larval *C. (Di.) haematopotus* are diverse and include most freshwater habitats suitable for *Culicoides* (Jones 1961). Larvae have been found in pond and stream margins, damp sand, mudflats, sedges, and reservoir sand swamps (Atchley and Wirth 1979; Williams 1955; Snow et al. 1957).

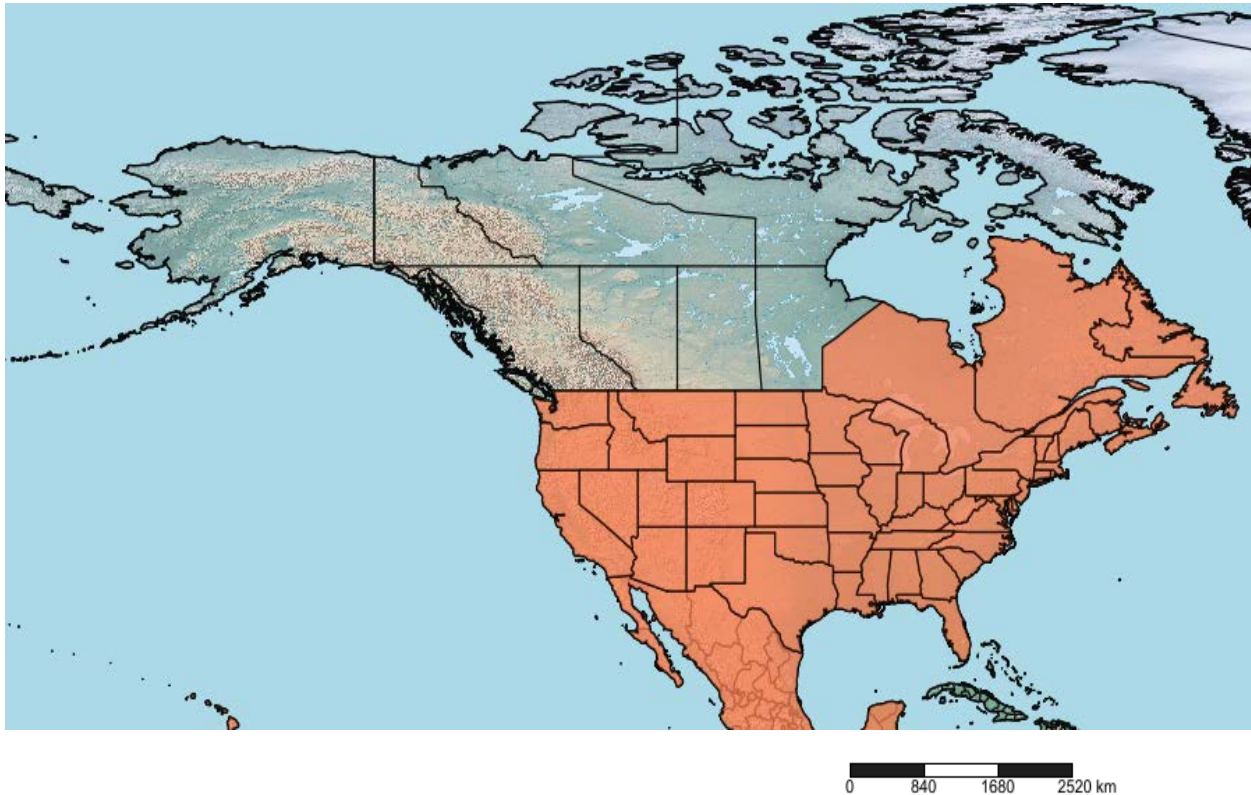
Distribution: Southern Canada, including Nova Scotia and Ontario, most of the continental U.S.A., throughout Mexico, and south to Honduras (Atchley and Wirth 1979; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (Di.) haematopotus* is often regarded as a general feeder (Hair and Turner 1968) and has been recorded biting humans in Tennessee (seldom), Texas, and Missouri (Snow and Pickard 1954; Pickard and Snow 1955; Wirth and Bottimer 1956; Snow et al. 1957; Childers and Wingo 1968). However, it also feeds on crows and grouse (Fallis and Bennett 1960, 1961) and its preference for the forest canopy (Snow 1955) and sensoria on the antennae suggest this species is primarily ornithophilic (Jamnback 1965).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides haematopotus* could occur in North America in orange, based on distribution data from the literature (Atchley and Wirth 1979; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides jamnbacki Wirth and Hubert, 1962

Differential diagnosis: *Culicoides jamnbacki* belongs to the [piliferus species group](#) and is similar to species in that group with non-necked spermathecae and relatively plain wings including [C. utowana](#), but differs by the slightly swollen, triangular 3rd palpal segment. *Culicoides jamnbacki* also resembles other plain-winged *Culicoides* including [C. franclemonti](#) and [C. atchleyi](#) but differs by the unequal spermathecae.

Diagnosis: Thorax brown. Eyes narrowly to moderately separated (Wirth and Hubert 1962). 3rd palpal segment small, triangular, and slightly swollen, with an irregular sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded, 5 distal flagellomeres elongate. Hind tibia uniformly brown. Pair of spermathecae unequal, rounded, and without necks (Wirth and Hubert 1962). Haltere pale brown.

Wing diagnosis: Average wing length 1.14 mm (Wirth and Hubert 1962). Wing with coarse and scarce macrotrichia (not visible in Fig.) (Wirth and Hubert 1962). Wing mostly uniform light grey or brown, with poorly defined or no pale spots as follows: post-stigmatic pale spot small, does not encroach into r_{2+3} ; *r-m* pale spot small, round, sits on *r-m* vein, does not reach anterior margin of wing (Wirth and Hubert 1962). Wing slightly dark brown at apex of C, without well-defined stigma (not evident in Fig.).

Habitat: Primarily woodland sites with freshwater seeps, stream margins, pools, swamps, and marshes and various substrates including mud, sphagnum, grass, or rotting leaves (Jamnback 1965). This species has been reared from a stream margin, a marsh, and a bog (Wirth and Hubert 1962).

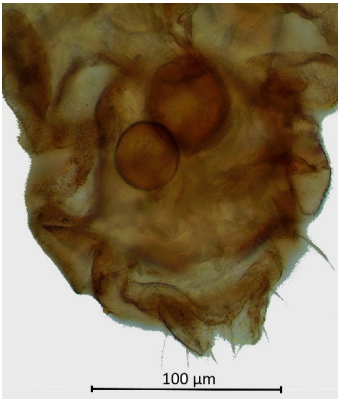
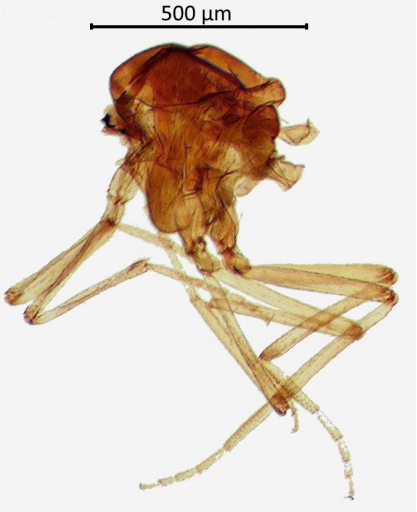
Distribution: Found in Ontario to Michigan in the west and Newfoundland, Nova Scotia, and North Carolina in the east (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

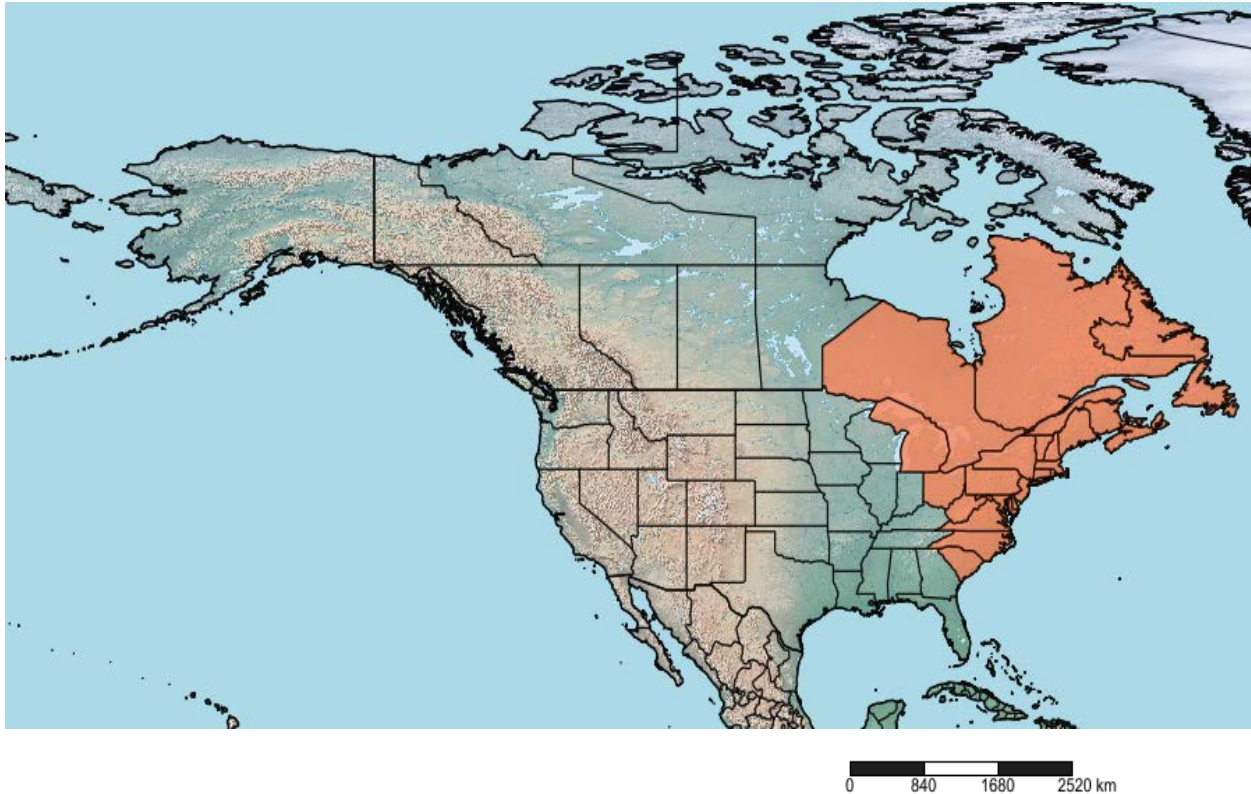
Remarks: Feeding habits unknown, mandibular teeth are well-developed (suggesting hematophagy), but proboscis is short (Jamnback 1965).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides jamnbacki* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides nanus Root and Hoffman, 1937

Differential diagnosis: *Culicoides nanus* resembles [C. travisi](#) and [C. footei](#) in having similar colouration and arrangement of pale spots on the wing but differs from *C. travisi* in having a swollen, globular 3rd palpal segment with a small, deep sensory pit. *Culicoides nanus* differs from *C. footei* in having non-necked spermathecae, and a 3rd palpal segment sensory pit that is shallower (extends 1/2–2/3 into the palpal segment), uniform, and unfolded.

Diagnosis: Thorax greyish-light brown, mesonotum dark brown (Root and Hoffman 1937). Eyes very narrowly separated. 3rd palpal segment short, globular, swollen, with a small, deep sensory pit. Proximal 8 flagellomeres short and barrel shaped, distal 5 flagellomeres very elongate. Hind tibia brown with slight paleness apically and well-defined basal pale band. Pair of spermathecae unequal, rounded, without sclerotized necks. Haltere dark brown.

Wing diagnosis: Wing length 0.8–1.0 mm (Root and Hoffman 1937; Blanton and Wirth 1979). Wing with dense macrotrichia (Root and Hoffman 1937), sparser basally. Wing grey with mostly poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot small, well-defined, can extend below R_{2+3} vein but does not extend into r_1 or r_{2+3} (Root and Hoffman 1937); $r-m$ pale spot small, not reaching the anterior wing margin; m_1 and m_2 with apical small spots; cu with small median posterior spot; a with distal posterior spot. Spots often only seen under certain light (Root and Hoffman 1937). Wing slightly dark brown at apex of C , without well-defined stigma.

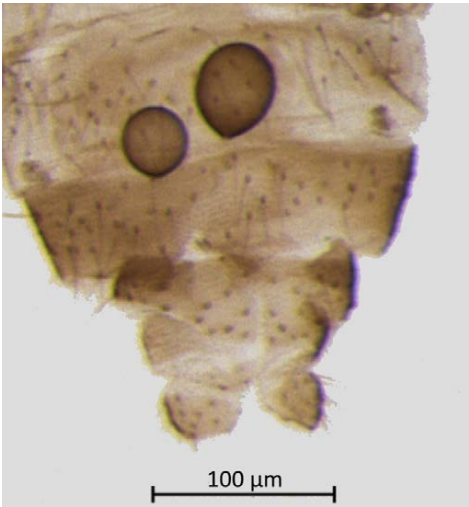
Habitat: Larvae and pupae of *C. nanus* have been found in tree holes (Foote and Pratt 1954).

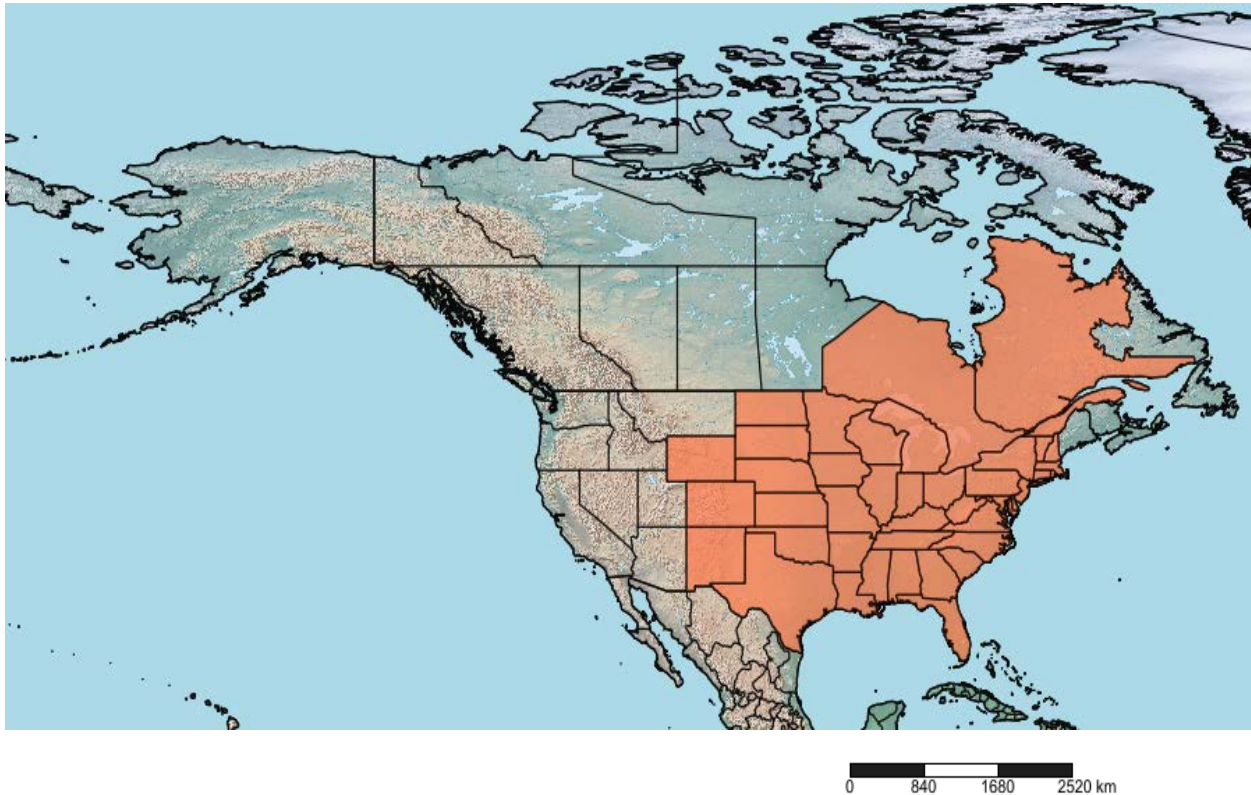
Distribution: Found from Colorado and Texas east to Quebec and Florida (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: Wing spots may be less distinct in the northern part of this species' range (Foote and Pratt 1954).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides nanus* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Avaritia) obsoletus (Meigen, 1818)

Ceratopogon obsoletus Meigen, 1818; *Ceratopogon varius* Winnertz, 1852; *Ceratopogon yezoensis* Matsumura, 1911; *Culicoides clavatus* Kieffer, 1921; *Culicoides concitus* Kieffer, 1922; *Culicoides heterocerus* Kieffer, 1921; *Culicoides intermedius* Okada, 1941; *Culicoides kabyliensis* Kieffer, 1922; *Culicoides lacteinervis* Kieffer, 1919; *Culicoides obscuripes* Santos Abreu, 1918; *Culicoides pegobius* Kieffer, 1922; *Culicoides rivicola* Kieffer, 1921; *Culicoides sintrensis* Cambournac, 1956.

Differential diagnosis: *Culicoides (Av.) obsoletus* resembles other Ontarian species in the subgenus *Avaritia* (*C. (Av.) sanguisuga*, *C. (Av.) chiopterus*) in having wings with a similar arrangement of large, contrasting but diffuse pale spots, including a post stigmatic pale spot that encroaches into r_{2+3} , but it differs by a larger 3rd palpal segment (≥ 1.5 times as long as 5th palpal segment) (Jamnback and Wirth 1963) and the comparably large body size (1–1.5 mm) (Jamnback and Wirth 1963).

Diagnosis: Thorax dark brown. Eyes contiguous (Jamnback 1965). 3rd palpal segment slightly swollen and triangular. Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres elongate. Hind tibia dark brown, paler basally. Pair of spermathecae rounded, equal or subequal in size, with short necks (Jamnback and Wirth 1963). Halteres pale, whitish.

Wing diagnosis: Average wing length 1.21 mm (Jamnback and Wirth 1963). Wing with dense macrotrichia apically. Wing grey with highly-contrasting but diffuse pale spots as follows: post-stigmatic pale spot large, encroaches into r_{2+3} ; $r-m$ pale spot large, reaches anterior margin of wing and extending into r_2 ; cu with large distal spot; a almost entirely pale with well-defined distal spot. Wing dark brown where R_1 meets C at the margin of the wing, with well-defined stigma where R_1 meets C .

Habitat: Larvae and pupae of *Culicoides (Avaritia)* spp. are widespread and found in many places (Jamnback and Wirth 1963), including tree hole debris, clay soil, manure piles, decaying cornstalk and leaves, rotting logs, sandy banks of streams, running water, decaying fungi, cow and sheep dung, *Sphagnum* bogs, marshes, swamps, and bare mud (Jamnback and Wirth 1963). *Culicoides (Av.) obsoletus* has been reared from chicken straw, spruce needles, soil polluted with chicken/horse/cow manure, marshes, and decaying cornstalks (Jamnback and Wirth 1963).

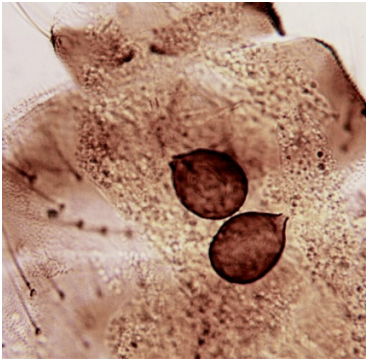
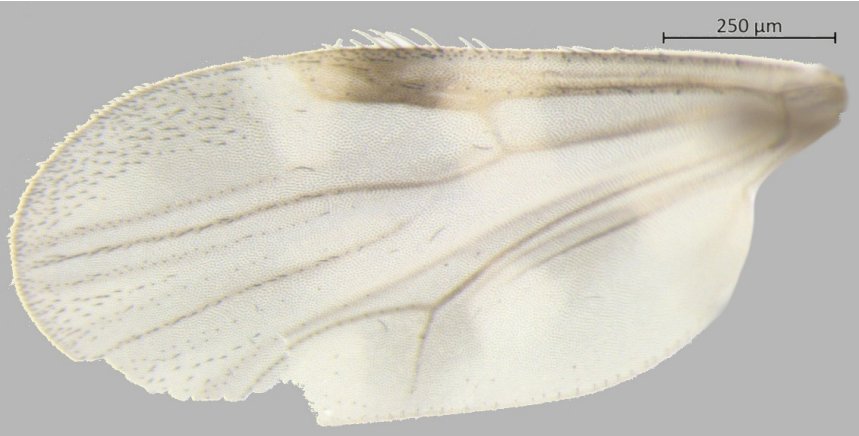
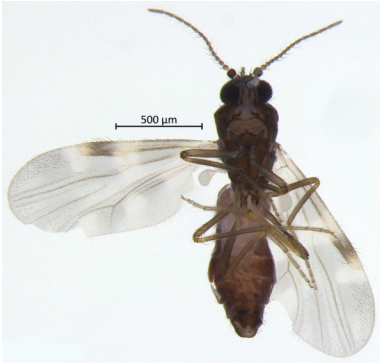
Distribution: Found in North America from Georgia and Tennessee northward to Nova Scotia, Ontario, and Quebec, and west to northern California, British Columbia, and Alaska (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009). This species is also found in Eurasia and North Africa (Jamnback and Wirth 1963).

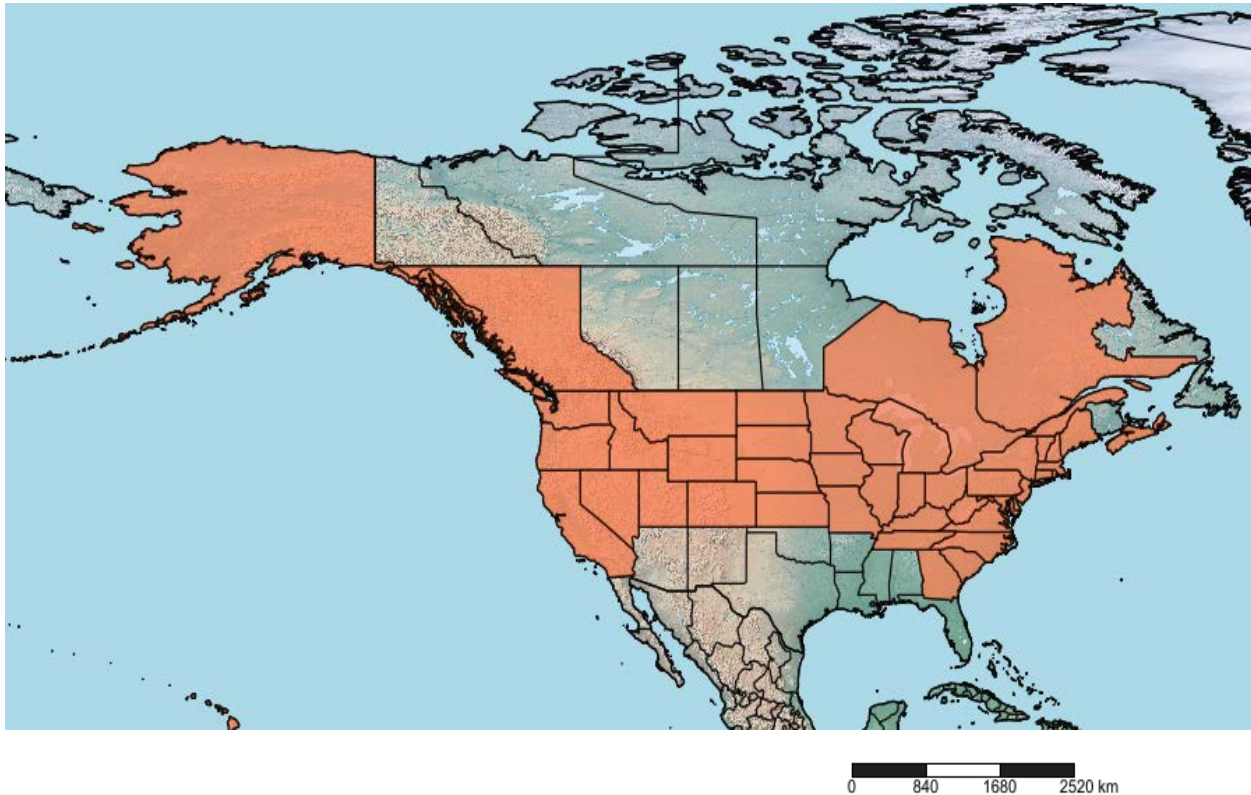
Remarks: Bites humans, like *C. (Av.) sanguisuga*, but less commonly (Jamnback and Wirth 1963). Has been noted to feed on man, horse, and cattle and commonly breeds in pastures and farmlands close to these animals (Jamnback 1965).

[Images](#)

[Distribution Map](#)

[Back to Subgenus *Avaritia* page](#)





Indication of which provinces/states where *Culicoides obsoletus* could occur in North America in orange, based on distribution data from the literature (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Culicoides) paraimpunctatus Borkent, 1995

Culicoides canadensis Wirth & Blanton, 1969.

Differential diagnosis: *Culicoides (C.) paraimpunctatus* closely resembles [C. \(C.\) yukonensis](#) in having the atypical wing pattern of large, coalesced pale spots covering most of the surface, with small dark spots interrupting the pale spots. *Culicoides (C.) paraimpunctatus* differs by the smaller body size, the contiguous eyes, the shorter distal flagellomeres, the small 3rd palpal segment, and the faint wing markings (Wirth and Blanton 1969a). *Culicoides (C.) paraimpunctatus* is also similar to the Palearctic species *C. (C.) impunctatus* Goetghebuer (Borkent and Grogan 2009), in having a smaller body size but differs by the larger size and the dark spot in *cu* (Wirth and Blanton 1969a). This species has generally plain wings for the *pulicaris* species group, and wing spots can appear faint (Wirth and Blanton 1969a).

Diagnosis: Thorax brown. Eyes contiguous for a short distance. 3rd palpal segment slender, with scattered sensoria on the distal half (Wirth and Blanton 1969a). Proximal 8 flagellomeres rounded or barrel shaped, flagellomeres 5–8 usually distinctly barrel shaped, distal 5 flagellomeres elongate (Wirth and Blanton 1969a). Hind tibia uniformly dark brown. Two unequal, rounded spermathecae with slender necks (Wirth and Blanton 1969a). Haltere pale grey or brown (Wirth and Blanton 1969a).

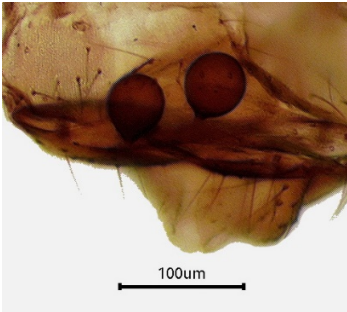
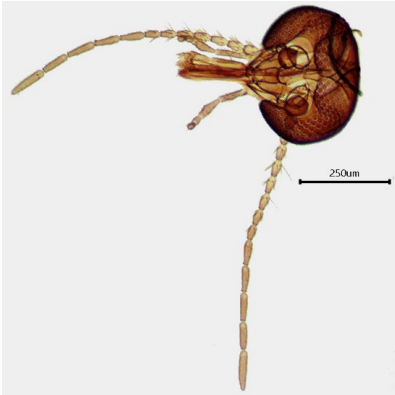
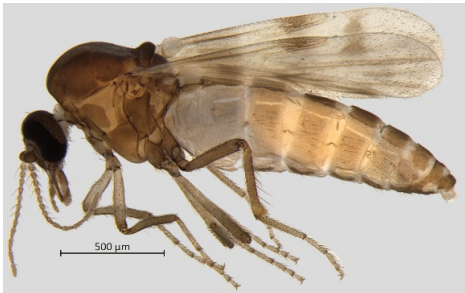
Wing diagnosis: Average wing length 1.5 mm (Wirth and Blanton 1969a). Wing with abundant macrotrichia on entire surface of wing, sparser basally (not visible in Fig.) (Wirth and Blanton 1969a); dark grey, mostly covered by large, diffuse and coalesced pale spots giving the impression of a pale wing with dark spots. Post-stigmatic pale spot large, encroaching into entirety of r_{2+3} . *r-m* pale spot very large, sitting on *r-m* and reaching anterior margin of wing, joins with spots in m_2 and *a*. Apices of veins M_1 , M_2 , and *CuA* dark. r_5 , m_1 and m_2 with large pale spots covering almost entirety of cell except median dark spot. *a* almost entirely pale except median dark spot on mid-*CuP*. Wing dark brown where R_1 meets *C* at the margin of the wing, with well-defined stigma.

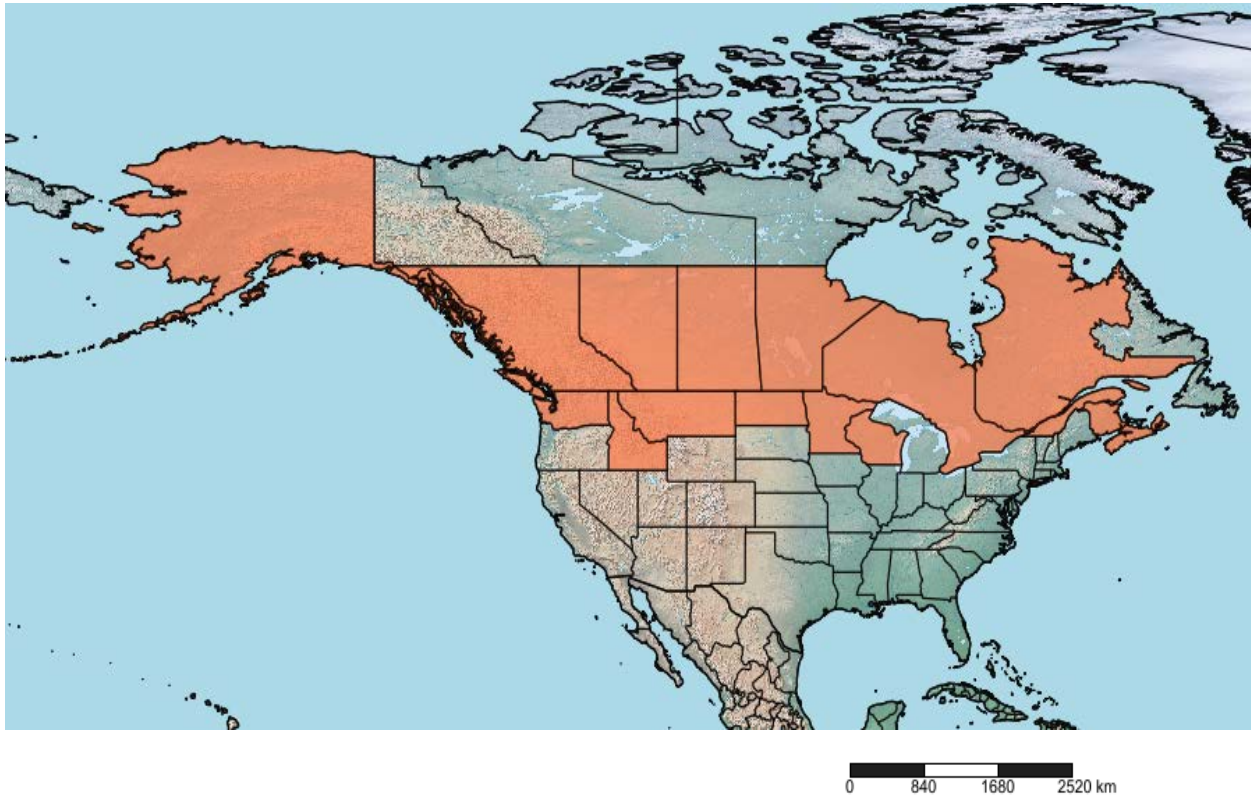
Habitat: From label data from Wirth and Blanton, (1969a): *Culicoides (C.) paraimpunctatus* (as *C. canadensis*) has been collected near freshwater habitats including lakes, streams, hot springs, creeks and springs.

Distribution: Found from Alaska to Nova Scotia in the north and British Columbia to Wisconsin in the south (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: Known to bite humans and considered a pest in Alaska and western Canada (Wirth and Blanton 1969a).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides paraimpunctatus* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides parapiliferus Wirth and Blanton, 1974

Misidentification: *Culicoides pseudopiliferus* Wirth and Hubert, 1962

Differential diagnosis: *Culicoides parapiliferus* belongs to the [piliferus species group](#) with which it shares in part elongated pale spots straddling the M_1 and M_2 veins on the wing, and a post-stigmatic pale spot that does not encroach into the r_{2+3} cell (Wirth and Blanton 1974). *Culicoides parapiliferus* can not be soundly identified to species using the current key due to intraspecific variation and close resemblance with species in the *piliferus* species group. It closely resembles [C. alexanderi](#) and [C. testudinalis](#), we suggest close comparison of wing and 3rd palpal segment figures to delineate these species.

Diagnosis: Thorax brown. Eyes bare, broadly separated (Wirth and Blanton 1974). 3rd palpal segment elongate and slender. Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Hind tibia uniformly brown. Pair of spermathecae unequal, rounded, without necks (Wirth and Blanton 1974). Haltere pale brown or grey.

Wing diagnosis: Average wing length 1.15 mm (Wirth and Blanton 1974). Wing with coarse, moderate macrotrichia on entire wing surface (not visible in Fig.) (Wirth and Blanton 1974). Wing grey with large, poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot large, coalesced with elongate spots on M_1 and M_2 , does not encroach into r_{2+3} ; $r-m$ pale spot large, sits on $r-m$ vein, can extend up to anterior margin of wing (Wirth and Blanton 1974); r_5 and m_1 with large apical spots; m_2 with apical spot and pale spot at fork between CuA_1 and CuP ; cu almost entirely pale except proximal margin; a pale on margins, darker medially. Wing slightly dark brown at apex of C , without well-defined stigma.

Habitat: This species was reared from a muddy margin of a small pond in Long Island, New York, U.S.A. (Blanton and Wirth 1979).

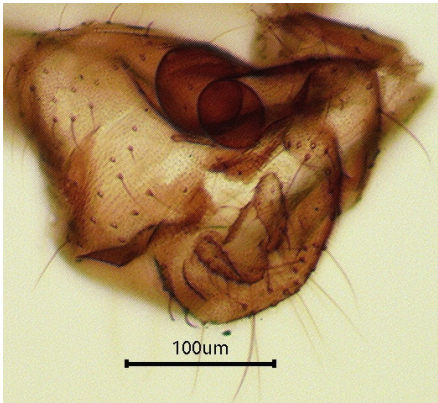
Distribution: Found from Ontario south to Iowa in the west and Massachusetts south to Florida in the east (Wirth and Blanton 1974; Wirth et al. 1985; Borkent and Grogan 2009).

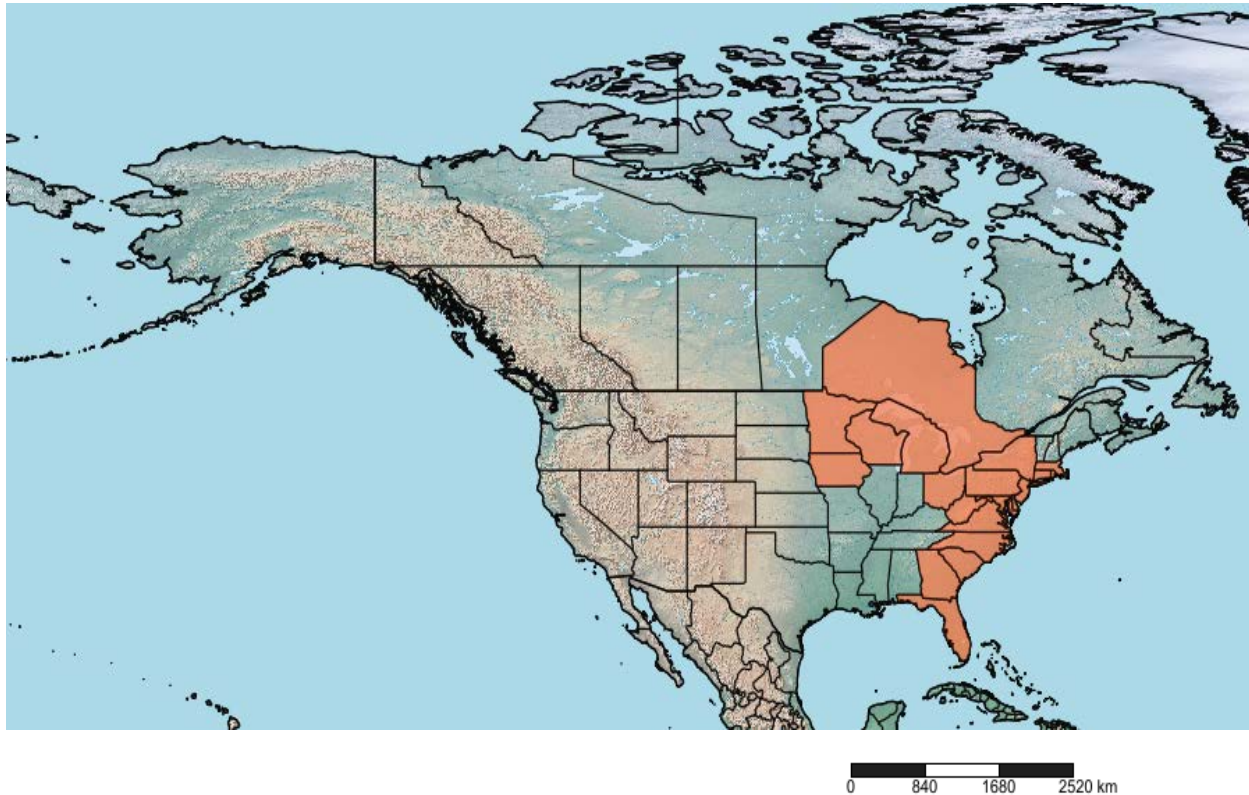
Remarks: Feeding habits unknown.

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides parapiliferus* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1974; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides piliferus Root and Hoffman, 1937

Differential diagnosis: *Culicoides piliferus* can be distinguished from other [piliferus group](#) species by the swollen 3rd palpal segment with a wide, round pit (Wirth and Hubert 1962). It resembles the more commonly collected [C. downesi](#) in having a swollen 3rd palpal segment but differs by the well-defined *r-m* pale spot and smaller size (wing length 0.99-1.30 mm) (Wirth and Hubert 1962).

Culicoides piliferus also resembles [C. bicklevi](#) and [C. denticulatus](#) but has a smaller *r-m* pale spot (Wirth and Hubert 1962). *C. piliferus* resembles *C. scanloni* Wirth and Hubert –which is not recorded in Ontario but occurs in close range (Michigan, in part (Borkent and Grogan 2009)) – in having similar antennal sensoriae, short proximal flagellomeres, pale thorax and halteres and a wing with small spots, but differs by the larger size, and swollen 3rd palpal segment (Blanton and Wirth 1979).

Diagnosis: Thorax light brown. Eyes contiguous to narrowly separated on the midline (Wirth and Hubert 1962). 3rd palpal segment triangular and swollen with a large sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate (Wirth and Blanton 1974). Hind tibia uniformly brown. Pair of spermathecae rounded, unequal, without necks (Wirth and Hubert 1962). Haltere pale brown.

Wing diagnosis: Average wing length 1.12 mm (Wirth and Hubert 1962). Wing with coarse, moderately dense macrotrichia (Wirth and Hubert 1962). Wing grey with mostly poorly contrasting and diffuse or well-defined pale spots as follows: M_1 and M_2 with indistinct elongate pale spots straddling each vein; post-stigmatic pale spot small, does not encroach into r_{2+3} (Wirth and Hubert 1962); *r-m* pale spot well-defined, round, moderately large, sits on *r-m* vein; r_5 and m_1 with apical pale spots; m_2 with apical pale spot and spot at joint between CuA_2 and CuP ; *cu* with moderate to large distal spot (Wirth and Hubert 1962); *a* with distal and proximal spots. Wing dark brown at apex of *C*, with stigma.

Habitat: Blanton and Wirth (1979) provide a summary of larval habitats of *C. piliferus*: reared from moist sand, clumps of grass, freshwater soil habitats, stream margins, mud, *Sphagnum* bogs, fern bogs, and marshes (Murray 1957; Snow et al. 1957; Jones 1961; Wirth and Hubert 1962; Jamnback 1965; Hair et al. 1966).

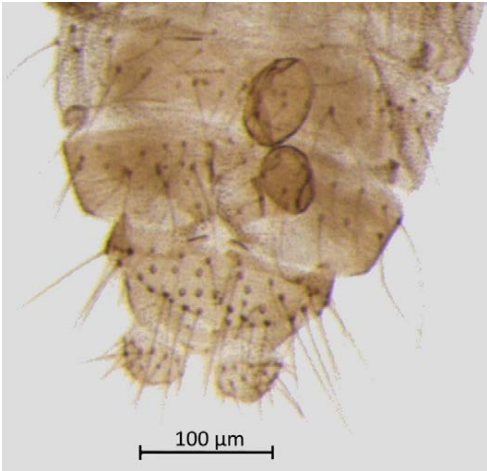
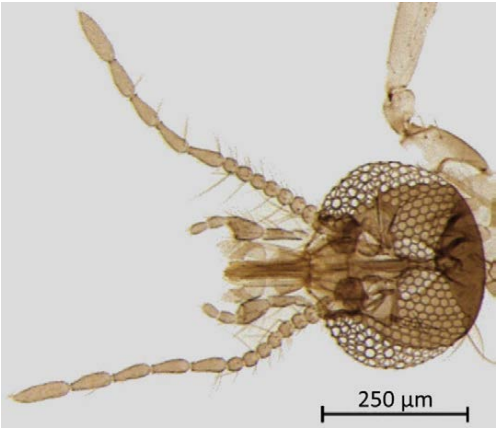
Distribution: Found from Wisconsin to Nova Scotia in the north and Nebraska to Louisiana and Florida in the south (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

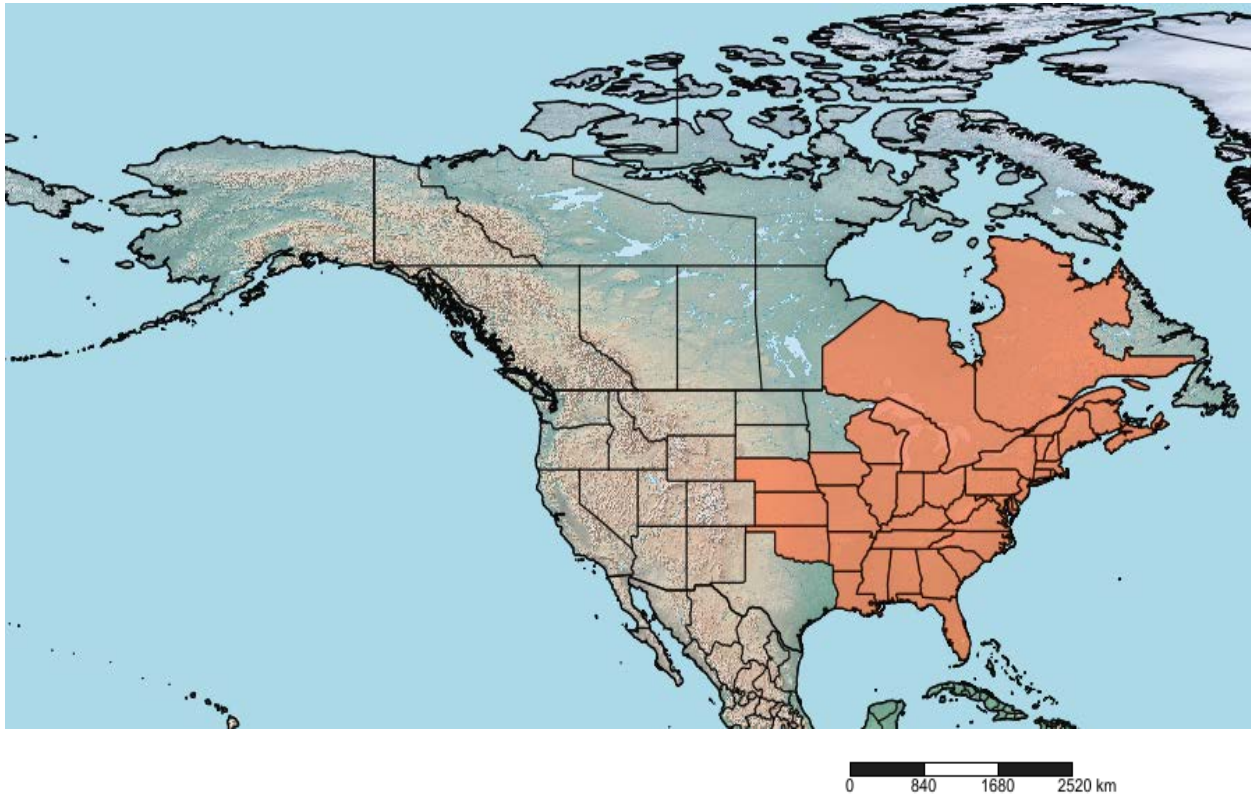
Remarks: Jamnback (1965) suggests this species is primarily ornithophilic based on antennal sensoria and proboscis length. This species has been recorded to feed on humans, goats, rabbits and turkeys (Wirth and Hubert 1962; Humphreys and Turner 1973). *Culicoides piliferus* is often not abundant in collections from Ontario (Wirth and Hubert 1962).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides piliferus* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Avaritia) sanguisuga (Coquillett, 1901)

Differential diagnosis: *Culicoides (Av.) sanguisuga* resembles other Ontarian [Avaritia](#) (especially *C. obsoletus*, but also *C. chiopterus*) in having a dark wing with large, poorly defined pale spots, including a post-stigmatic pale spot that encroaches into r_{2+3} , but differs by the elongate, slender 3rd palpal segment that is at least 1.5 times as long as the 5th palpal segment (Jamnback and Wirth 1963).

Diagnosis: Thorax dark brown. Eyes contiguous (Jamnback 1965). 3rd palpal segment elongate, slender. Proximal 8 flagellomeres barrel shaped; distal 5 flagellomeres elongate. Hind tibia uniformly light brown. Pair of spermathecae rounded, equal or subequal with short necks (Jamnback and Wirth 1963). Haltere whitish.

Wing diagnosis: Average wing length 1.12 mm (Jamnback and Wirth 1963). Wing with sparse macrotrichia distally (Jamnback and Wirth 1963). Wing grey, with either faint or distinct pattern (Jamnback and Wirth 1963) of pale spots as follows: M_2 with elongate pale spots straddling vein on same plane as post-stigmatic pale spot; post-stigmatic pale spot large, encroaches into r_{2+3} , reaches M_1 ; $r-m$ pale spot large, reaches anterior margin of wing; r_5 with large apical spot; m_1 and m_2 with apical elongate spots, m_2 pale medially; cu with large median spot touching posterior margin; a with distal spot. Wing dark brown where R_1 meets C at the margin of the wing, with well-defined stigma.

Habitat: Larvae and pupae of *Culicoides (Avaritia)* are widespread and found many places. They have been found in tree hole debris, clay soil, manure piles, decaying cornstalks and leaves, rotting logs, sandy banks of streams, running water, decaying fungi, cow and sheep dung, *Sphagnum* bogs, marshes, swamps, and bare mud (Jamnback and Wirth 1963). *Culicoides (Av.) sanguisuga* immatures were found in accumulations of dry leaves, and this habitat is thought to be characteristic for breeding in the Adirondack region (New York, U.S.A.) (Jamnback and Wirth 1963). They were also found in clean straw piles and spruce needles, but these habitats seemed to be less common (Jamnback and Wirth 1963).

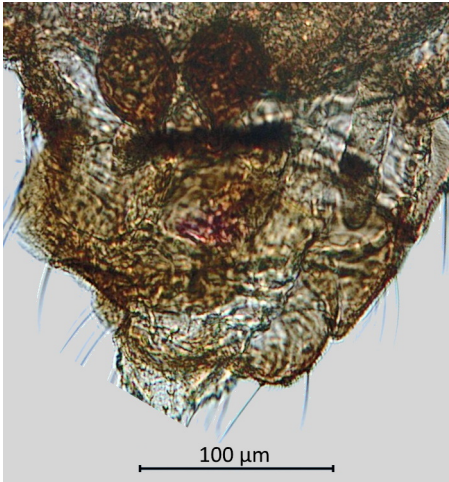
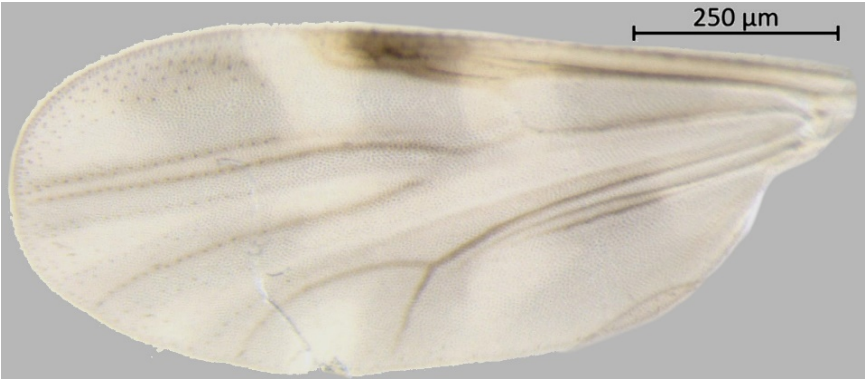
Distribution: Alaska east to Nova Scotia in the north and California east to Georgia in the south (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009).

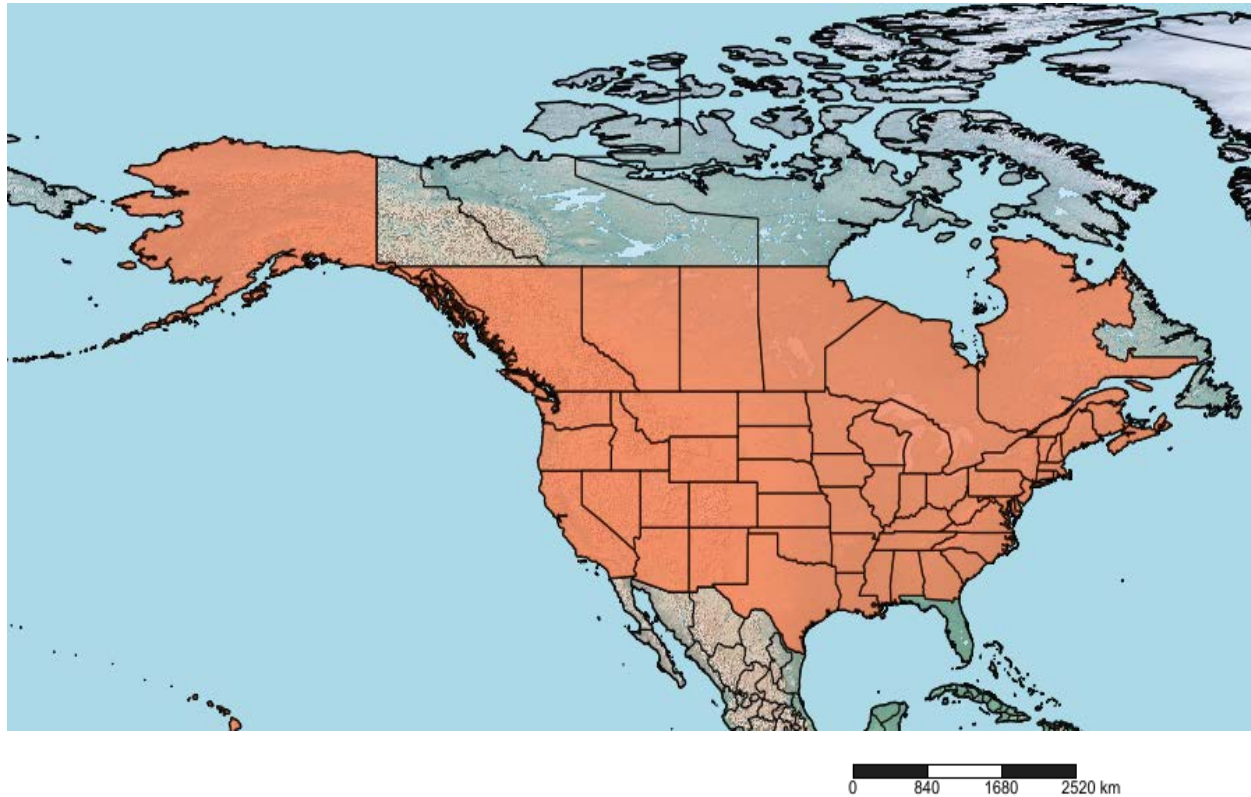
Remarks: *Culicoides (Av.) sanguisuga* bites humans and is a common pest in eastern North American forests (Jamnback and Wirth 1963). It is also known to feed on horses, cattle, rabbits, hares, and birds (Jamnback 1965).

[Images](#)

[Distribution Map](#)

[Back to Subgenus Avaritia page](#)





Indication of which provinces/states where *Culicoides sanguisuga* could occur in North America in orange, based on distribution data from the literature (Jamnback and Wirth 1963; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides snowi Wirth and Jones, 1956

Differential diagnosis: *Culicoides snowi* belongs to the [piliferus species group](#) and resembles species in the group with relatively plain wings and non-necked spermathecae but can be distinguished by the pale white wing coupled with fine macrotrichia, and the small, subequal spermathecae (Wirth and Hubert 1962).

Diagnosis: Thorax brownish black to dark brown. Eyes moderately to broadly separated (Wirth and Hubert 1962). 3rd palpal segment triangular, moderately swollen with a large, round, deep sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded or barrel shaped, distal 5 flagellomeres elongate. Hind tibia uniformly light brown. Pair of spermathecae rounded, subequal, without necks (Wirth and Hubert 1962). Haltere pale grey or brown.

Wing diagnosis: Average wing length 1.04 mm (Wirth and Hubert 1962). Wing with numerous fine macrotrichia on entire surface (Wirth and Hubert 1962). Wing mostly uniform grey with poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot small, does not encroach into r_{2+3} ; $r-m$ pale spot can be large, does not extend to anterior wing margin (Wirth and Hubert 1962). Wing slightly dark brown at apex of C , without well-defined stigma.

Habitat: This species has been reared from immatures collected from tree holes or tree wounds (Wirth and Hubert 1962).

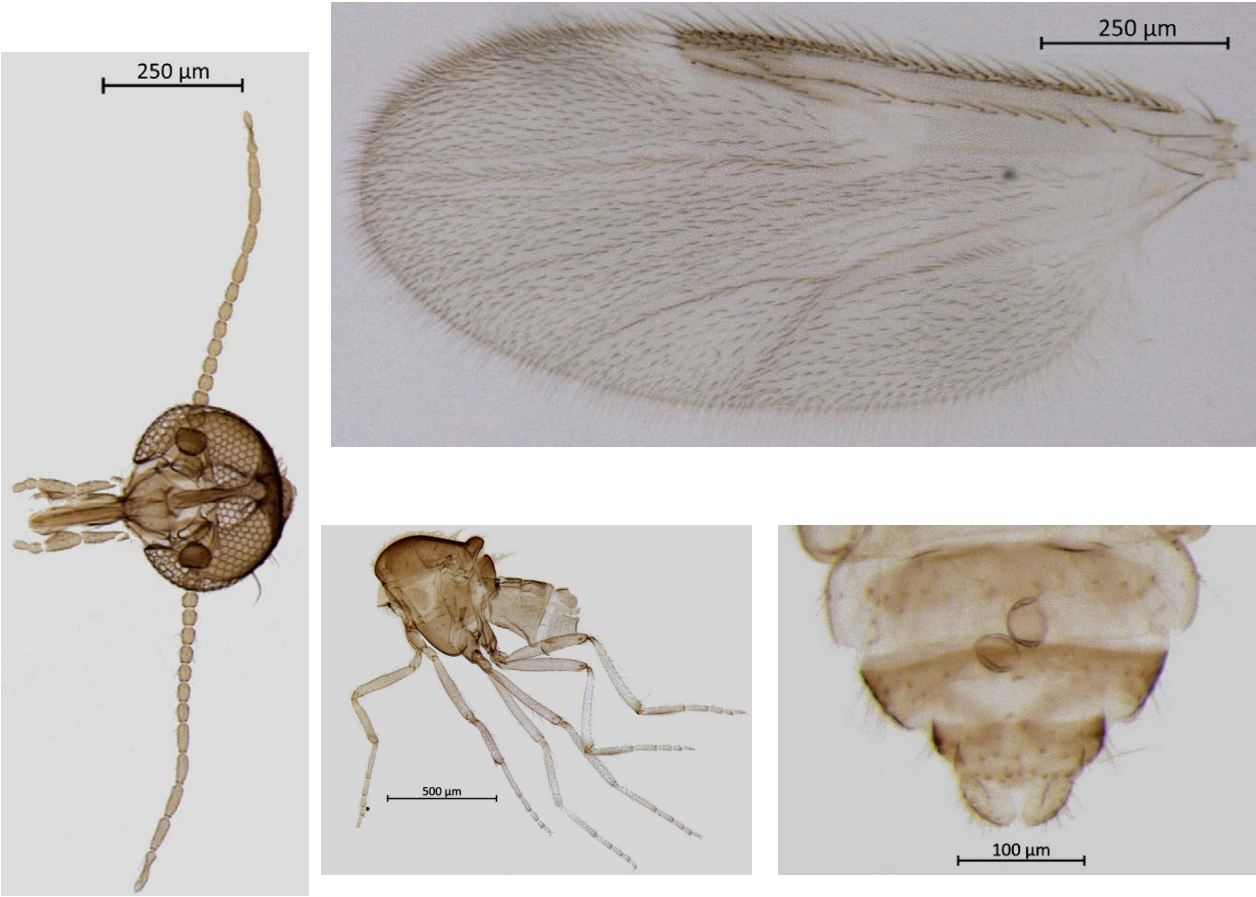
Distribution: Found from Illinois to Quebec, south to Mississippi and Florida (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

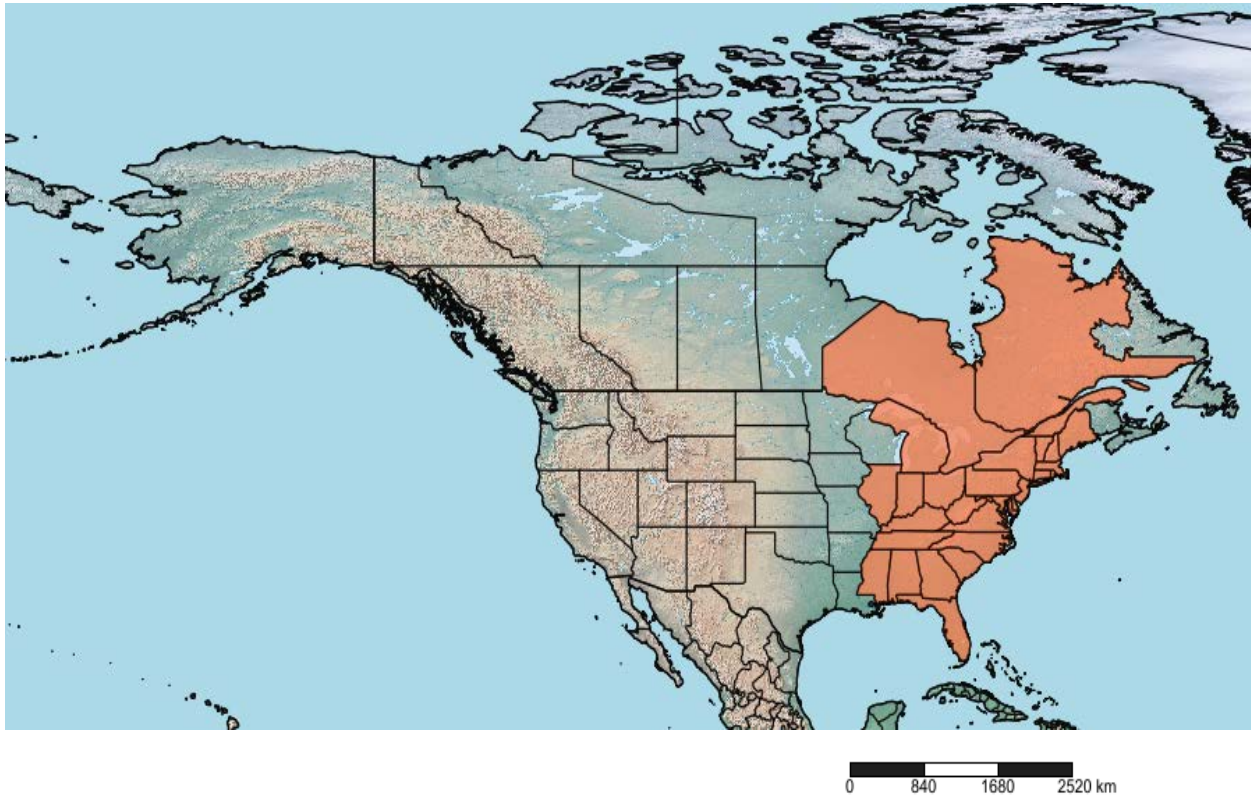
Remarks: *Culicoides snowi* has been noted to bite humans (Wirth and Hubert 1962).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides snowi* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Beltranmyia) sphagnumensis Williams, 1955

Culicoides carjalaensis Glukhova, 1957.

Differential diagnosis: *Culicoides (B.) sphagnumensis* resembles [C. \(B.\) crepuscularis](#) in having similar pale spots on the medial wing and a single large spermatheca, but it lacks pale spots in the apical portions of m_1 and m_2 (Williams 1955).

Diagnosis: Thorax dark brown. Eyes narrowly separated. 3rd palpal segment swollen and triangular. Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Hind tibia dark brown, pale basally. Single spermatheca large, oval, with a long neck that is characteristic of the subgenus *Beltranmyia* (neck not visible in Fig.) (Williams 1955). Haltere pale brown.

Differential diagnosis: Average wing length 1.43 mm (Williams 1955). Wing with long and numerous macrotrichia, bare in *c* (Williams 1955). Wing grey or brown with mostly poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot small, does not extend into r_{2+3} (Williams 1955); *r-m* pale spot large, overlaps *r-m* vein but sometimes seems to derive beside the vein (Williams 1955), coalesces with spot in m_1 ; m_1 may have faint, elongate median spot; *cu* with faint median spot; *a* with spot in antero-apical corner. Wing slightly dark brown at apex of *C*, without well-defined stigma.

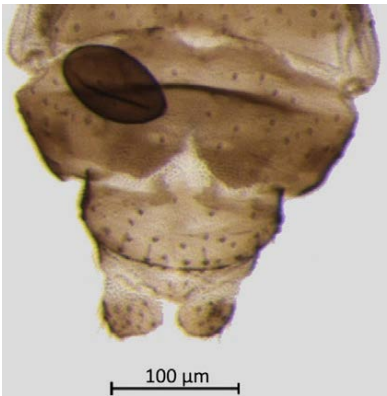
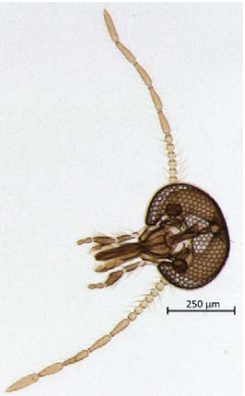
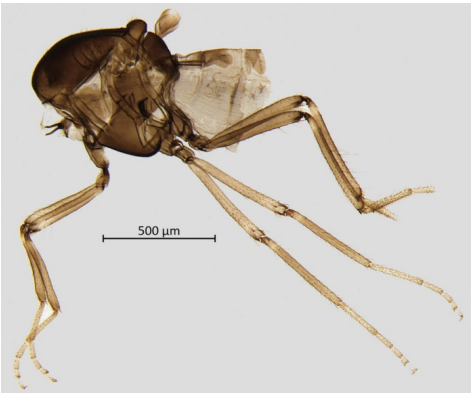
Habitat: *Culicoides (B.) sphagnumensis* is often associated with the moss genus *Sphagnum* (Williams 1955).

Distribution: Found Alaska east to Newfoundland, and south to West Virginia (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (B.) sphagnumensis* is primarily ornithophilic (Fallis and Bennett 1960; Fallis and Bennett 1961; Bennett 1960) and is an intermediate host for the protozoan parasite of grouse, *Haemoproteus canachites* and for *Haemoproteus* spp. in crows and finches (Fallis and Bennett 1960; Fallis and Bennett 1961).

[Images](#)

[Distribution Map](#)



Culicoides (Silvaticulicoides) spinosus Root and Hoffman, 1937

Differential diagnosis: *Culicoides (S.) spinosus* resembles other Ontarian *Culicoides* that have relatively simple, hairy wings, such as [C. \(S.\) biguttatus](#), [C. \(Culicoides\) frohnei](#) and [C. travisi](#). It differs from *C. (S.) biguttatus* by the generally large and diffuse pale spots, and sometimes-present faint pale spots in the *cu* and *a* cells on the apical/posterior wing margin (*C. (S.) biguttatus* only ever has two very bright spots, the *r-m* crossvein and post-stigmatic pale spot, on otherwise plain, grey wings). *C. (S.) spinosus* differs from *Culicoides (C.) frohnei* by its smaller size (~1mm, in contrast to 1.6mm) (Wirth and Blanton 1969a; Root and Hoffman 1937). It differs from *C. travisi* in having a slightly swollen nearly triangular 3rd palpal segment with a shallow sensory pit. *Culicoides (S.) spinosus* also resembles *C. (S.) loisae* Jamnback, a species not recorded in Ontario but occurring in close range (New York and Quebec, in part (Borkent and Grogan 2009)) in having a relatively plain wing, a slender 3rd palpal segment, and ovoid necked spermathecae, but differs by the presence of the post-stigmatic pale spot (Blanton and Wirth 1979).

Diagnosis: Thorax brownish-grey. Eyes slightly separated. 3rd palpal segment subequal or equal to the second, slightly swollen and nearly triangular with an irregular shallow pit. Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres elongate. Hind tibia dark brown, paler basally and apically but without well-defined pale bands. Pair of spermathecae equal, rounded, with sclerotized necks. Haltere pale grey or white.

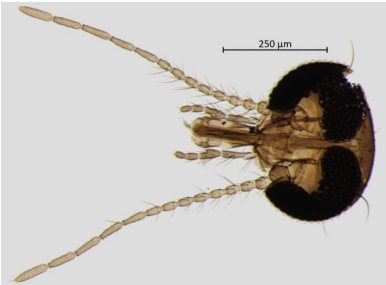
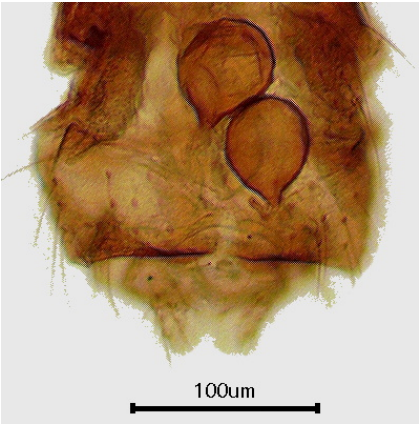
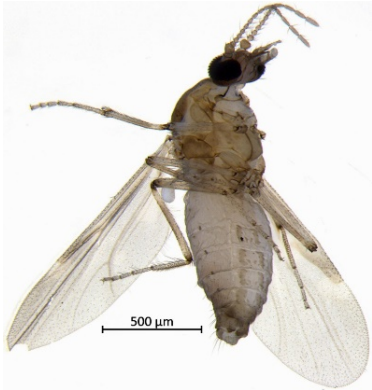
Wing diagnosis: Approximate wing length 0.9 mm (Root and Hoffman 1937). Wing with long, dense and distinct macrotrichia (Foote and Pratt 1954). Wing grey with poorly contrasting, diffuse, pale spots as follows: post-stigmatic pale spot variable in size, and does not often extend into the r_{2+3} but can; also can overlap with the R_{4+5} (Foote and Pratt 1954); *r-m* pale spot moderately large, may extend to anterior wing margin; *cu* with very indistinct median spot and *a* with indistinct distal and proximal spots, both only seen under specific lighting (Foote and Pratt 1954). Wing slightly dark brown at apex of *C*, without well-defined stigma.

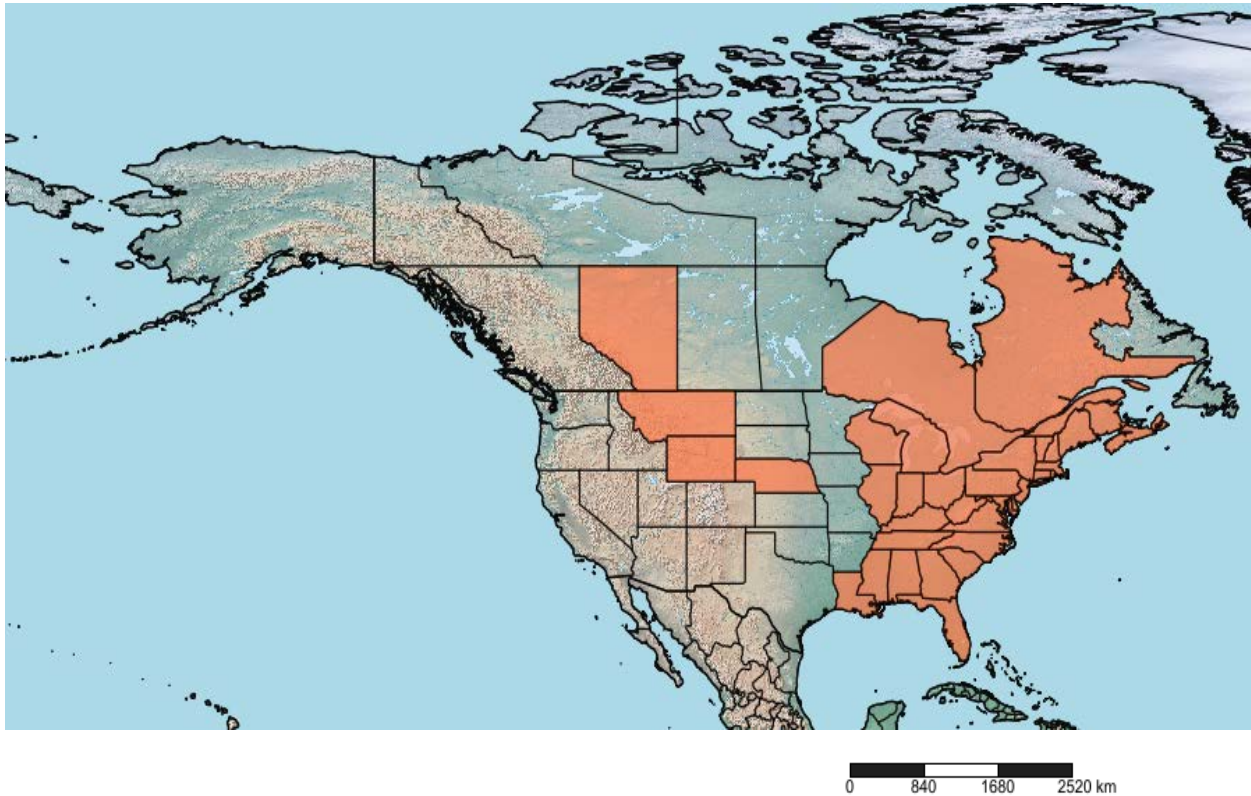
Habitat: Blanton and Wirth (1979) provide a summary of larval habitats for *C. (S.) spinosus*: from freshwater habitats such as reservoir margins, rain pools, sand bars, stream margins, puddles, ponds, and swamps, as well as from substrates such as mud, grass roots and dead leaves (Snow et al. 1957; Jones 1961; Jamnback 1965; Hair et al. 1966; Battle and Turner 1970; Gazeau and Messersmith 1970).

Distribution: Found in the west from Alberta south to Nebraska, and in the east from Wisconsin to Nova Scotia, south to Louisiana and Florida (Foote and Pratt 1954; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: Blanton and Wirth (1979) summarize feeding habits of adult *C. (S.) spinosus*: recorded biting man during the day (Snow 1955; Snow et al. 1957) and it is suggested there is a feeding preference toward mammals (Jamnback 1965). Feeds on goats, rabbits, and galliform birds (Humphreys and Turner 1973).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides spinosus* could occur in North America in orange, based on distribution data from the literature (Foote and Pratt 1954; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Oecacta) stellifer (Coquillett, 1901)

Ceratopogon stellifer Coquillett, 1901.

Differential diagnosis: *Culicoides (O.) stellifer* resembles [C. \(O.\) furensoides](#) in having a similar contrasting wing pattern with numerous pale spots, but differs by also having additional pale spots in r_5 and m_1 that reach the apical wing margin. [Culicoides \(Monoculicoides\) albertensis](#) and [C. \(M.\) variipennis](#) also have similar contrasting wing patterns but can be differentiated by the V-shaped pale area in cu along CuA_1 and CuA_2 , which *C. (O.) stellifer* lacks.

Diagnosis: Thorax brown. Eyes narrowly separated (Hoffman 1925). 3rd palpal segment slightly swollen and elongate with a broad, irregular, and shallow sensory pit (Root and Hoffman 1937). Proximal 8 flagellomeres barrel-shaped, tapered distally; distal 5 flagellomeres elongate. Pair of spermathecae equal, rounded, with sclerotized necks (Root and Hoffman 1937). Haltere grey with a yellow base (Hoffman 1925).

Wing diagnosis: Average wing length 1.2 mm (Hoffman 1925). Wing sparsely macrotrichose below M_1 (Hoffman 1925), dark grey with highly contrasting, well-defined pale spots as follows: post-stigmatic pale spot irregularly shaped, extends below R_{2+3} , but does not extend into r_{2+3} ; $r-m$ pale spot large, can reach anterior margin of wing; r_5 with very small apical spot, large median spot; m_1 with small apical, subapical, and median spots; m_2 with large apical spot and elongate median spot; cu with median spot touching posterior margin of wing; a with distal small spot and basal pale, diffuse area. Wing dark brown at apex of C , with well-defined stigma.

Habitat: Blanton and Wirth (1979) provide a summary of larval habitats for *C. (O.) stellifer* including a variety of substrates such as moist soil, mud, decaying leaves, grass, as well as a variety of freshwater habitats including reservoir margins, mudflats, pools, swamps, springs, ponds, and streams (Williams 1955; Wirth and Bottimer 1956; Murray 1957; Snow et al. 1957; Jones 1961; Hair et al. 1966; Jamnback 1965; Childers and Wingo 1968; Gazeau and Messersmith 1970; Battle and Turner 1970; Kardatzke and Rowley 1971).

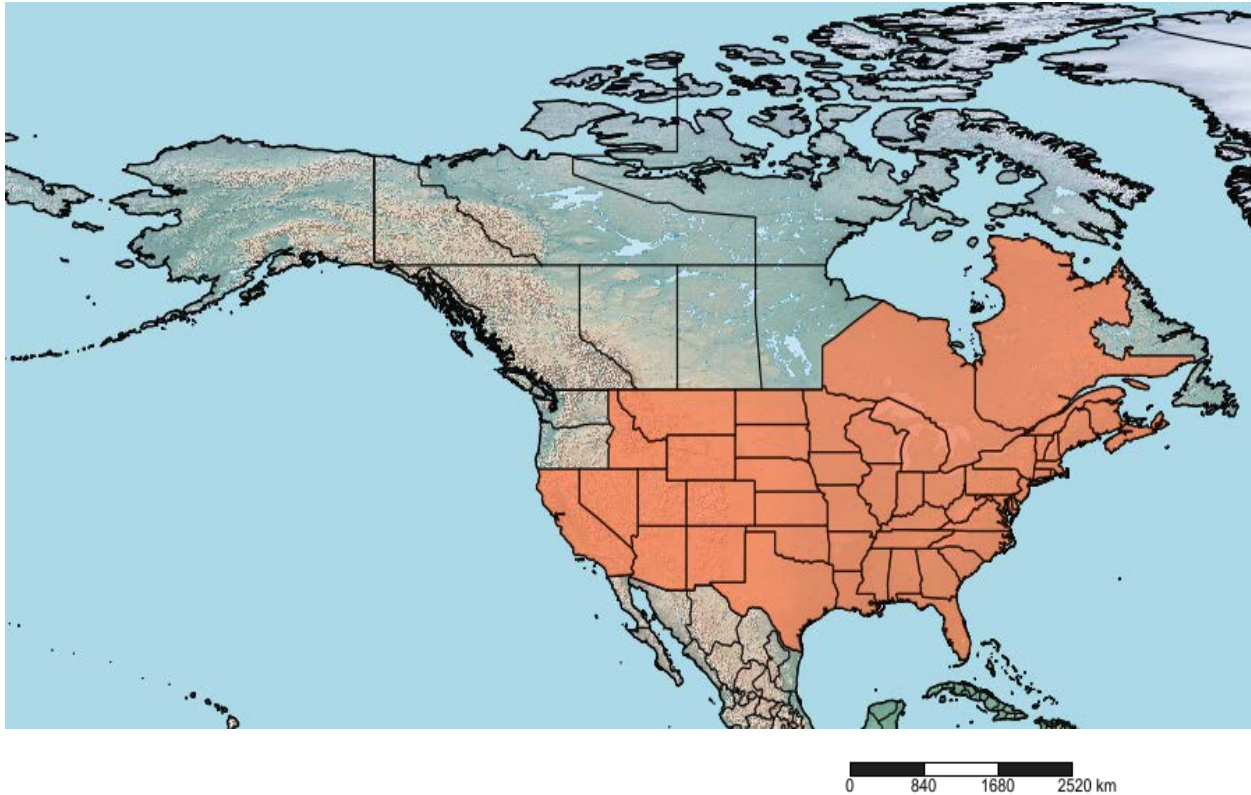
Distribution: Found from Montana south to California, east to Nova Scotia and Florida (Wirth et al. 1985). It has been found in every state in the United States except Washington and Oregon (Borkent and Grogan 2009).

Remarks: *Culicoides (O.) stellifer* is a commonly collected species in the eastern United States (Foote and Pratt 1954). This species is implicated as a vector of EHDV in the southeastern United States and suggest the possibility of *C. stellifer* transmitting BTV but more data is needed (McGregor et al. 2019; Shults et al. 2020). This species has been recorded to feed on white-tailed deer, fallow deer, elk, and turkey (Humphreys and Turner 1973; McGregor et al. 2019), and it has been noted to bite humans as well (Pers. Comm. Vigil, 2022).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides stellifer* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Wirthomyia) stilobezzioides Foote and Pratt, 1954

Differential diagnosis: *Culicoides (W.) stilobezzioides* resembles other *Culicoides* that have plain, hairy wings, especially *C. (Amossovina) atchleyi*, but differs by the denser wing macrotrichia and large, globular 3rd palpal segment.

Diagnosis: Thorax pale brown (Foote and Pratt 1954). Eyes narrowly separated (Jamnback 1965). 3rd palpal segment swollen and globular, with a deep sensory pit with a large opening (Jamnback 1965). Proximal 8 flagellomeres rounded, distal 5 flagellomeres very elongate (3X as long as proximal 8 flagellomeres) and tapered distally. Pair of spermathecae unequal, rounded, without necks (Jamnback 1965). Haltere brown, apically white or yellow (Jones 1956).

Wing diagnosis: Average wing length 1.54 mm (Jamnback 1965). Wing with moderate to abundant macrotrichia (Foote and Pratt 1954; Jamnback 1965), mostly uniform grey or brown; post-stigmatic pale spot small (if visible at all), does not extend into r_{2+3} , $r-m$ pale spot small and indistinct to absent, does not reach anterior wing margin (Jamnback 1965). Wing uniformly brown at apex of C, without well-defined stigma.

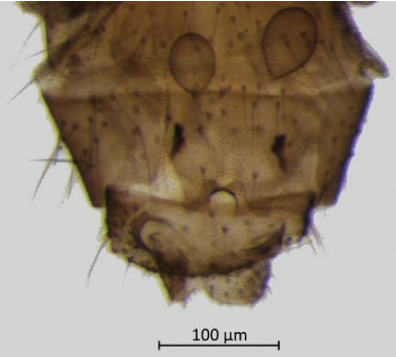
Habitat: *Culicoides (W.) stilobezzioides* was collected from crows in a woodland habitat (Bartlett and Anderson 1979).

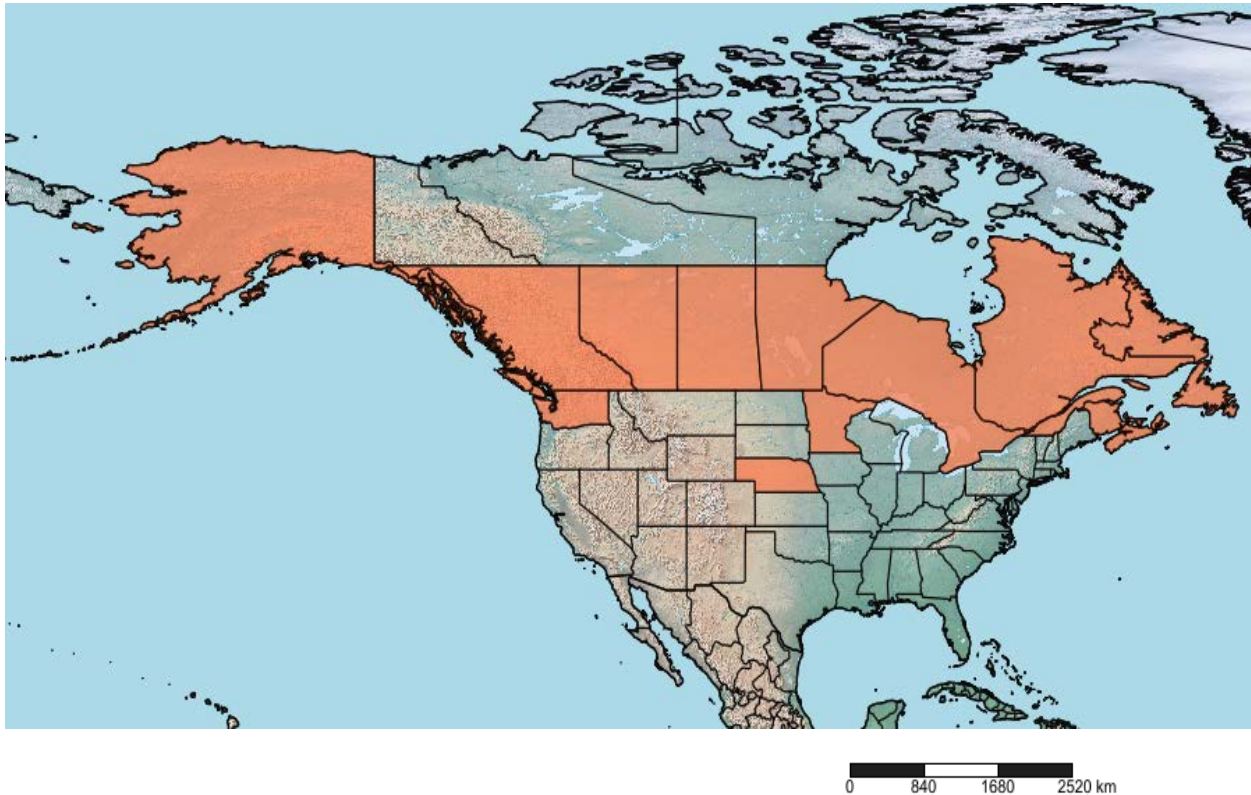
Distribution: Found from Alaska south to Washington, east to Newfoundland (Jamnback 1965; Wirth et al. 1985), in addition to Nebraska and Minnesota (Borkent and Grogan 2009).

Remarks: This species is ornithophilic and acts as a potential intermediate host for *Chandlerella chitwoodae* Anderson, *Parahaemoproteus velans* Coatney and Roudabush and *Haemoproteus* spp. (Fallis and Bennett 1961; Khan and Fallis 1971; Bartlett and Anderson 1979). This species is similar to *C. (Beltranmyia) sphagnumensis* in that it is found high in forests, and it is most active at dusk (Jamnback 1965). It has been recorded feeding on humans one single time (Jamnback 1965).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides stilobezzioides* could occur in North America in orange, based on distribution data from the literature (Jamnback 1965; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides testudinalis Wirth and Hubert, 1962

Differential diagnosis. *Culicoides testudinalis* belongs to the [piliferus species](#) group and closely resembles several species depending on the degree of wing markings, which varies. Specimens with poorly marked wings may resemble [C. \(Silvaticulicoides\) biguttatus](#) and/or [C. jamnbacki](#), but differ by the sparser macrotrichia on the wing, the dark halteres, moderately separated eyes, and the unequal, non-necked spermathecae (Wirth and Hubert 1962). Specimens with more well-defined wing markings resemble [C. alexanderi](#) and [C. parapiliferus](#) and were previously separated by eye separation which is supposedly narrower in *C. alexanderi* (Wirth and Hubert 1962; Jamnback 1965), however this is not evident from our figures, and we suggest close comparison of wing and 3rd palpal segment figures to delineate these species.

Diagnosis: Thorax brownish-black to dark brown. Eyes broadly separated (Wirth and Hubert 1962). 3rd palpal segment nearly triangular and slightly swollen, with a large shallow sensory pit (Wirth and Hubert 1962). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Pair of spermathecae unequal, rounded, without necks (Wirth and Hubert 1962). Haltere pale brown.

Wing diagnosis: Average wing length 1.04 mm (Wirth and Hubert 1962). Wing with coarse, numerous macrotrichia on entire wing surface (Wirth and Hubert 1962), brown or grey with poorly contrasting, diffuse pale spots as follows: M_1 and M_2 with elongate spots sitting on veins on same plane as post-stigmatic pale spot; post-stigmatic pale spot large, coalesced with elongate spot on M_1 , does not encroach into r_{2+3} (Wirth and Hubert 1962); $r-m$ pale spot may or may not extend to anterior wing margin, r_5 and m_1 with small subapical spots; r_2 with apical pale spot and elongate basal pale spot. cu almost entirely pale, darker proximally; a mostly pale, darker on midpoint of CuP . Wing slightly dark brown at apex of C , without well-defined stigma.

Habitat: *Culicoides testudinalis* had been reared from a fern bog (Wirth and Hubert 1962), a *Sphagnum* bog, and a pond margin (Jamnback 1965).

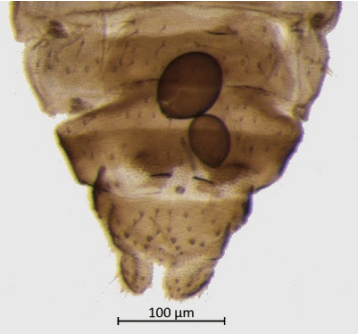
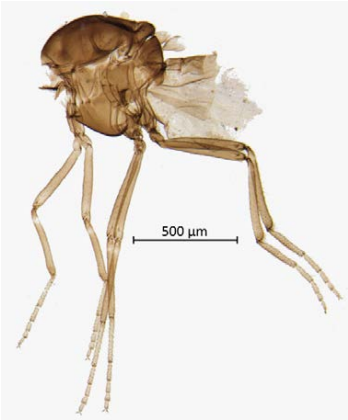
Distribution: Found from Wisconsin to Nova Scotia in the north to Louisiana to Florida in the south (Wirth and Hubert 1962; Wirth et al. 1985).

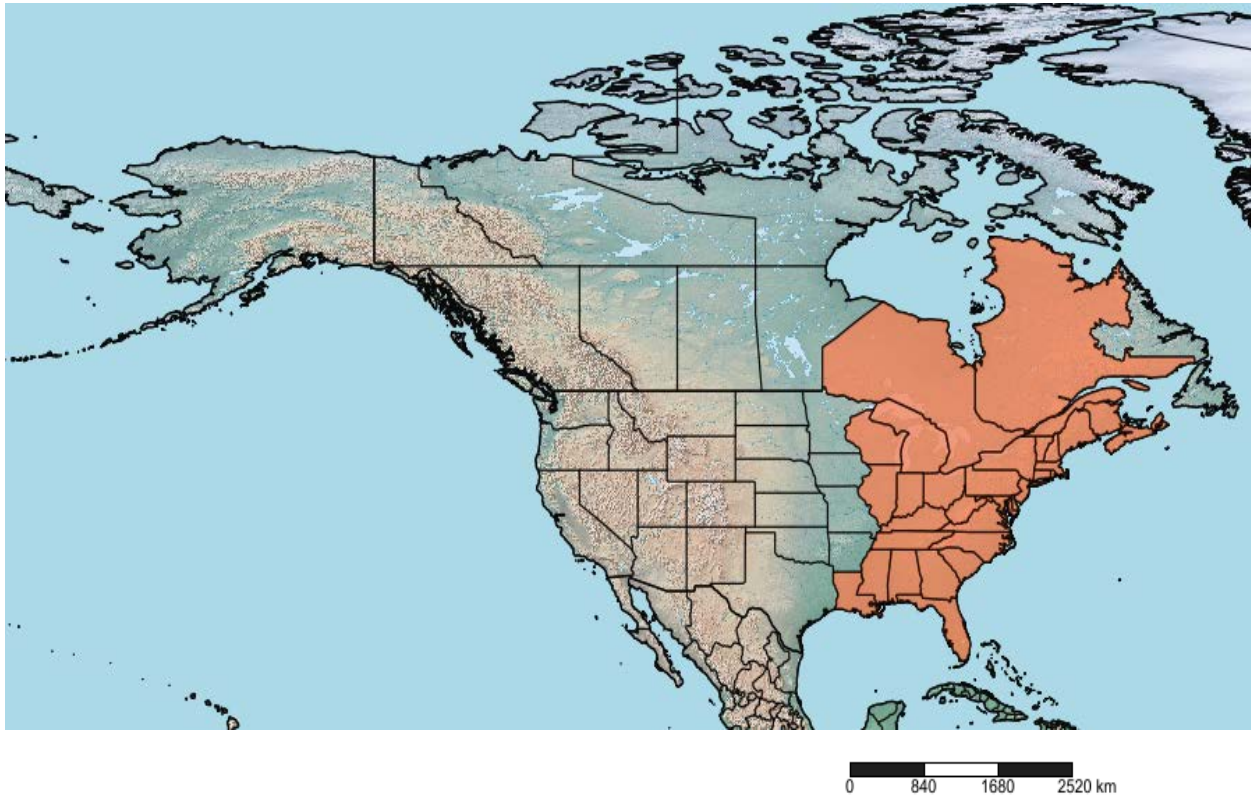
Remarks: This species has only been recorded feeding on turtles (Jamnback 1965; Wirth and Hubert 1962; Blanton and Wirth 1979) and is the only species of *Culicoides* in Ontario to feed on animals other than birds or mammals.

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides testudinalis* could occur in North America in orange, based on distribution data from the literature (Wirth and Hubert 1962; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides travisi Vargas, 1949

Culicoides horneae Foote & Pratt, 1954; *Culicoides simulans* Root & Hoffman, 1937.

Differential diagnosis: *Culicoides travisi* resembles other Ontarian *Culicoides* that have a relatively plain, hairy wing with only diffuse post-stigmatic and *r-m* pale spots readily visible ([C. \(*Silvaticulicoides*\) *biguttatus*](#) and/or [C. \(*S.*\) *spinusus*](#)), though additional faint pale spots are often present along the wing margin in *r₅*, *m₁*, *m₂*, and *cu*. It can also be differentiated by its large, swollen 3rd palpal segment with a wide sensory pit and non-necked spermathecae (Blanton and Wirth 1979). *Culicoides travisi* is very similar to the Palearctic and western American species *C. (Oecacta) kibunensis* Tokunaga, which has not been recorded in Ontario. Differentiating features between female specimens of *C. travisi* and *C. (O.) kibunensis* are not well established, though more definitive characteristics have been described between male specimens (Wirth and Blanton 1969b). *Culicoides travisi* also resembles the treehole-breeding species [C. *nanus*](#) and [C. \(*Diphaomyia*\) *footei*](#) in having pale spots on the anterior wing margin, but is larger, has a triangular 3rd palpal segment, and only the post-stigmatic and *r-m* pale spots are well-defined (Foote and Pratt 1954).

Diagnosis: Thorax brown. Eyes narrowly separated. 3rd palpal segment large and triangular, with a large, shallow sensory pit (Blanton and Wirth 1979). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate. Pair of spermathecae subequal, rounded, without necks (Blanton and Wirth 1979). Haltere pale with a dark base.

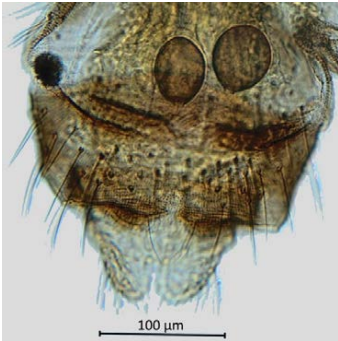
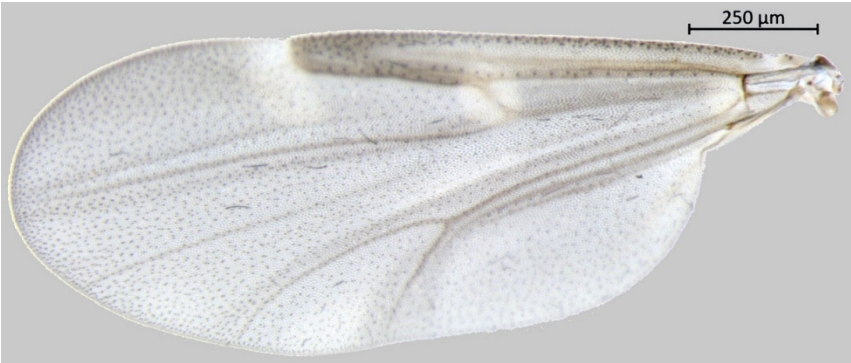
Wing diagnosis: Wing length 1.40 mm (Blanton and Wirth 1979). Wing with sparse macrotrichia, mostly plain grey or brown, with poorly contrasting, diffuse pale spots as follows: post-stigmatic pale spot small, not encroaching into *r₂₊₃*; *r-m* pale spot small, round, can reach anterior wing margin; *r₅*, *m₁*, *m₂*, *cu*, and *a* with very indistinct pale marginal spots only seen at some angles (Foote and Pratt 1954). *r₂₊₃* dark brown. Wing dark brown at apex of *C*.

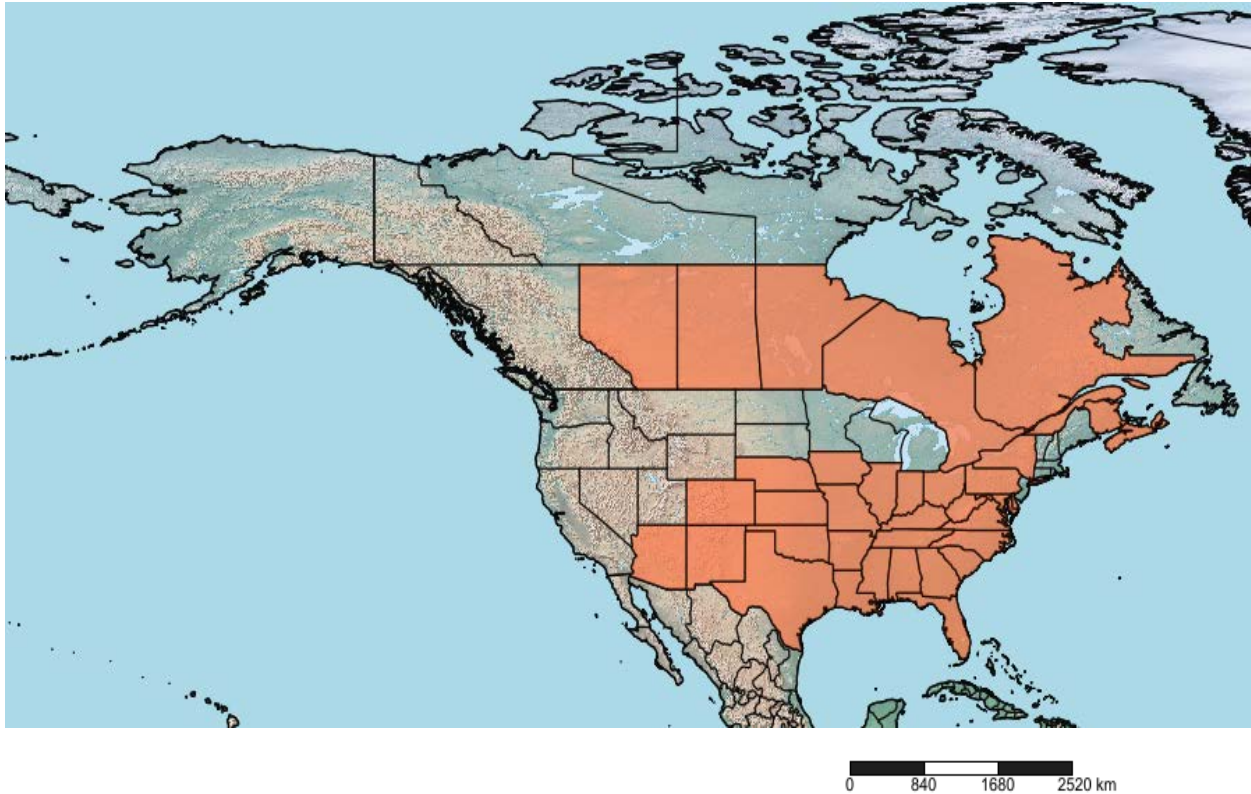
Habitat: Blanton and Wirth (1979) provide a summary of some larval habitats of *C. travisi* including a number of freshwater habitats such as spring-fed bottomlands, reservoirs, leafy pools, sand or mud bars, wet grass, marshes, detritus near streams, and ephemeral pools (Williams 1955; Snow et al. 1957; Jones 1961; Hair et al. 1966; Jamnback 1965; Childers and Wingo 1968; Kardatzke and Rowley 1971).

Distribution: In Canada from Alberta to Nova Scotia (Borkent and Grogan 2009); in the U.S.A. in the west from Colorado to Arizona and in the east from Ohio and New York south to Florida (Foote and Pratt 1954; Wirth et al. 1985).

Remarks: Blanton and Wirth provide a summary of feeding habits of *C. travisi*: suggested to be primarily ornithophilic (Jamnback 1965) but has also been recorded to feed on humans (Snow and Pickard 1954; Snow 1955), horses, and small mammals (Pickard and Snow 1955; Hair and Turner 1968).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides travisi* could occur in North America in orange, based on distribution data from the literature (Foote and Pratt 1954; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides utowana Jamnback, 1965

Differential diagnosis: *Culicoides utowana* belongs to the [piliferus species group](#) and is very similar to *C. franclemonti* in having a plain wing and non-necked spermathecae but differs by the unequal spermathecae and a slightly more swollen 3rd palpal segment (Cochrane 1974).

Diagnosis: Eyes moderately separated (not visible in Fig.) (Jamnback 1965). 3rd palpal segment short, triangular, moderately swollen with a deep sensory pit that has a large opening (Jamnback 1965). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate, especially the 13th segment. Two unequal, rounded spermathecae without necks (Jamnback 1965). Haltere light brown.

Wing diagnosis: Average wing length 1.10 mm (Jamnback 1965). Wing with abundant macrotrichia arranged in longitudinal rows, especially in r_5 , m_1 and m_2 (Jamnback 1965), mostly uniform light brown; r - m pale spot and post-stigmatic pale spot small if visible; m_1 , m_2 , r_5 , and cu cells can have very faint pale spots (Jamnback 1965). Wing very slightly dark brown at apex of C , without well-defined stigma.

Habitat: This species has been reared from larvae collected from a wet leaf depression (Jamnback 1965).

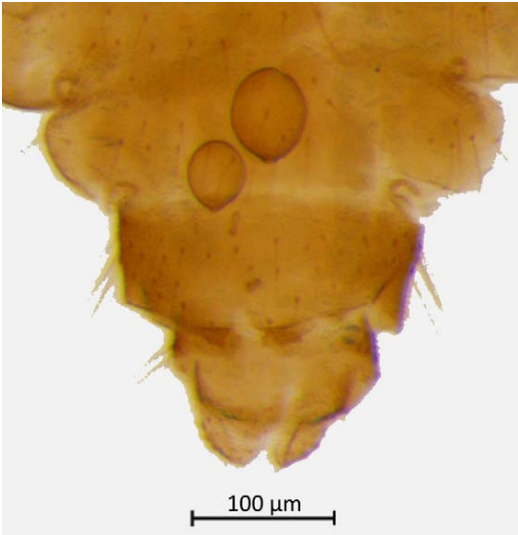
Distribution: Found in New York State and Ontario (Jamnback 1965; Wirth et al. 1985; Borkent and Grogan 2009).

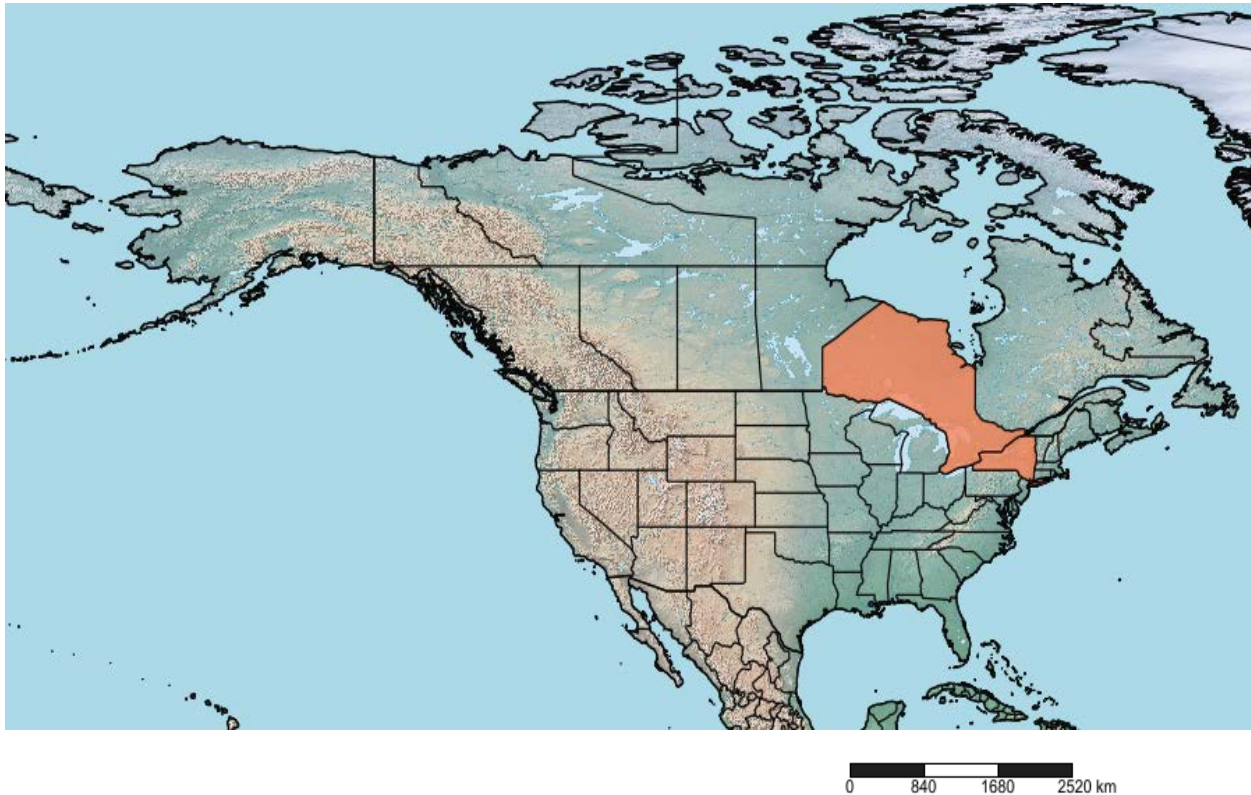
Remarks: Not much is known about this species, but its reduced dentition indicates it may be non-hematophagous (Jamnback 1965).

[Images](#)

[Distribution Map](#)

[Back to piliferus species group page](#)





Indication of which provinces/states where *Culicoides utowana* could occur in North America in orange, based on distribution data from the literature (Jamnback 1965; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Monoculicoides) variipennis (Coquillett, 1901)

Ceratopogon variipennis Coquillett, 1901.

Differential diagnosis: The subgenus *Monoculicoides* can be distinguished from all other Ontarian *Culicoides* by the single, C-shaped spermatheca. *Culicoides (M.) variipennis* very closely resembles *C. (M.) albertensis* in having a dark wing with numerous, highly contrasting pale spots and a distinctive C-shaped spermatheca, but differs in its slender 3rd palpal segment with a small round pit. Other differentiating features can be seen in male specimens (Holbrook et al. 2000).

Diagnosis: Thorax dark brown. Eyes widely separated. 3rd palpal segment slender, elongate, at most slightly swollen with a small round sensory pit (Holbrook et al. 2000). Proximal 8 flagellomeres barrel shaped and covered with sensoria, distal 5 flagellomeres elongate, though close to barrel-shaped. Single spermatheca C-shaped (Holbrook et al. 2000). Haltere dark brown or grey.

Wing diagnosis: Average wing length 1.7 mm, but highly variable (Wirth and Jones 1957). Wing with dark macrotrichia (Wirth and Jones 1957), dark grey with highly contrasting, clearly delineated pale spots as follows: M_1 and M_2 with pale lines adjacent to veins; post-stigmatic pale spot irregularly shaped, does not encroach into r_{2+3} ; $r-m$ pale spot large, extends to anterior wing margin and coalesces with spot in m_2 ; r_5 with small subapical spot and larger distal spot; m_1 with pair of small subapical spots and basal elongate pale spot; m_2 with subapical spot and diffuse pale markings on basal 3/4; cu mostly pale, with a dark funnel shape on CuA_2 vein; a with distal and basal spots. Wing dark brown at apex of C , with well-defined stigma.

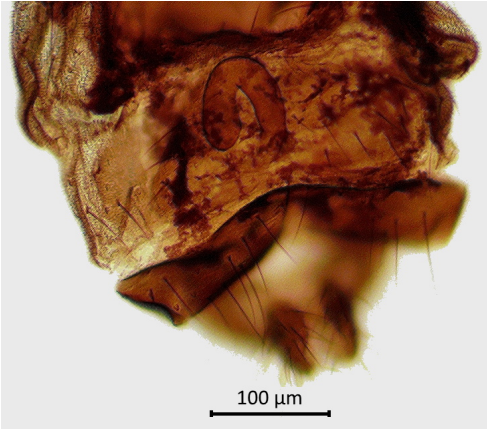
Habitat: *Culicoides (M.) variipennis* specimens have been reared from mud and cow manure, as well as from clay-loam margins from a creek (Wirth and Jones 1957).

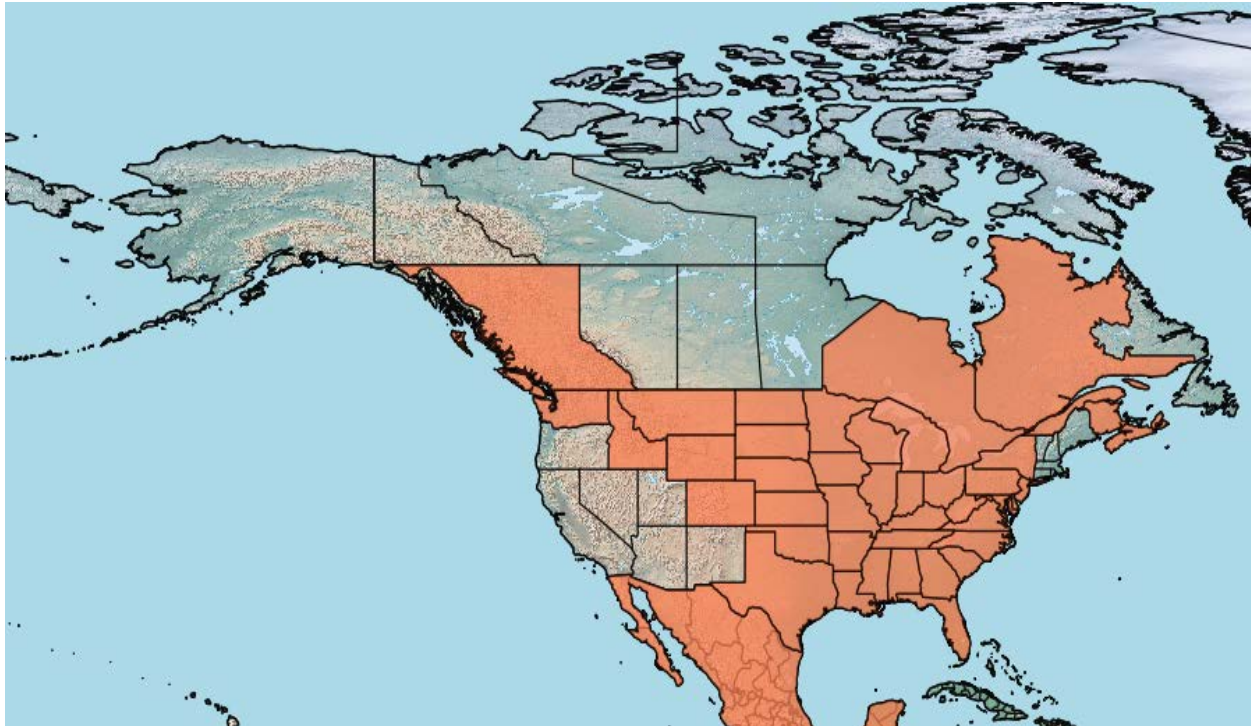
Distribution: Collected from British Columbia, Ontario, Quebec and Nova Scotia in Canada, and found from Washington, Montana, and Texas, east to New York and south to Louisiana to Florida in the U.S.A.; found in the entirety of Mexico (Borkent and Grogan 2009; Jewiss-Gaines et al. 2017; Holbrook et al. 2000).

Remarks: Species in the *C. variipennis* species complex were originally described as subspecies of *C. (M.) variipennis* (Wirth and Jones 1957). In 2000, Holbrook et al. reassessed the five subspecies in the North American *C. variipennis* species complex and elevated *C. sonorensis* to species status while making *C. (M.) albertensis*, and *C. (M.) australis* synonyms of *C. (M.) sonorensis* (Holbrook et al. 2000). More recently, Shults et al. (2022a, 2022b) used SNP data to reassess the group and elevated *C. albertensis* to species status, meaning the *C. variipennis* species complex presently contains four species (*C. (M.) variipennis*, *C. (M.) sonorensis*, *C. (M.) albertensis* and *C. (M.) occidentalis*). Definitive identification of species in the *C. (M.) variipennis* is crucial to vector surveillance programs, as the morphologically similar *C. (M.) sonorensis* is the primary North American vector of bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV) which infect domestic and wild ruminants worldwide (Tabachnik 1996; Ruder et al. 2015). There is one record of *C. (M.) variipennis* biting a human, but it is more likely to feed on larger mammals (Whitehead 1934; Wirth and Jones 1957).

[Images](#)

[Distribution Maps](#)





Indication of which provinces/states where *Culicoides variipennis* could occur in North America in orange, based on distribution data from the literature (Wirth and Jones 1957; Wirth et al. 1985; Borkent and Grogan 2009; Jewiss-Gaines et al. 2017).

Culicoides (Hoffmania) venustus Hoffman, 1925

Differential diagnosis: *Culicoides (H.) venustus* resembles the non-Ontarian species *C. (H.) insignis* Lutz (Southern U.S.A., South America (Borkent and Grogan 2009)), which is a confirmed vector of bluetongue virus, in having a post-stigmatic pale spot extending into r_{2+3} and a pale V-shaped spot in the basal corner of *cu*, but differs by the completely pale *r-m* crossvein and the two distal pale spots in m_1 (Blanton and Wirth 1979).

Diagnosis: Thorax coppery-brown. Eyes narrowly separated (Hoffman 1925). 3rd palpal segment moderately swollen, triangular with a small sensory pit (Root and Hoffman 1937). Proximal 8 flagellomeres barrel-shaped, and distal 5 flagellomeres very elongate. Two rounded equal or subequal spermathecae with short necks (Root and Hoffman 1937). Halteres yellow basally, base and tip brown (Hoffman 1925).

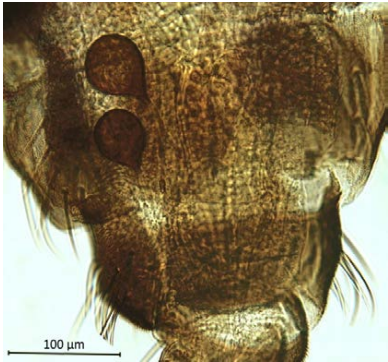
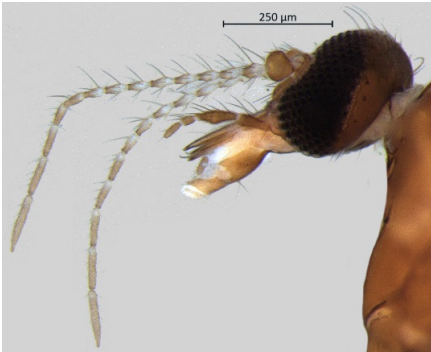
Wing diagnosis: Average wing length 1.5 mm (Hoffman 1925). Wing macrotrichose on apical third (Hoffman 1925), dark grey or brown with highly contrasting, clearly defined pale spots as follows: M_1 and M_2 pale on apical margin of wing; M_2 with pair of small spots straddling vein on roughly same plane as post-stigmatic spot; post-stigmatic pale spot large, encroaching into r_{2+3} ; *r-m* pale spot large, sitting on *r-m* and extending to anterior wing margin; r_5 with elongate distal V-shaped spot; m_1 with small apical and subapical spot, m_2 with small apical spot, spot at joint between CuA_1 and CuP and basally; *cu* pale on median posterior margin and on basal corner; *a* with distal small pale spot, median large spot and basal elongate spot. Wing dark brown at apex of *C*, with well-defined stigma.

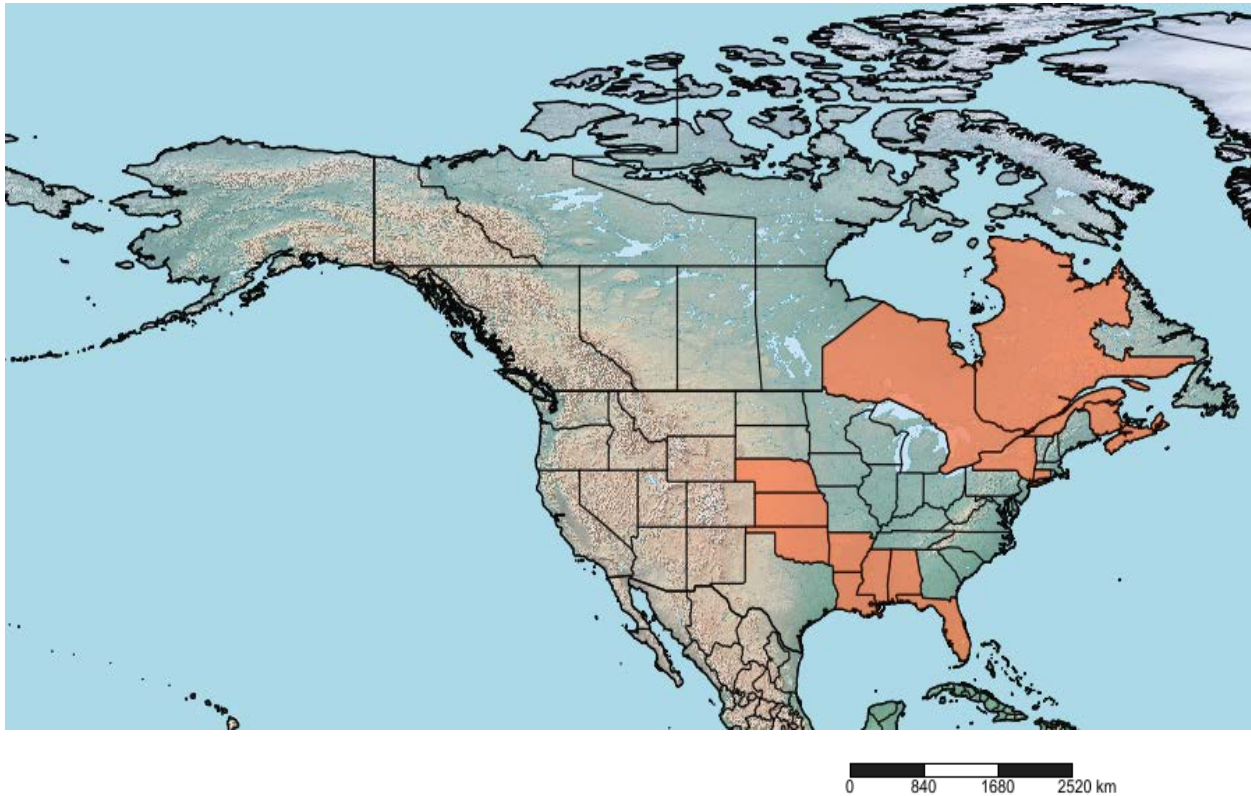
Habitat: Blanton and Wirth (1979) provide a summary of larval habitats for *C. (H.) venustus*, noting it is often found in wet pastures and stream margins (Snow et al. 1957; Jones 1961; Jamnback 1965; Hair et al. 1966; Rowley 1971).

Distribution: In Canada found from Ontario to Nova Scotia (Borkent and Grogan 2009). In the United States, found in New York, Connecticut (Root and Hoffman 1937) and Nebraska south to Louisiana and Florida (Wirth et al. 1985).

Remarks: Jamnback (1965) suggested a tendency for this species to feed on mammalian blood, which was later confirmed by McGregor et al. (2019), who also implicated *C. (H.) venustus* as a vector of epizoonotic hemorrhagic disease virus (EHDV).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides venustus* could occur in North America in orange, based on distribution data from the literature (Root and Hoffman 1937; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Amossovia) villosipennis Root and Hoffman, 1937

Differential diagnosis: *Culicoides (Am.) villosipennis* resembles other species in the subgenus *Amossovia* with a distinct wing pattern of well-defined, highly contrasting pale spots but is distinguished by its more restricted pale spots, including the *r-m* pale spot, which does not extend into m_1 , and the post-stigmatic pale spot (Wirth and Blanton 1967; Root and Hoffman 1937). *Culicoides (Am.) villosipennis* resembles *C. (Am.) beckae* Wirth and Blanton, a species not found in Ontario but occurring in close range (New York, in part (Borkent and Grogan 2009)), in having similar a similar dark wing with highly contrasting small pale spots, but differs by the pale haltere, the uniformly brown hind femur, and the longer distal flagellomeres ($\geq 2.5X$ length of proximal flagellomeres) (Wirth and Blanton 1967).

Diagnosis: Thorax dark brown. Eyes moderately separated (Wirth and Blanton 1967). 3rd palpal segment triangular and swollen, with a large, shallow sensory pit (Wirth and Blanton 1967). Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres very elongate. Pair of spermathecae subequal and rounded with short, slender necks (Wirth and Blanton 1967). Haltere pale brown or grey (Wirth and Blanton 1967).

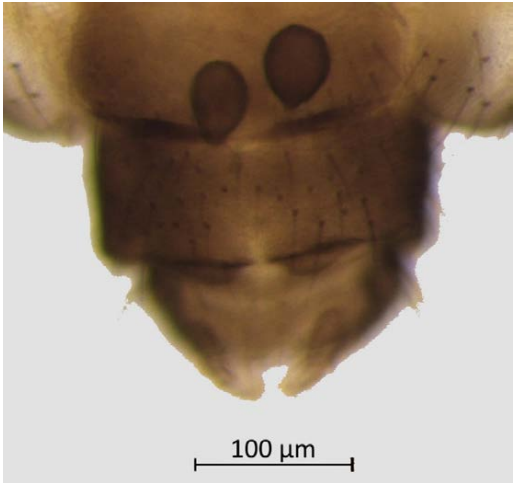
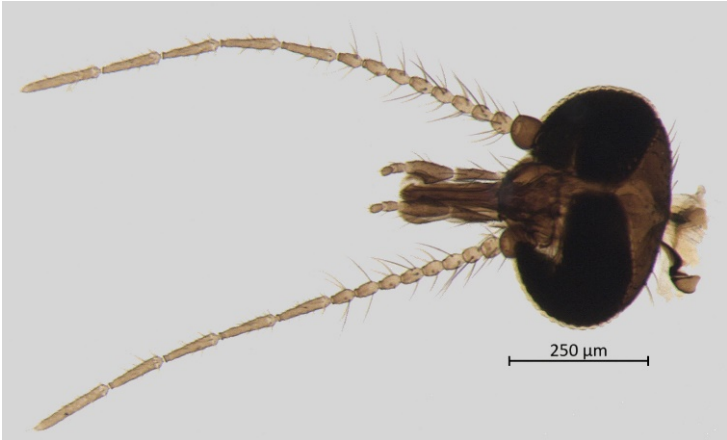
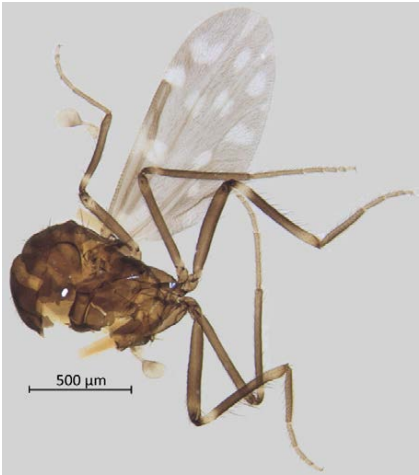
Wing diagnosis: Average wing length 1.62 mm (Wirth and Blanton 1967). Wing with numerous macrotrichia (Wirth and Blanton 1967), dark grey or brown with highly contrasting, well-defined pale spots as follows: M_1 and M_2 pale apically and with small spots straddling veins on same plane as post-stigmatic pale spot; post-stigmatic pale spot small, does not extend into r_{2+3} (Wirth and Blanton 1967); *r-m* pale spot small or large, sits on the *r-m* vein, may or may not extend to anterior wing margin (Wirth and Blanton 1967); r_5 with large, irregular subapical spot, m_1 and m_2 with small subapical spots; *cu* with median pale spot; *a* with two small distal spots. Wing slightly dark brown at apex of *C*, with a well-defined stigma. Base of wing pale.

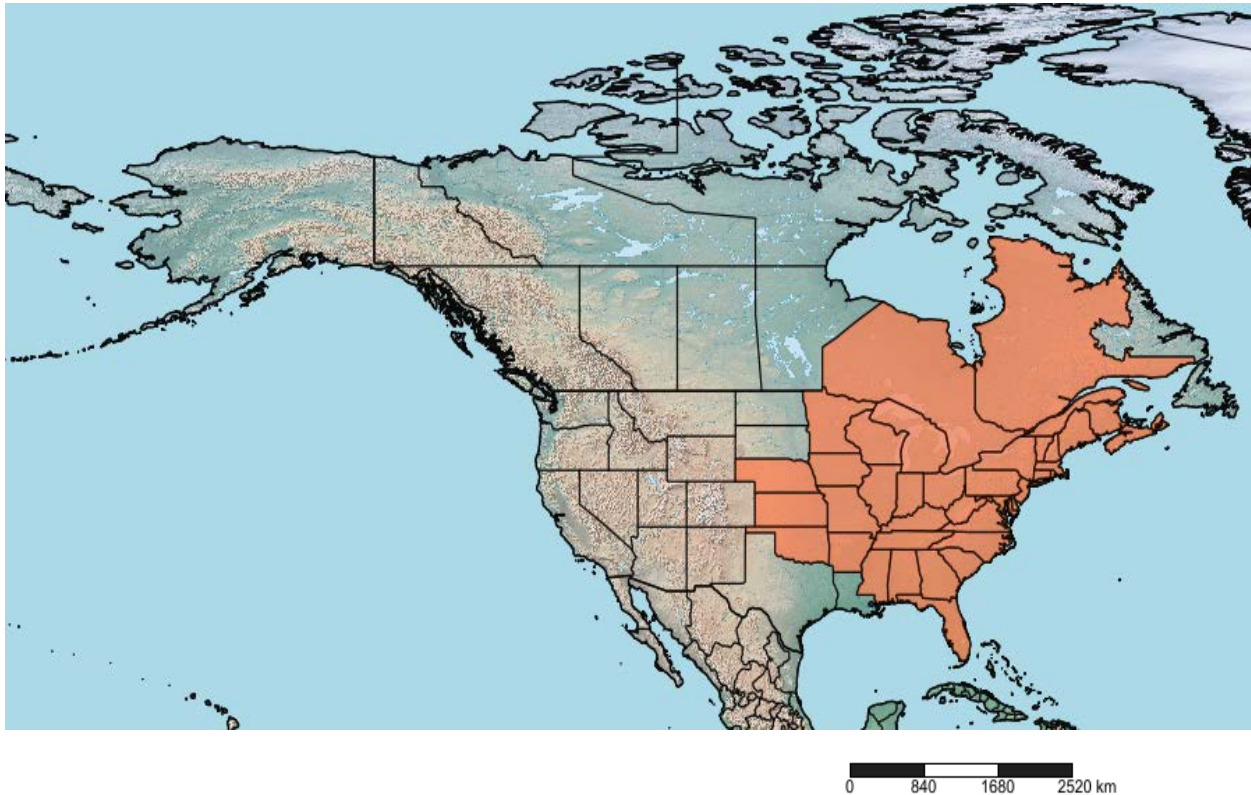
Habitat: *Culicoides (Am.) villosipennis* has been reared from moist or wet tree or stump holes (Wirth and Blanton 1967).

Distribution: Wisconsin to Nova Scotia and Maine in the north, and Nebraska, Oklahoma, and Florida in the south (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (Am.) villosipennis* has been recorded to feed on poultry and turkey (Messersmith 1965; Humphreys and Turner 1973). There is one record of this species biting a human (Hair and Turner 1968).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides villosipennis* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1967; Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Beltranmyia) wisconsinensis Jones, 1956

Differential diagnosis: *Culicoides (B.) wisconsinensis* resembles *C. (B.) bermudensis* Williams, which has not been recorded in Ontario but occurs in close range (New York, in part (Borkent and Grogan 2009)), in having a relatively plain wing, but *C. (B.) wisconsinensis* is much darker in colour and has more macrotrichia on the wing (not visible in Fig.) (Jamnback 1965). The relatively plain wing also resembles that of *C. (B.) hollensis* Melander and Brues which also occurs in close range (New Brunswick, in part (Borkent and Grogan 2009)), but *C. (B.) wisconsinensis* differs by its swollen 3rd palpal segment. Depending on the extent of pale spots, *C. wisconsinensis* may also resemble *C. (Silvaticulicoides) biquttatus*, but differs by the large size, and the single oval spermatheca.

Diagnosis: Thorax brown to dark brown. Eyes separated (Jamnback 1965). 3rd palpal segment triangular, swollen, with a large, shallow sensory pit (Jamnback 1965). Proximal 8 flagellomeres rounded, distal 5 flagellomeres elongate, slightly globular. Single spermatheca large, oval, with a long neck (Jamnback 1965). Haltere pale brown.

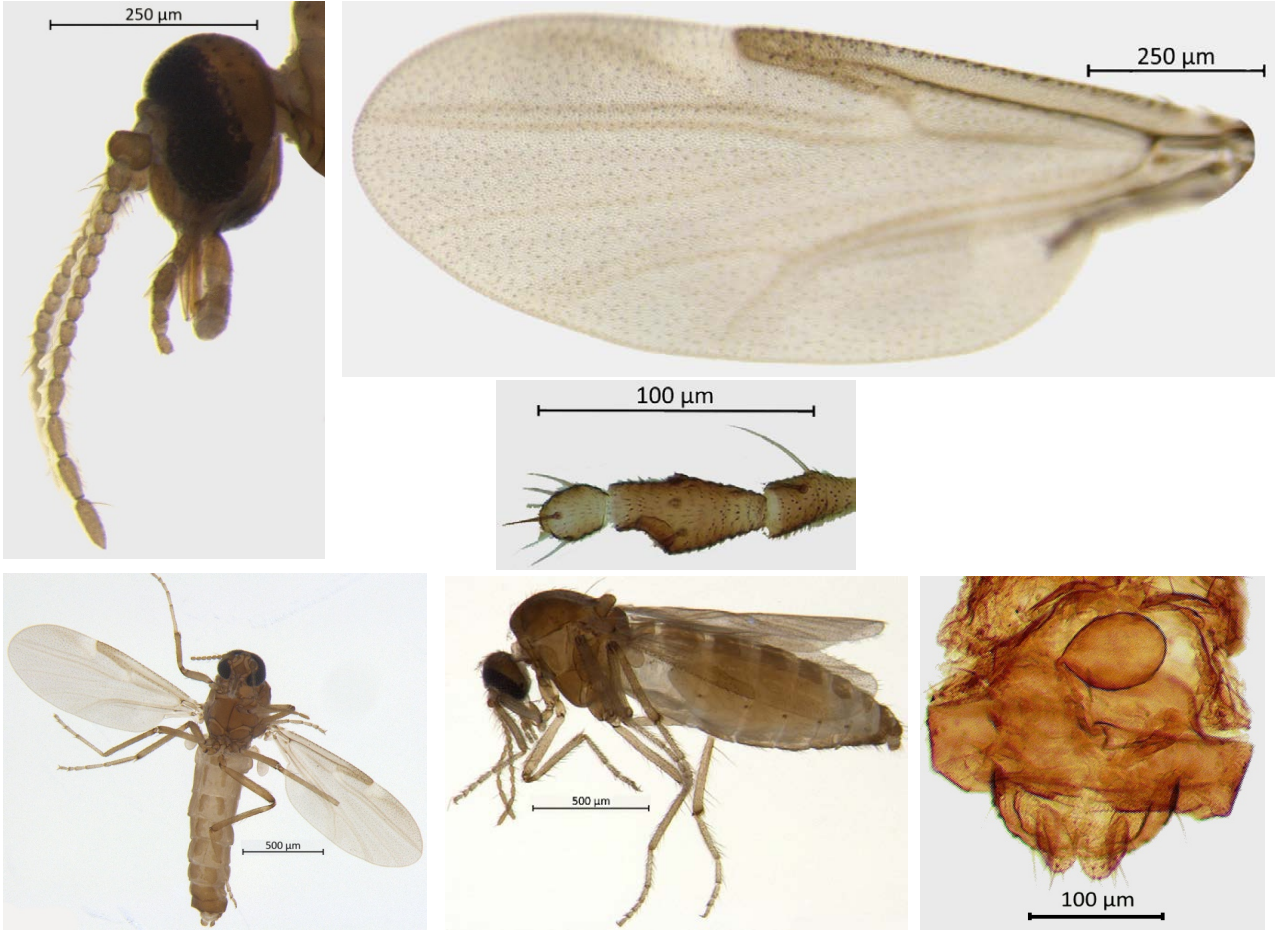
Wing diagnosis: Average wing length 1.2 mm (Jamnback 1965). Wing with coarse, abundant macrotrichia (not visible in Fig.) (Jamnback 1965), mostly uniform grey or brown with very indistinct, pale diffuse spots as follows: post-stigmatic pale spot small, does not extend into r_{2+3} , $r-m$ pale spot, small, sits on $r-m$ crossvein; all of the elongate faint pale spots over these veins can sometimes be seen under low lighting. Wing slightly dark brown at apex of C , without well-defined stigma.

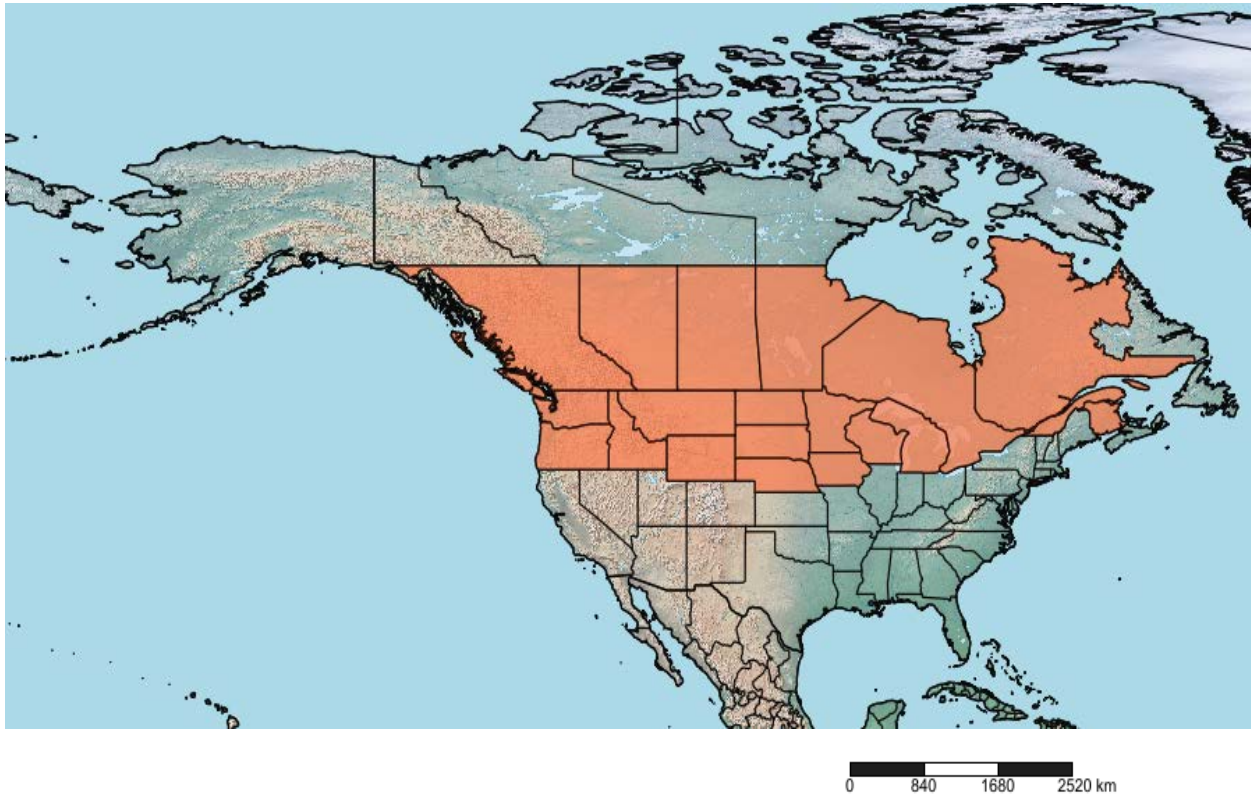
Habitat: This species has been reared from larvae collected in peat muck, brackish water marshes, and margins of freshwater lagoons—most often from a thin layer of soft mud (Jamnback 1965).

Distribution: In Canada, this species is found from British Columbia east to New Brunswick (Borkent and Grogan 2009); in the U.S.A., it is found from Washington and Oregon south to Nebraska and Iowa, and east to Michigan (Wirth et al. 1985; Borkent and Grogan 2009).

Remarks: *Culicoides (B.) wisconsinensis* has not been found to feed on blood (Jamnback 1965). *Culicoides (B.) wisconsinensis* resembles both *C. (B.) hollensis* and *C. (B.) bermudensis*, which are species not recorded from Ontario but occurring in close range (New York); both species breed exclusively in saline habitats and are mostly restricted or most common on eastern coasts or southern states (Jamnback 1965).

[Images](#)
[Distribution Map](#)





Indication of which provinces/states where *Culicoides wisconsinensis* could occur in North America in orange, based on distribution data from the literature (Wirth et al. 1985; Borkent and Grogan 2009).

Culicoides (Culicoides) yukonensis Hoffman, 1925

Differential diagnosis: *Culicoides (C.) yukonensis* closely resembles the Palearctic species *C. (C.) pulicaris* Linnaeus in having a similar wing pattern including the pale apices of M_1 and M_2 but differs mainly by its Nearctic distribution (Wirth and Blanton 1969a). This species closely resembles [C. \(C.\) paraimpunctatus](#) in having mostly pale wings with small dark spots, but is generally larger, has very elongate distal flagellomeres, a more swollen 3rd palpal segment, as well as more well-defined and distinct wing markings (Wirth and Blanton 1969a).

Diagnosis: Thorax brown. Eyes usually meeting at a very short point (Wirth and Blanton 1969a). 3rd palpal segment slender, nearly triangular, with scattered sensoria (Wirth and Blanton 1969a). Proximal 8 flagellomeres barrel-shaped, distal 5 flagellomeres very elongate. Pair of spermathecae slightly unequal, rounded (Wirth and Blanton 1969a). Haltere pale brown or grey.

Wing diagnosis: Average wing length 1.97 mm (Wirth and Blanton 1969a). Wing with abundant macrotrichia, sparser proximally; dark brown with extensive, highly contrasting, pale markings, giving the impression of a pale wing with dark spots. Wing markings as follows: post-stigmatic pale spot large, encroaching into entire r_{2+3} cell; coalesced with pale spots on m_1 , m_2 and c forming large pale area interrupted by small median dark spots on r_5 , m_1 , m_2 and c ; $r-m$ pale spot very large, sits on $r-m$, reaches anterior margin of wing and coalesces with spots on m_2 and a , forming large pale area interrupted by small dark spots on mid- c and mid- CuP . Apices of M_1 , M_2 , and CuA with light spot surrounded by dark area. Wing dark brown at apex of C , with well-defined stigma.

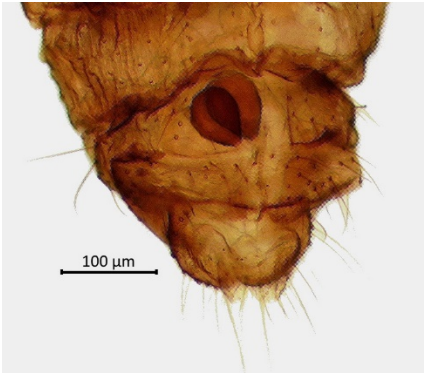
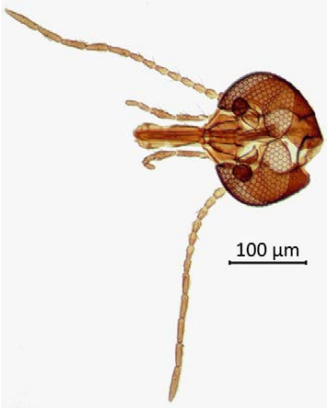
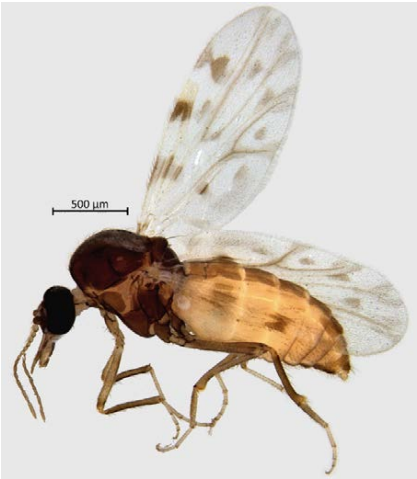
Habitat: *Culicoides (C.) yukonensis* has been reared from the boggy margin of streams, marshes and from *Sphagnum* bogs (Frohne 1953; Sailer et al. 1956).

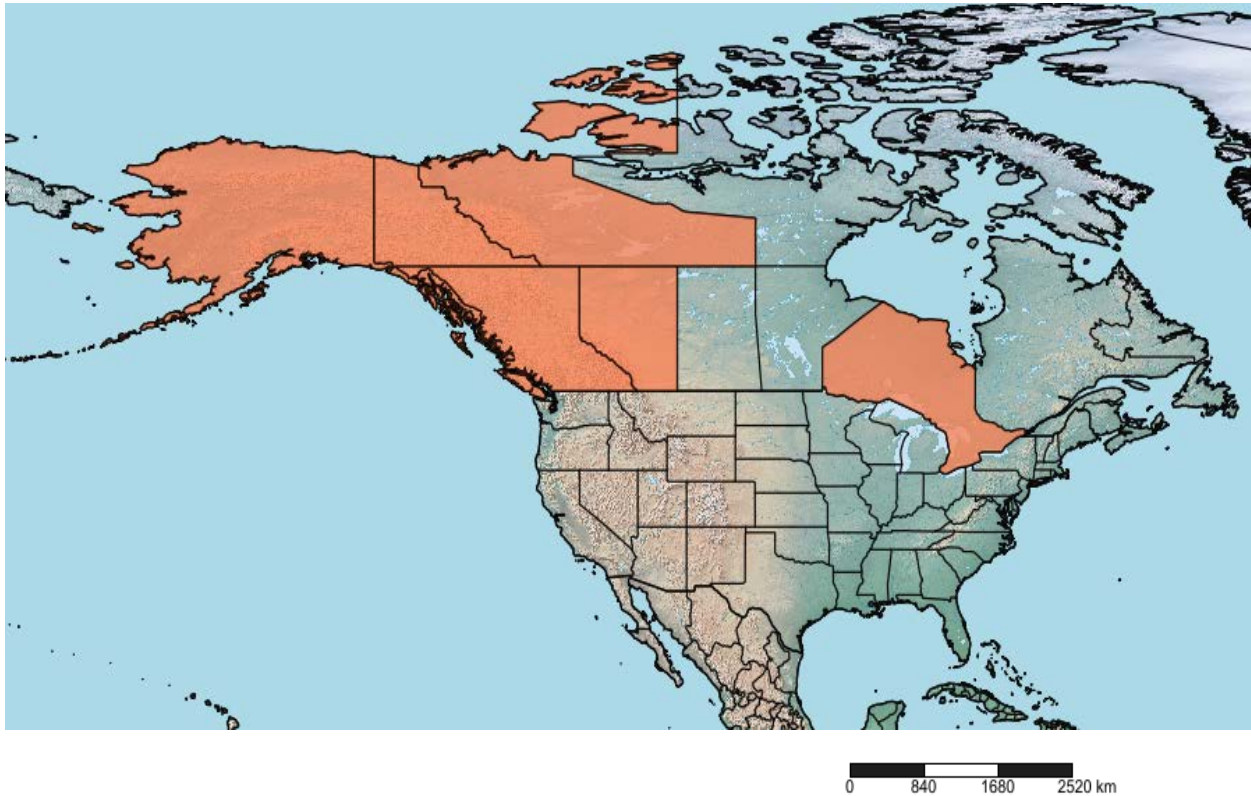
Distribution: Found in Alaska, Alberta, British Columbia, Northwest Territories, and Yukon (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009). However, this species has been found in collections in Ontario as well (pers. Comm. Borkent 2019).

Remarks: *Culicoides (C.) yukonensis* has been reported to feed on humans (Wirth and Blanton 1969a).

[Images](#)

[Distribution Map](#)





Indication of which provinces/states where *Culicoides yukonensis* could occur in North America in orange, based on distribution data from the literature (Wirth and Blanton 1969a; Wirth et al. 1985; Borkent and Grogan 2009; pers. Comm. Borkent 2019).

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