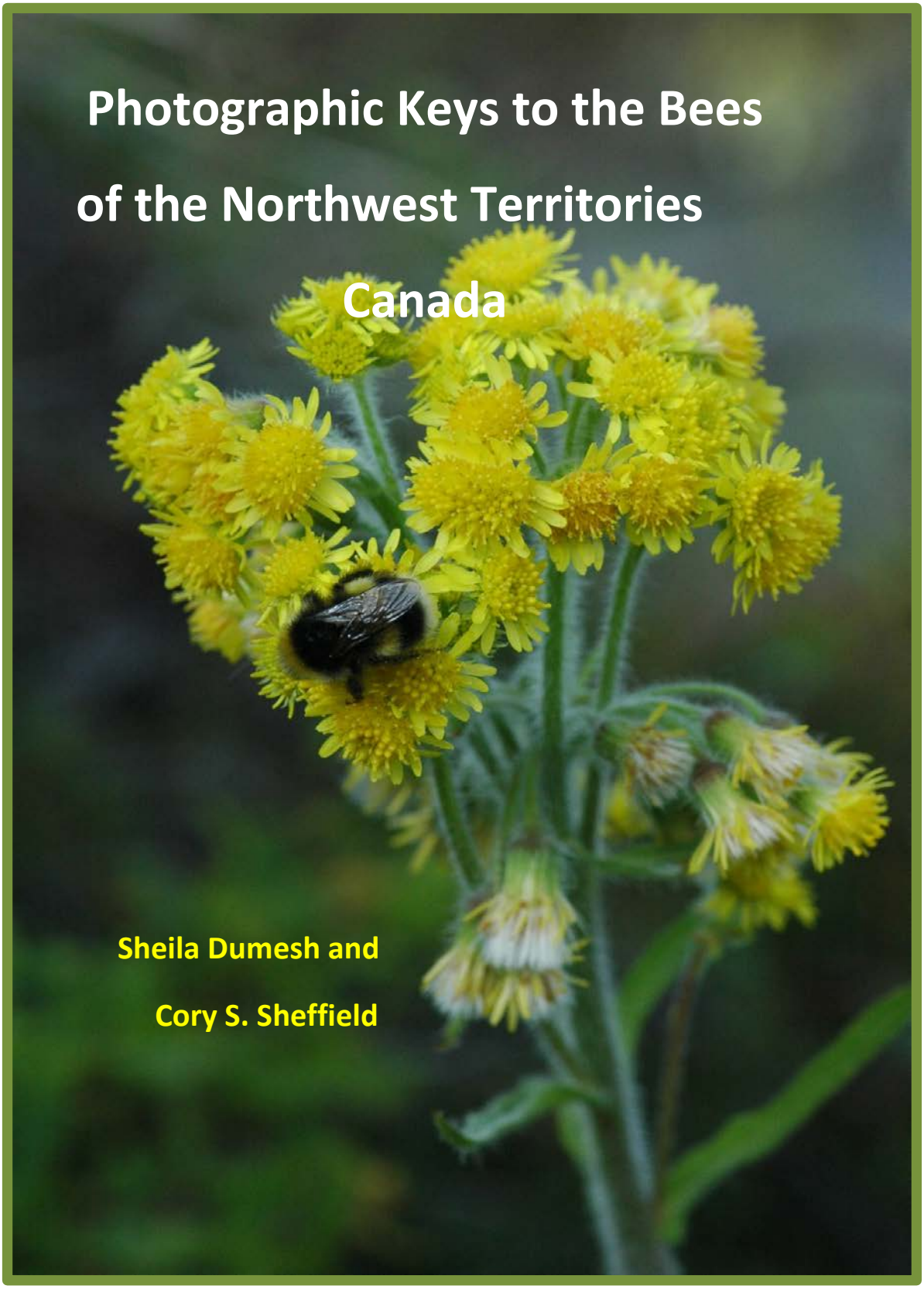
Photographic Keys to the Bees of the Northwest Territories Canada



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Cover photo: *Bombus cryptarum in the Mackenzie Mountains ©GNWT/R Decker*

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2014

Contents

Abstract 1

Introduction 1

Methods 2

Results and Discussion 2

Literature Cited 6

Acknowledgments 8

Appendix A 8

Key to bee genera of the Northwest Territories, Canada 8

- Key to bee species of the 33
- Northwest Territories, Canada 33
  - Colletes 33
  - Hylaeus 42
  - Andrena 47
  - Dufourea 80
  - Halictus 80
  - Lasioglossum 84
  - Sphecodes 101
  - Hoplitis 106
  - Osmia 112
  - Anthidium 137
  - Stelis 141
  - Coelioxys 146
  - Megachile 154
  - Epeolus 173
  - Nomada 173
  - Anthophora 180

Bombus 184

Abstract

We present a photographic identification guide and atlas to all species of bees of the Northwest Territories, Canada. So far, 109 bee species, within 18 genera, have been recorded in the Northwest Territories, Canada. It is suggested that further surveys in this vast landscape will be necessary to better understand the diversity of bee species in this region of northern Canada.

Introduction

Pollinators play an extremely important role in maintaining terrestrial ecosystems. Approximately 35% of crops are pollinator-dependent (Klein *et al.,* 2007) and most of these pollinators are bees (Kremen *et al.*, 2002; Gallai *et al.*, 2008). The classic example is the honey bee (*Apis mellifera* L.), managed worldwide for its pollination services and production of honey and wax (National Academy of Sciences, 2007). However, this species is at risk due to continued threat from diseases and other mortality factors, such as CCD (vanEnglesdorp et al., 2009). Although honey bees are used for many pollination services, wild bee species are sometimes more effective in the pollination of certain crops (Buchmann and Nabhan, 1996; National Academy of Sciences, 2007). Wild bee populations play essential ecological as well as economic roles (Biesmiejer *et al.*, 2006; National Academy of Sciences, 2007), thus expanding our knowledge of these insects is of great importance.

Bees are considered keystone taxa in most terrestrial ecosystems (Sheffield *et al.*, 2003) and are also excellent indicators of the state of the environmental because they have a higher extinction risk than do other organisms (Packer, 2010). Both the diversity and abundance of native bees are declining due to the intensification of agriculture and other anthropogenic impacts (Biesmiejer *et al.*, 2006; Kremen *et al.*, 2002; Steffan-Dewenter *et al.*, 2005).

The study of taxonomy, although exceedingly important, is suffering from a barrier where the number of experts is not nearly enough to identify the vast number of species. As interest in bee diversity is peaking, the ability to recognize them to species level is becoming increasingly important. There are currently over 19,700 bee species worldwide (Ascher and Pickering, 2012), however identification skills for bees are not common, especially for genera with a multitude of species. Without the ability to place names on specimens, survey work will not yield much useful information and biodiversity and pollination studies prove difficult.

Recent scientific advancements include DNA barcoding, a method increasingly used over the last several years to aid in identification of organisms. The Consortium for the Barcode of Life (CBOL) was initially launched in 2004 in Guelph, Ontario and has since been gaining recognition internationally. This method specifically uses mitochondrial DNA to obtain short and standardized genetic sequences where diversity could be used to differentiate among animal species (Ratnasingham and Heber, 2007). With the help of this technique, many problematic bee taxa could be resolved.

It is particularly crucial to increase our understanding of the bees of Canada's north, as this region is experiencing the most dramatic effects of climate change; the flora and pollinators are expected to be

impacted through processes such as phenological mismatching due to changed conditions (Lovejoy and Hannah, 2005). Furthermore, being particularly temperature dependent (even for insects), bee populations and distributions are expected to respond rapidly to a warming climate.

Methods

We created photographs using museum specimens and provided photographic dichotomous keys to genus and species. All characters used in the key are illustrated. Images were taken using a Visionary Digital BK Plus imaging system with a Canon EOS 40D digital SLR camera and processed with Adobe Photoshop. The identification keys were generated by referring to previously written keys and modifying them specifically for the bee species of the NWT. Many keys were updated and, for this, we examined an array of specimens to incorporate them into the keys. The keys referenced include Mitchell (1960), Packer et al. (2007), Sheffield et al. (2011), Rightmyer et al. (2010), Gibbs (2010), Stephen (1954), Williams (personal communication).

The resources we provide allow for species level identification with the aid of images for a user-friendly interface. This makes it possible for the key to be usable by anyone with a microscope and a computer. These data will help to monitor bees and contribute to current knowledge on the status of these species.

Location data (Appendix C) were mapped using GIS ArcMap 10.1 and were supplied by Laurence Packer, Molly Rightmyer, Terry Griswold, Nick de Silva, Jason Gibbs, Paul Williams, Anne Gunn, Syd Cannings, and Discoverlife.org. Additional bumble bee location data were obtained from Leif Richardson (Williams et al. 2014). We also retrieved many records from these museum collections: Packer Collection at York University (Toronto, ON), Canadian National Collection (Ottawa, ON), Lyman Entomological and Research Laboratory at McGill University (Montreal, QC).

Results

One photographic key to the genera of bees for the NWT is presented in Appendix A. The genera key is modified from Packer et al. (2007). The only bee species alien to NWT's ecosystems but part of a growing apiary home industry, *Apis millifera,* is also keyed in Appendix A. The genera key leads to a set of keys to bee species (Appendix B) organized based on classification by Michener (2007) (Table 1).

Table 1. List of bee genera in the NWT and key details

Genera	Key details and notes	Appendix
Colletidae – Plasterer bees and relatives		
Colletes	Five (5) species of plasterer bees are known to occur in the NWT. *Colletes* are solitary bees, individually constructing a nest with provisioned cells for their eggs, but then leave and do not feed their offspring. They are ground nesting bees. They are known as plasterer bees due to their use of a cellophane-like secretion for lining nests. A defining characteristic of this genus is the s-shaped second recurrent	B1

	vein on the forewing.	
Hylaeus	Four (4) species of masked bees are known to occur in the NWT. They have yellow or cream markings on their face and body. *Hylaeus* bees are cavity nesters, usually constructing nests in dead plant twigs or stems, lining the individual provisions with a cellophane-like secretion. Females do not have pollen-collecting hairs like most other bees because they carry pollen internally in their crop.	B1

Andrenidae – Andrenid bees

Andrena	Seventeen (17) species of miner bees are known to occur in the NWT. An additional species *A. nigrihirta*), is not included in the key, was collected only once (Map 19: Yellowknife 1949), and needs verification. They are ground nesting bees and known as mining bees due to their habitat of digging soil and sand for constructing underground nests. A defining characteristic of this genus is the facial foveae, which are longitudinal depressions (varying in length) on the face between the compound eye and the antenna. The facial foveae are usually covered in dense, short, velvety hairs, but are more prominent in females than males.	B2
Panurginus	One species, *P. ineptus,* may occur in the NWT. Specimens need verification.	A

Halictidae – Halictic bees

Dufourea	Only one species of Dufourea sweat bee is known to occur in the NWT. *Dufourea fimbriata* is oligolectic, a floral specialist, on *Potentilla*. It is a solitary bee nesting in burrows below ground. The defining characteristics are the antennae arising low on the face and the forewing with 2 submarginal cells. They are relatively uncommon in Canada. Refer to the key in Dumesh and Sheffield (2012) for *Dufourea* in all of Canada.	B3
Halictus	Three (3) species of sweat bees are known to occur in the NWT. Species from subgenera *Seladonia* (metallic green) and *Protohalictus* (not metallic) and are present in the NWT. These sweat bees are ground nesters and can be eusocial or solitary bees. Sometimes the same species can exhibit different behaviour depending on climate (Soucy and Danforth 2001). A defining characteristic of this genus is the apical hair bands on the abdominal segments (*Lasioglossum* have basal hair bands).	B3
Lasioglossum	Twelve (12) species of veined sweat bees are known to occur in the NWT. Species from subgenera *Lasioglossum* (strong-veined), as well as	B3

	Evylaeus (weak-veined) and *Dialictus* (metallic) are present in the NWT. Nine species are included in the key. Some species are missing due to recent taxonomic revisions: *L. laevissimum, L. novascotiae,* and *L. seillean (*new: *Gibb et al. 2013). L. rufitarse* in North America, including in the NWT, are now recognized as *L. inconditum* (Gibb et al. 2013). These bees are ground nesting and can be eusocial or primitively eusocial. Members of this genus are called sweat bees as they are known to lick sweat off of mammals (including humans). A defining characteristic of this genus is the basal hair bands on the abdominal segments (*Halictus* have apical hair bands).	
Sphecodes	Three (3) species of parasitic Halictic bees are known to occur in the NWT. Due to incomplete taxonomic knowledge of this genus in North America, the key is tentative. More species could be found in the NWT. All species are cleptoparasitic. Females do not have pollen collecting hairs as they use the resources of other bees which they parasitize. A defining characteristic is their coarse punctures and red abdomen, whereas the rest of the body is black.	B3

Megachilidae – Leafcutter bees and relatives

Hoplitis	Three (3) species of Hoplitis mason bees are known to occur in the NWT. An additional species, *H. fulgida*, is not included in the key and may be present. These solitary bees build nests in the ground.	B4
Osmia	Thirteen (13) species of mason bees are known to occur in the NWT. These solitary bees build mud nests in burrows, cavities or in old wood.	B4
Anthidium	Two (2) species of potter bees are known to occur in the NWT. An additional species, *A. palliventre*, is not included in the key, was collected once (map 44), and needs verification. These solitary bees build cells in their nest with resin, plant fragments, mud or a mix of material in burrows, cavities or in old wood.	B4
Stelis	Three (3) species of parasitic mason bees are known to occur in the NWT. An additional un-described but distinct species is provided in the key. Due to incomplete taxonomic knowledge of this genus in North America, the key is tentative. More species could be found in the NWT. All species are cleptoparasitic.	B4
Coelioxys	Five (5) species of cuckoo leafcutter bees are known to occur in the NWT. All species are cleptoparasitic.	B4
Megachile	Nine (9) species of leafcutter bees are known to occur in the NWT.	B4

	Species from subgenera *Sayapis*, *Xanthosarus*, *Megachile* are present in the NWT. An additional species *M. centumcularis*, not included in the key, was collected only once and needs verification. These solitary bees build nest cells with plant fragments in burrows or cavities.	

Apidae – Honey bees and relatives

Epeolus	Only one species of *Epeolus* cuckoo bee, *E. minimus,* is known to occur in the NWT. All species are cleptoparasitic.	B5
Nomada	Six (6) species of nomad bees are known to occur in the NWT. Due to incomplete taxonomic knowledge of this genus in North America, the key is tentative. Many more species could be found in the fauna of the NWT. All species are cleptoparasitic.	B5
Anthophora	Two (2) species of flower bees are known to occur in the NWT. These solitary bees build nest in the soil.	B5
Bombus	Twenty-one (21) species of bumble bees are known to occur in the NWT. Species from subgenera *Bombus, Pyrobombus, Alpinbombus, Subterraneobombus, and Psithyrus* are present in the NWT. Psithyrus are cleptoparasitic. All other subgenera are eusocial, forming small to somewhat large colonies that in our region mostly survive a single season. Bumble bee queens hibernate. Alpinbombus prefer cold regions.	B5
Apis	Only one species, western honey bee (*A. mellifera)*, is known to have been introduced to the NWT. They are advanced eusocial species, forming multi-year cooperative hives with different reproductive and worker castes. They are notorious for their honey and wax production. Colonies can survive our harsh winters only if shelter is provided.	A and B5

Discussion

Currently, there are over 800 known bee species in Canada and 109 of these, belonging to 18 genera, have been recorded for the NWT. This project has yielded working keys to all genera and species currently known from the NWT. The key couplets are illustrated to facilitate identification; this will allow both expert and novice users to put names on bee species. Having the tools to identify species will allow for further studies on bees in Northern Canada. Identification guides are important not only for melittologists and other entomologists, but for all other researchers and naturalists interested in assessing and monitoring fauna. The map distributions of bee species currently found in this region will also help determine where further sampling should take place. Prior to this study, a guide to the bee species of NWT was unavailable.

Monitoring the flora and fauna of Northern Canada is extremely important for assessing their status and conservation requirements. This project was intended towards providing a better understanding of the distribution and conservation status of bees in the NWT through establishing a guide to identify bee species in the region and by compiling a location database of all species recorded from this region. Studying the bee diversity in the NWT is especially important as the Arctic is among the ecosystems most prone to the effects of climate change. Bees act keystone organisms in most terrestrial ecosystems due to their role as pollinators. By providing this service, bees benefit many other organisms in their ecosystem. Furthermore, they have great potential for environmental monitoring and could be used to assess ecosystem health.

There is a lack of data on bees (and other insects) from Northern Canada, and many bee species remain unrecorded, and the true distribution of many may be much broader. Several species have only recently been recorded as presented here. It is essential to continue surveying more land, in more remote areas of the NWT, as this will give us a better understanding of the bee communities which occur here. There are many species recorded from adjacent Yukon and provinces to the south that have not yet been found in the NWT. Extensive sampling in this region will probably yield interesting species records and possibly some generic additions. DNA barcoding is proving very important in species identification. A growing database acts as a storage library of reference DNA sequences for known species. These data could be accessed and compared to problematic or otherwise difficult to determine species. With the help of DNA barcoding, advancements have been made on finding new species, raising sub-species to species, synonymizing species, and associating sexes of one species previously described as different species. With the help of DNA barcoding, (recently collected) bee specimens could be processed and compared to others in the database in order to help with identification. This will also contribute to the ongoing efforts of DNA barcoding and increase the number of Arctic/circumpolar records currently in the database.

There still remain unresolved taxonomic problems for many groups of bees. Identification keys are unavailable for some genera, while others have been very well studied. For example, *Nomada, Sphecodes,* and *Stelis* are cleptoparasitic genera for which identification keys covering all species are not yet available for all of North America. Some studies have been done elsewhere in North America; however, many gaps remain in our knowledge of these groups. In such cases, specimens must be compared to the available species descriptions, some of which were written many decades ago and may not be useful. In addition, several genera include species which are very difficult to differentiate based on morphological characteristics. These require taxonomic experts to review all known species, and perhaps new ones, to come up with a means of identifying them. Another issue is variation within species. An example of this is the colour variation in *Bombus*. Species of bumble bees exhibit different colour patterns, even within the same species. This makes it difficult to identify these species, unless all variants are recorded and accounted for. For all of the above reasons, having illustrations of the characters used in keys is an extremely valuable tool to help during identification. Much more work is necessary to produce a working key for all Canadian bees, but the present keys for the NWT could be looked at as one step towards that goal.

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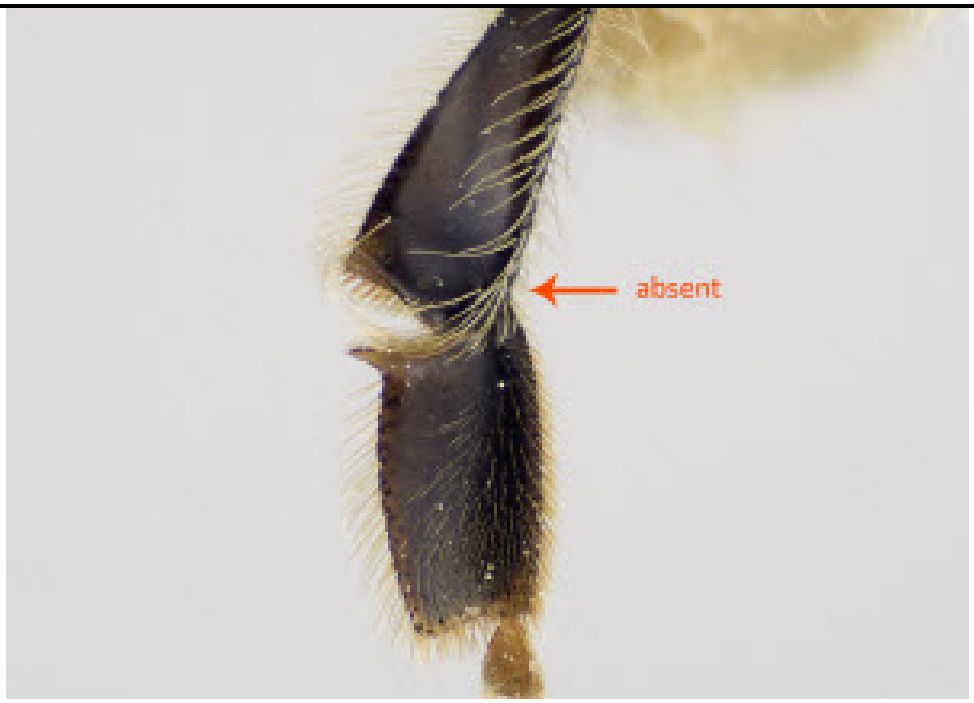
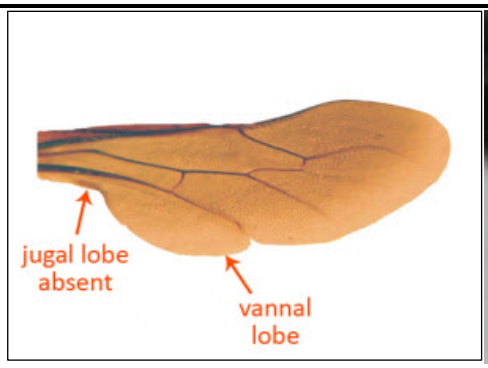
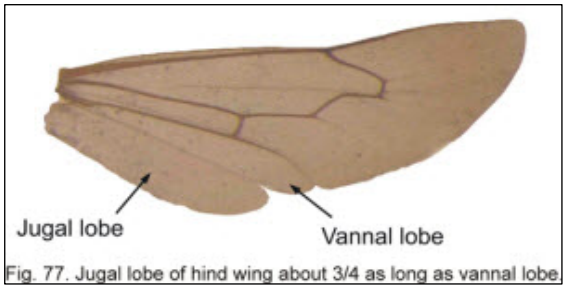
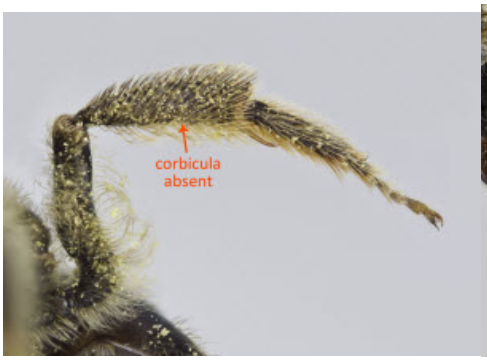
Appendix A: Key to bee genera of the Northwest Territories, Canada

The sexes differ in the number of metasomal terga (6 in females, 7 in males) and the number of antennal segments (12 in females, 13 in males).

1. Forewing with three submarginal cells (fig 1a) 2	 Figure 1a
Forewing with two submarginal cells (fig 1b) 11	 Figure 1b

2(1). Hind tibial spurs absent (fig 2a) . . . . . ***Apis mellifera*** L. (Appendix B5)	 Figure 2a
Hind tibial spurs present (fig 2b), though sometimes hidden by hair (fig 2c) 3	Figure 2c

3(2).Jugal lobe of hind wing absent (fig 3a); female usually with hind basitarsus very strongly expanded and with corbicular structure on hind tibia (fig 4a) . . . . . ***Bombus*** (Appendix B5)	 Figure 3a Figure 4a
Jugal lobe of hind wing present (fig 3b);female lacking strongly expanded hind basitarsus, hind tibia without corbicula (fig 4b,c) 4	 Fig. 77. Jugal lobe of hind wing about 3/4 as long as vannal lobe. Figure 3b  Figure 4b Figure 4c

4(3). Forewing with posterior portion of second recurrent vein arcuate outwardly, making it somewhat S-shaped on the right wing (backwards S on the left wing) (fig 5a) . . . . . .

Colletes

(Appendix B1)

Figure 5a

Forewing with posterior portion of second recurrent vein not outwardly arcuate (fig 5b,c) 5

Figure 5b

Figure 5c

5(4). Forewing with basal vein strongly arched (fig 6a); female usually with narrow pseudopygidial area on T5 (fig 7a-c) [females lacking this area are usually shiny and black with red on metasoma and lack a scopa on the hind leg]. 6

Figure 6a

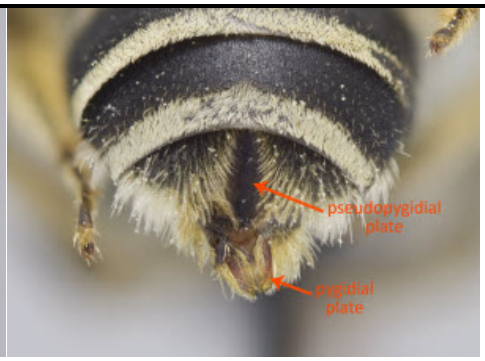
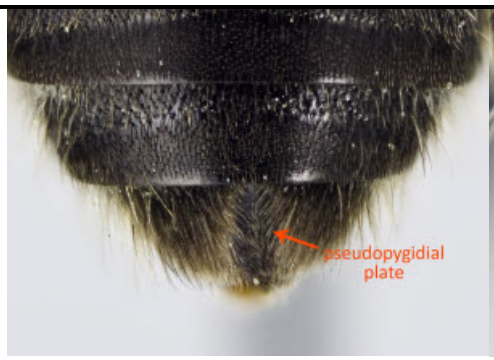
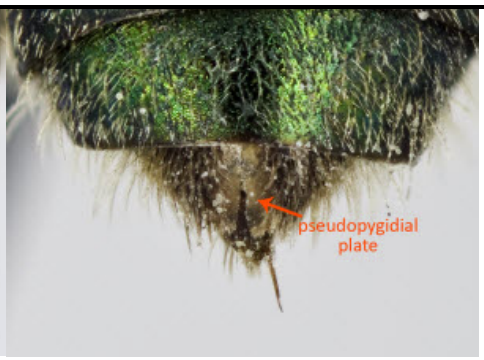
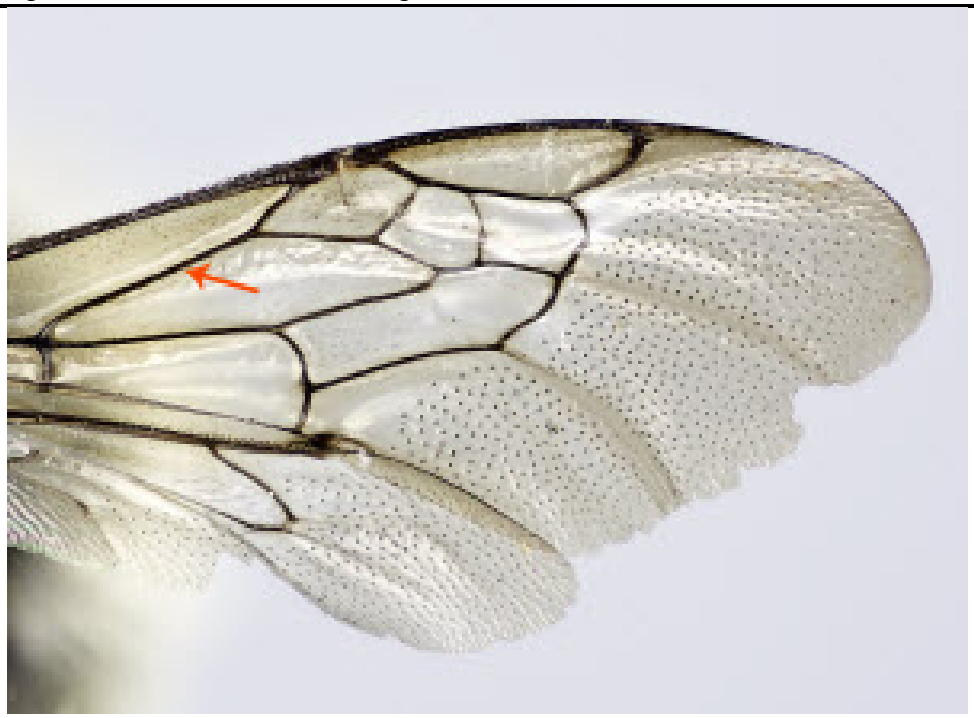
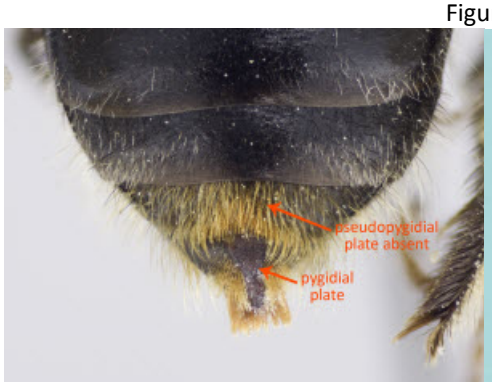
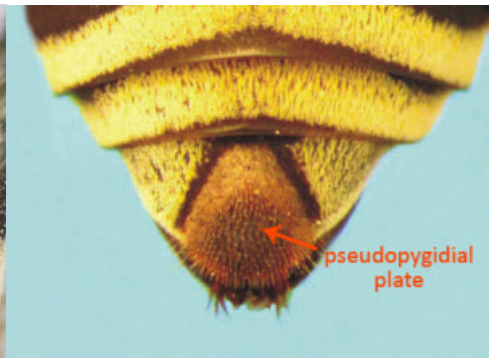


Figure 7a

	 Figure 7b  Figure 7c
Forewing with basal vein not strongly arched though it may be slightly curved, but not strongly towards the base (fig 6b); T5 usually without pseudopygidial area (fig 7d), but IF present THEN body broad with pattern of white appressed pubescence (fig 7e) 18	 Figure 6b   Figure 7d Figure 7e

6(5).Apical wing veins weakened, at least in females (fig 8a); metasomal hair bands, if present (females), basal in position (fig 9a,b), males lacking distinct apical hair bands; IF metasoma with reddish markings (uncommon) THEN body either not shiny and/or without coarse sculpture and with distinct scopa on hind leg of female (fig 10a) . . . . . .

Lasioglossum

(Appendix B3)

Figure 8a

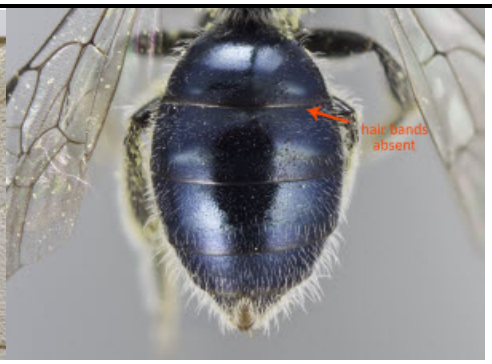


Figure 9a

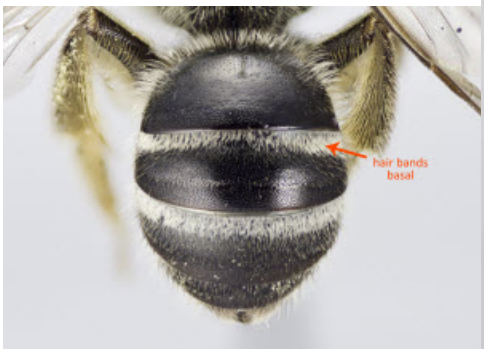


Figure 9b

Figure 10a

Apical wing veins strong (fig 8b); metasomal hair bands, if present, apical in position (fig 9c), males with or without distinct apical hair bands, IF without apical hair bands THEN metasoma usually red marked and body shiny and usually with coarse sculpture and without scopa on hind leg (fig 10b) 7

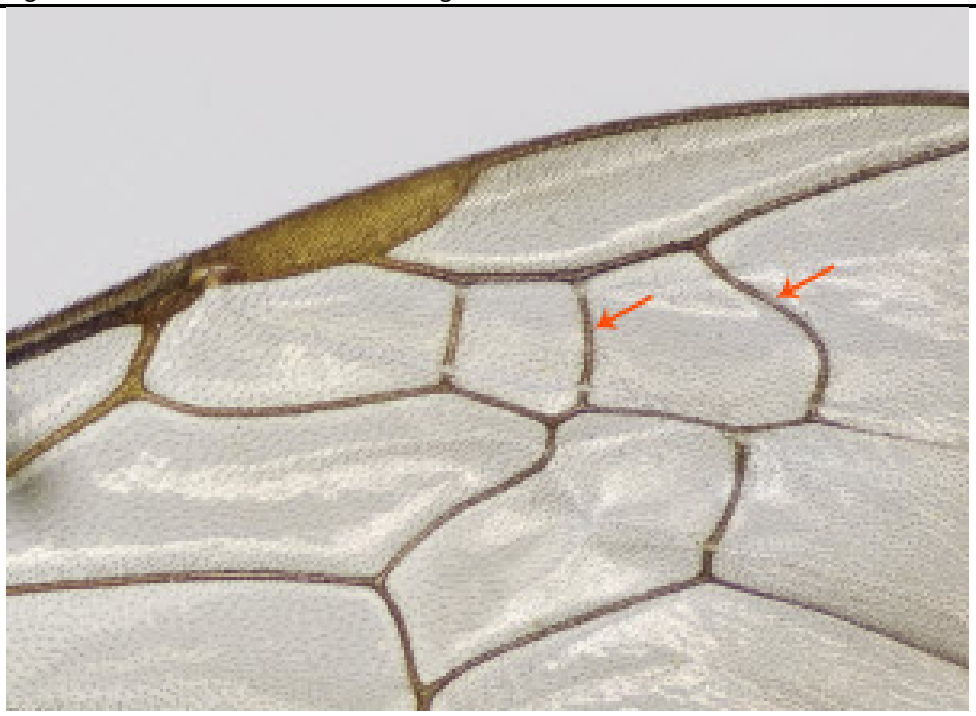


Figure 8b

	Figure 9c Figure 10b
7(6).Metasomal terga with distinct apical hair bands (NOTE these may be abraded in older specimens in which they are generally more easily detected towards the side of the metasoma); female with distinct scopa on hind leg; integument black-brown (fig 11a) or dull metallic blue or green (fig 11b). . . . . ***Halictus*** (Appendix B3)	Figure 11a Figure 11b
Metasomal terga without distinct apical hair bands; female lacking scopa; integument shiny black and red (fig 11c), if entirely black then body very shiny and coarsely sculptured (fig 11d) . . . . ***Sphecodes*** ***(***Appendix B3)	Figure 11c Figure 11d

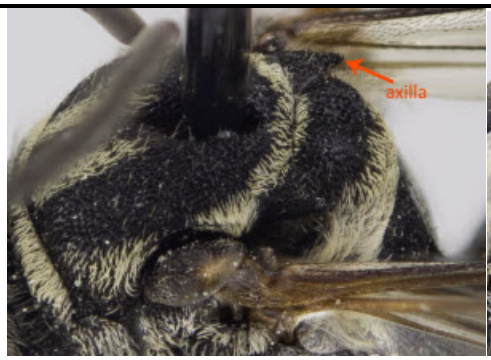
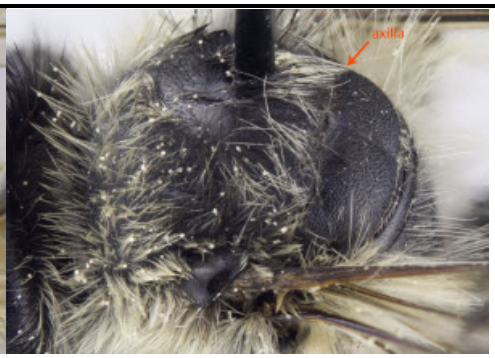
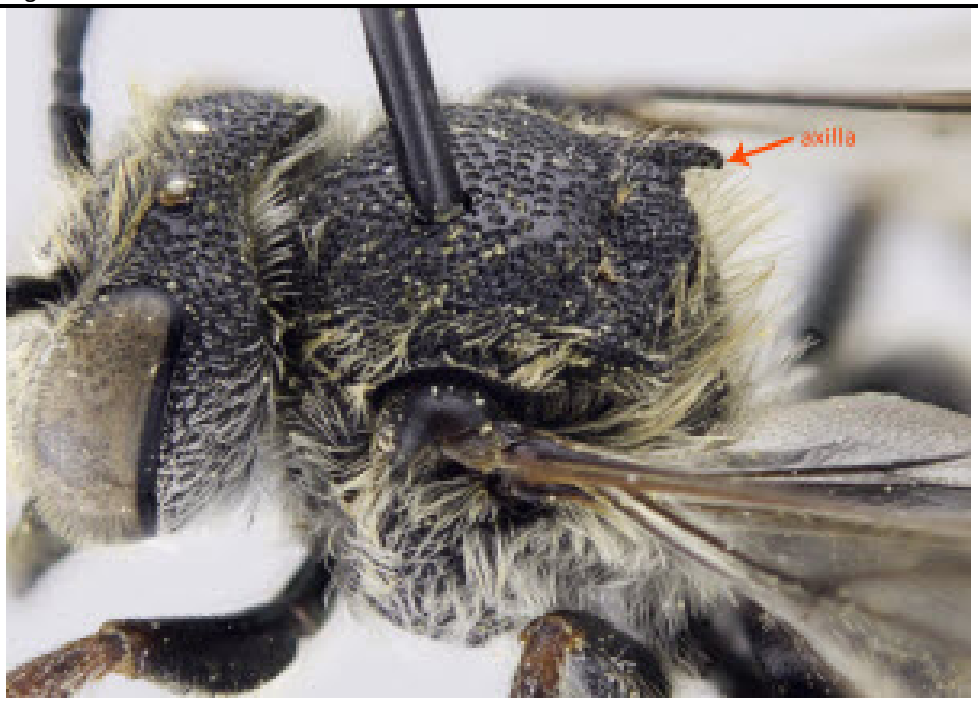
8(5). Axilla produced into a rounded lobe or an angle or spine, clearly not continuing outline of scutellum (fig 12a,b); body mostly black with bands or spots of pale appressed pubescence . .***Epeolus*** (Appendix B5)	 Figure 12a Figure 12b
Axilla not produced, continuing outline of scutellum (fig 12c,d); body variously coloured or patterned 9	 Figure 12c  Figure 12d
9(8). Face with two subantennal sutures (fig 13a); female with facial foveae shallow and entirely covered in short dense velvety hairs (fig 14a,b) . . . . . . ***Andrena*** (Appendix B2)	 Figure 13a

	Figure 14a Figure 14b
Face with one subantennal suture (fig 13b); female without facial foveae (fig 14c) 10	Figure 13b Figure 14c
10(9).Integument of metasoma, and often mesosoma, marked with yellow, orange or red (fig 15a), sometimes entirely reddish (fig 15b); apical hair bands on metasomal terga absent (fig 16a); scopa in female absent (fig 17a); female S6 with specialized bristles (fig 18a). . . . . **_Nomada_** (Appendix B5)	Figure 15a Figure 15b Figure 16a Figure 17a Figure 18a

Integument of metasoma not marked with yellow, orange or red (fig 15c) . . . . . ***Anthophora*** (Appendix B5)	 Figure 15c
11(1).Axilla produced to a lobe, angle or spine lateral to scutellum (fig 19a) . . . . . ***Coelioxys*** (Appendix B4)	 Figure 19a

Axilla not produced as a lobe, angle or spine lateral to scutellum (fig 19b) 12	Figure 19b
12(11). Second submarginal cell much shorter than first, usually only half as long; first recurrent vein received by first submarginal cell or meeting first transverse cubital vein (fig 20a) [IF second submarginal cell is 2/3 as long as first, THEN first recurrent vein clearly in first submarginal cell]; female without scopa 13	Figure 20a

Second submarginal cell at least 2/3 as long as first and usually receiving first recurrent vein (fig 20b); female with scopa present or absent 14

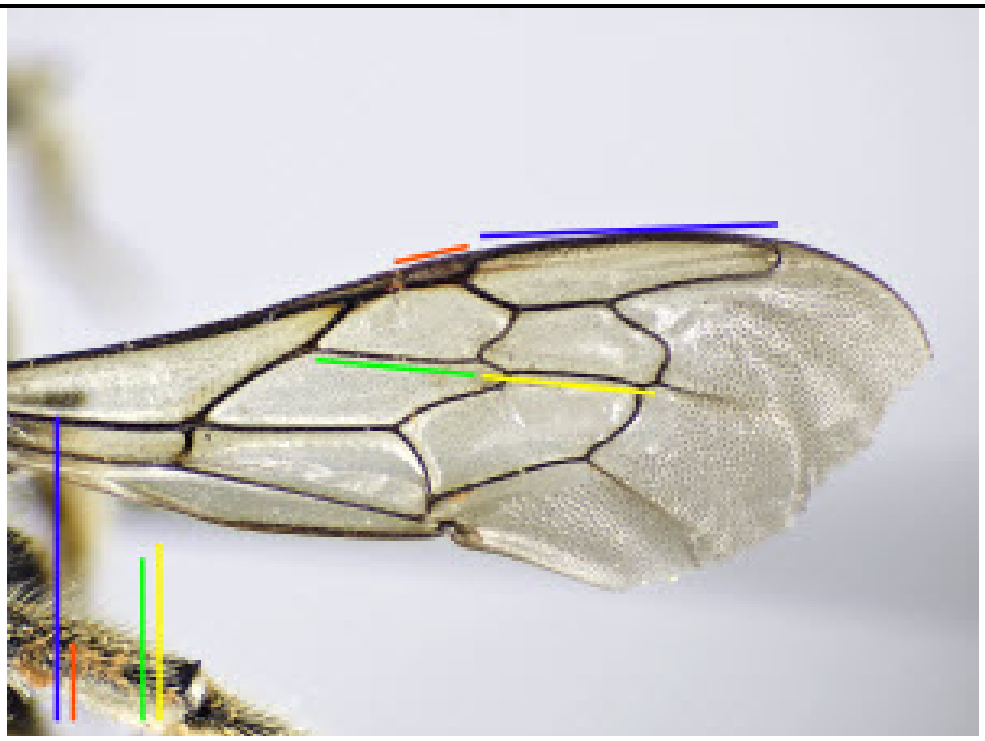


Figure 20b

13(12).Jugal lobe of hind wing about ¾ as long as vannal lobe (fig 21a); glossa truncate or bilobed (fig 22a); black bees usually with white or yellow markings on legs and face but lacking white or yellow integument on metasoma (metasoma rarely largely red) (fig 23a,b) . . . . . .

Hylaeus

(Appendix B1)

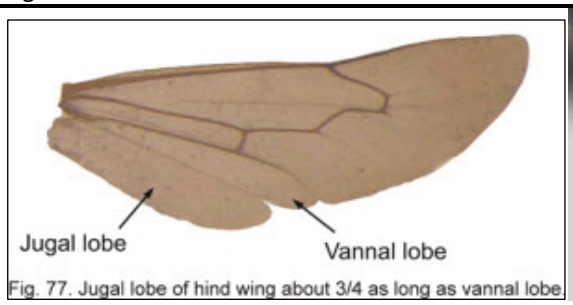


Fig. 77. Jugal lobe of hind wing about 3/4 as long as vannal lobe.

Figure 21a

Figure 22a

Figure 23a

Figure 23b

Jugal lobe of hind wing less than ¼ as long as vannal lobe (fig 21b); glossa pointed (fig 22b); yellow, orange or red markings on metasoma, sometimes entirely pale coloured (fig 23c,d) . .. . .

Nomada

(Appendix B5)

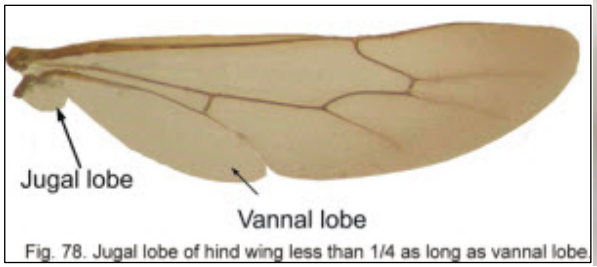


Figure 21b

Figure 22b

Figure 23c

Figure 23d

14(12).Female with facial fovea (fig 24a); both sexes with two subantennal sutures (fig 25a,b), except rarely in males, such males have a discrete facial fovea that lacks hairs (fig 26a) 15

Figure 24a

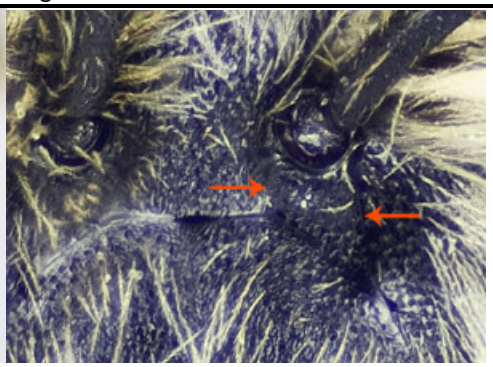


Figure 25a

Figure 25b

Figure 26a

Neither sex with facial fovea (fig 24b); both sexes with one subantennal suture (fig 25c,d). 16	 Figure 24b Figure 25c Figure 25d
15(14).Female with facial fovea present covered in short velvety hairs (fig 27a); both sexes usually with long dense hairs (fig 28a) especially the face in the male; lateral surface of propodeum with long hairs forming a corbicula in the female (fig 29a); male with gonobase (fig 30a) [Marginal cell pointed at apex; fig 31a].	 Figure 27a Figure 28a

Andrena

(Appendix B2)

Figure 29a

Figure 30a

Both sexes with facial fovea lacking hairs (fig 27b); males with face not covered in long hairs (fig 28b); females without corbicula on lateral surface of propodeum (fig 29b); male without gonobase (fig 30b) [Marginal cell truncate at apex; fig 31b] . . . . . .

Figure 27b

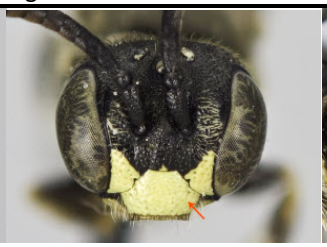


Figure 28b

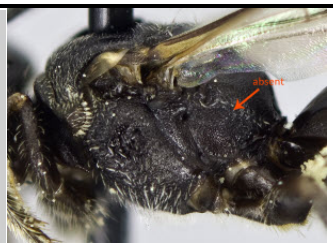


Figure 29b

Panurginus

Species of this genus have not yet been recorded for the Northwest Territories, but have been recorded in Yukon; therefore, it is likely that they occur in the adjacent Northwest Territories. In anticipation of these occurrences, these genera are included here.

Figure 30b

Figure 31b

16(14).Metasoma with cream, yellow, orange or red markings or entirely pale (fig 32a-c) 17	 Figure 32a Figure 32b Figure 32c
Metasoma lacking cream, yellow, orange or red markings or entirely pale (fig 32d,e) 20	 Figure 32d Figure 32e

17(16). Basal vein strongly curved, especially towards base (fig 33a) . . . . . ***Sphecodes*** (Appendix B3)	Figure 33a
Basal vein straight, if curved then not especially strongly so towards base (fig 33b) 18	Figure 33b

18(17).Metasomal scopa absent in females (fig 34a); males lacking strong spines or protuberances on apical metasomal segments (fig 35a-c; images are of females); labrum broader than long or squarish; mandible with at most one subapical tooth(fig 36a). . . . . .

Nomada

(Appendix B5)

Figure 34a

Figure 35a

Figure 35b

Figure 35c

Figure 36a

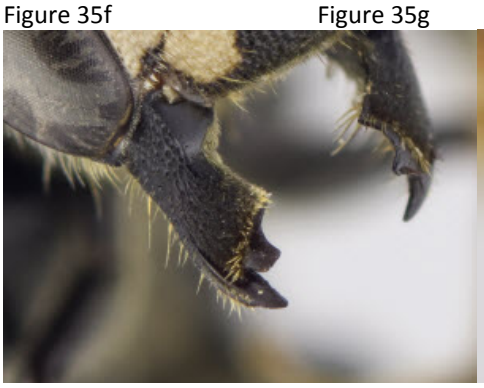
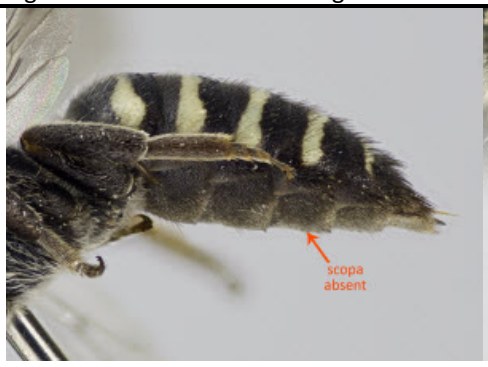
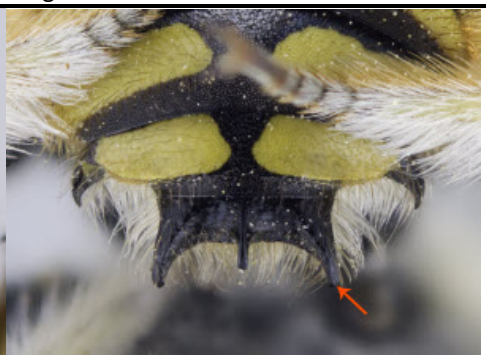
Metasomal scopa present (fig 34b) or absent (fig 34c) in females; males USUALLY with spines or protuberances on apical metasomal segments (fig 35d-g); labrum longer than broad; mandible with more than one subapical tooth (fig 36b,c) or with an untoothed margin with a preapical notch. 19

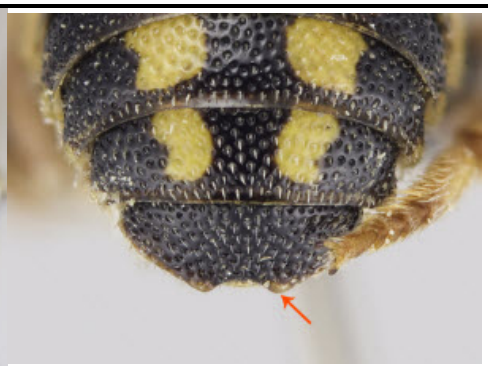
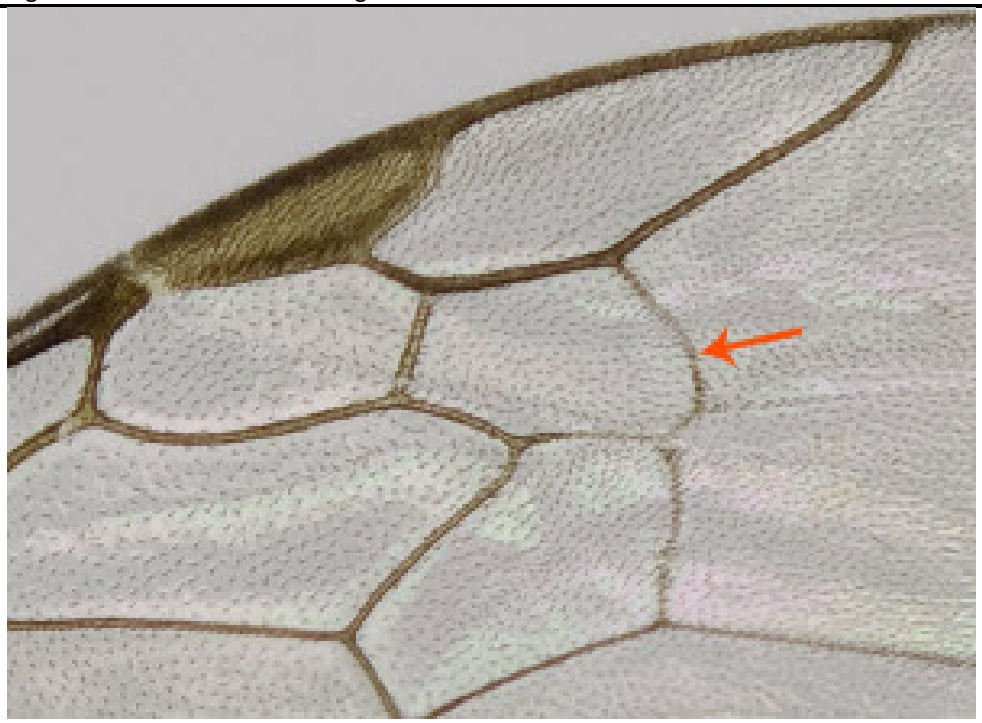
Figure 34b

Figure 34c

Figure 35d

Figure 35e

	 Figure 35f Figure 35g  Figure 36b Figure 36c
19(18). Female scopa absent (fig 37a); male lacking spines or protuberances near apex of metasoma (fig 38a) . . . . . . ***Stelis*** (Appendix B4)	 Figure 37a Figure 38a
Female scopa present (fig 37b); male metasoma with apical spines or processes (fig 38b-d) . . . . . . ***Anthidium*** (Appendix B4)	 Figure 37b Figure 38b

	 Figure 38c Figure 38d
20(16). Apical wing veins reduced (fig 39a) . . . . . ***Lasioglossum*** (Appendix B3)	 Figure 39a

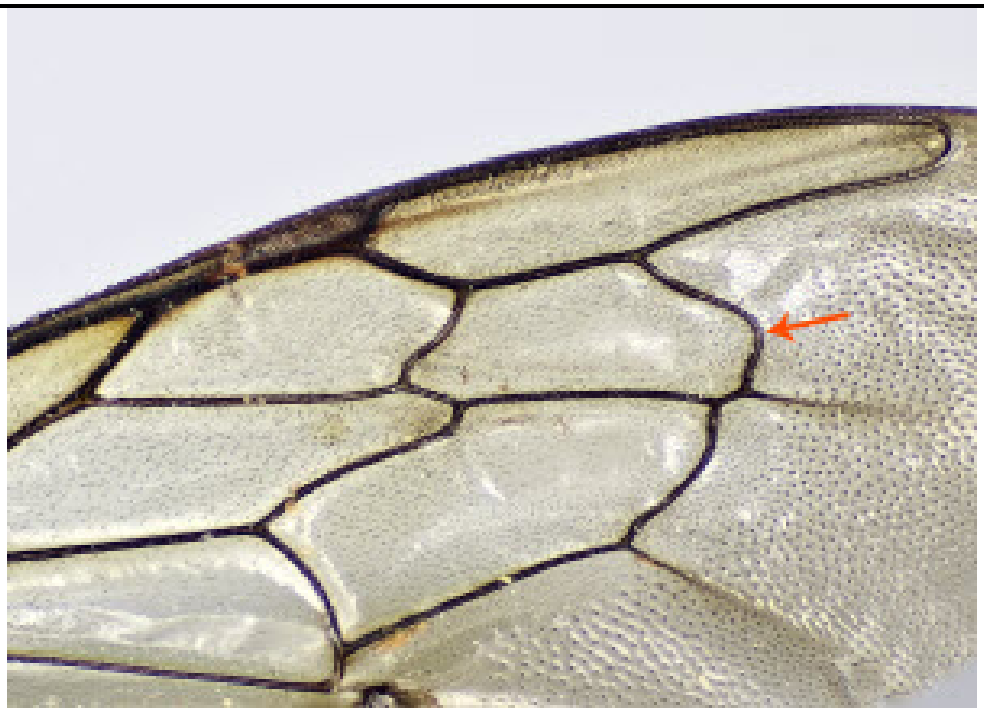
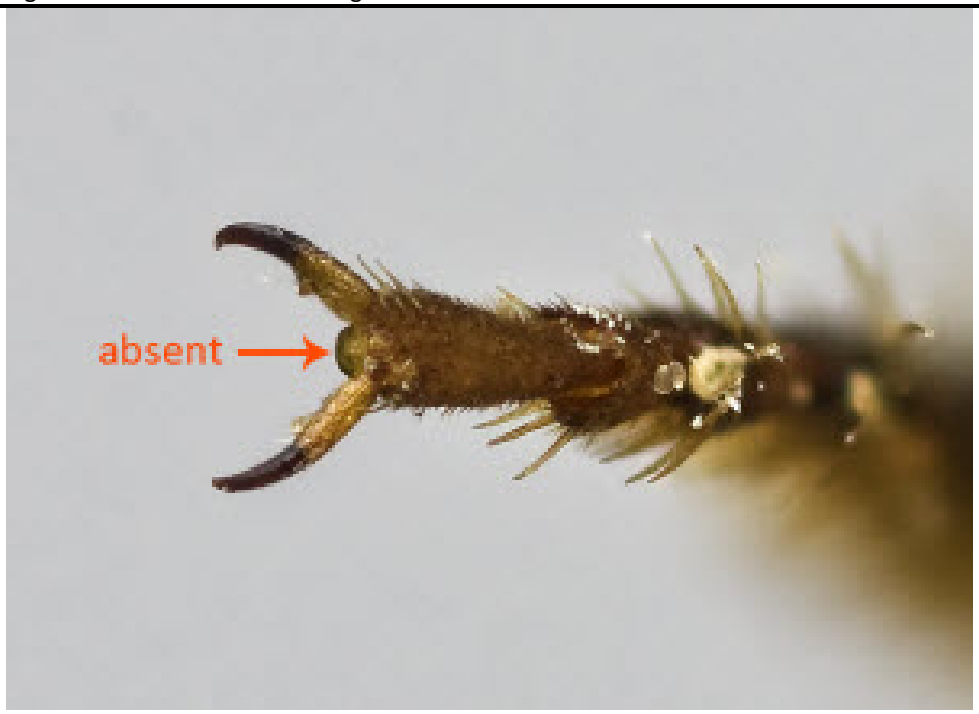
Apical wing veins not reduced (fig 39b) 21	 Figure 39b
21(20). Episternal groove present below scrobal groove though sometimes weak (fig 40a); female with tibial scopa only (fig 41a) [antennae low on face] . . . . ***Dufourea*** (Appendix B3)	 Figure 40a Figure 41a
Episternal groove absent below scrobal groove (fig 40b,c); female usually lacking tibial scopa (fig 41b) OR present on hind tibia AND hind basitarsis (fig 41c) 22	 Figure 40b Figure 40c

	 Figure 41b Figure 41c
22(21).Arolia absent (fig 42a) . . . . . . ***Megachile*** (Appendix B4)	 Figure 42a

Arolia present (fig 42b) 23	 Figure 42b
23(22). Mesoscutum with parapsidal lines not much longer than broad (fig 43a,b) . . . . . ***Osmia*** (Appendix B4)	 Figure 43a Figure 43b

Mesoscutum with parapsidal lines elongate (fig 43c) . . . . . . ***Hoplitis*** (Appendix B4)	 Figure 43c

Appendix B: Key to bee species of the Northwest Territories, Canada

B1: Key to bee species in the Colletidae family

Colletes

1. Antennae with 12 segments (fig 44a); metasoma with 6 visible segments (fig 45a) [females] 2	Figure 44a Figure 45a
Antennae with 13 segments (fig 44b); metasoma with 7 visible segments (fig 45b) [males] 6	Figure 44a Figure 45b

2(1). Malar space almost as long as broad (fig 46a) (female) . . . . . .

Colletes impunctatus

Nylander

(App. C, Map 4)

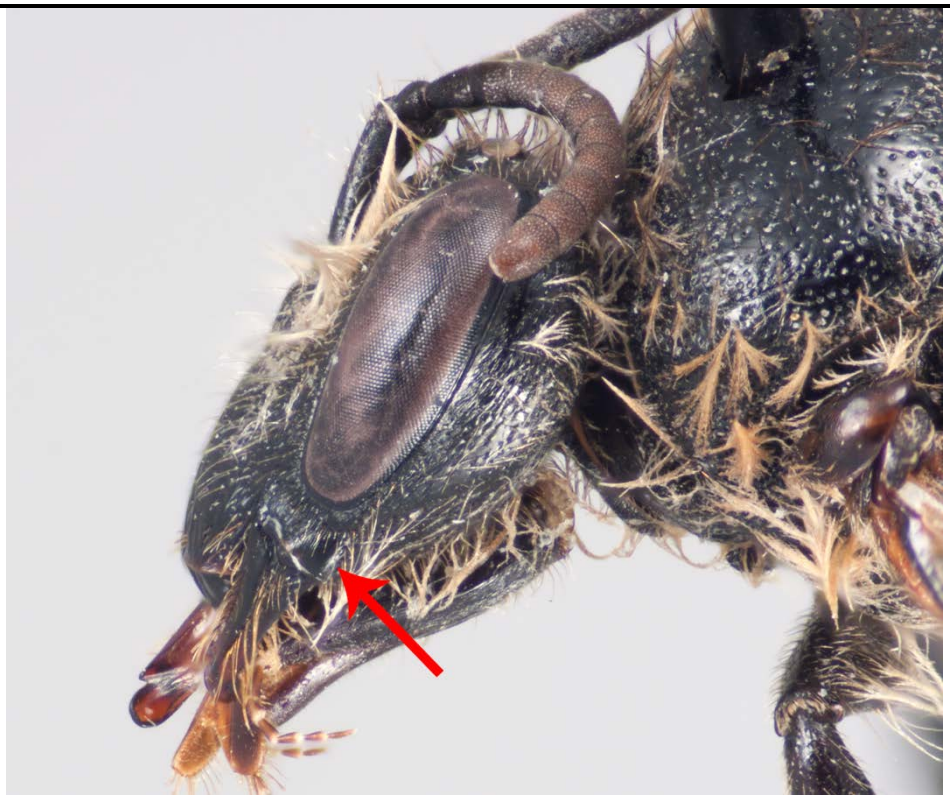
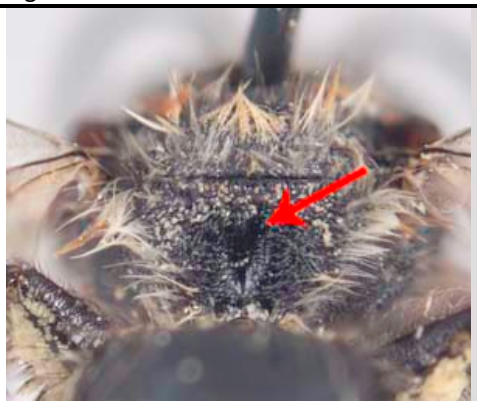
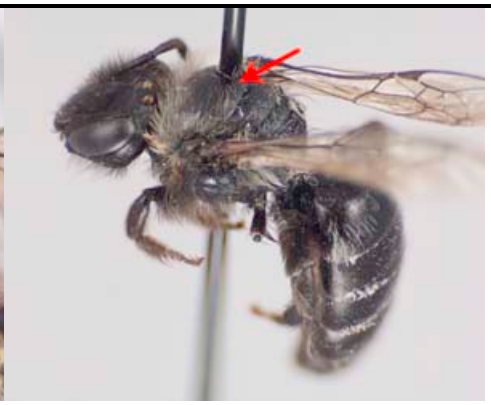


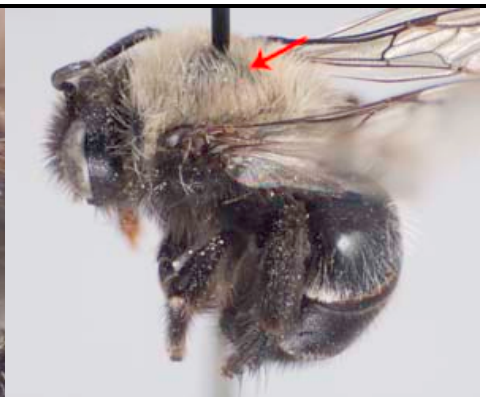
Figure 46a

Malar space much shorter than broad (fig 46b) 2

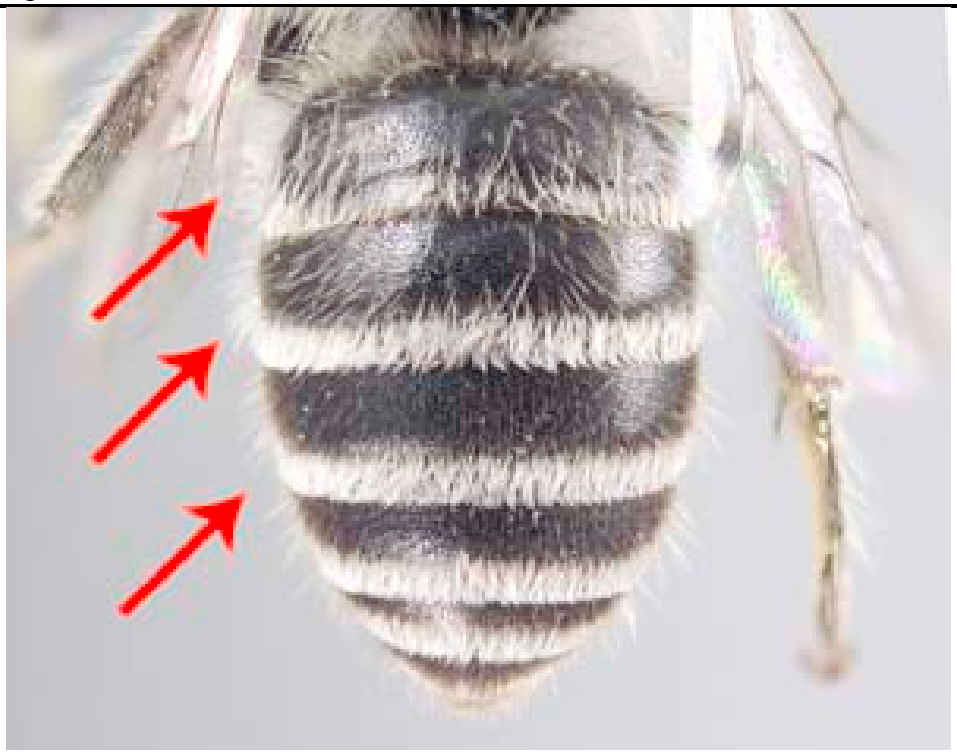
Figure 46b

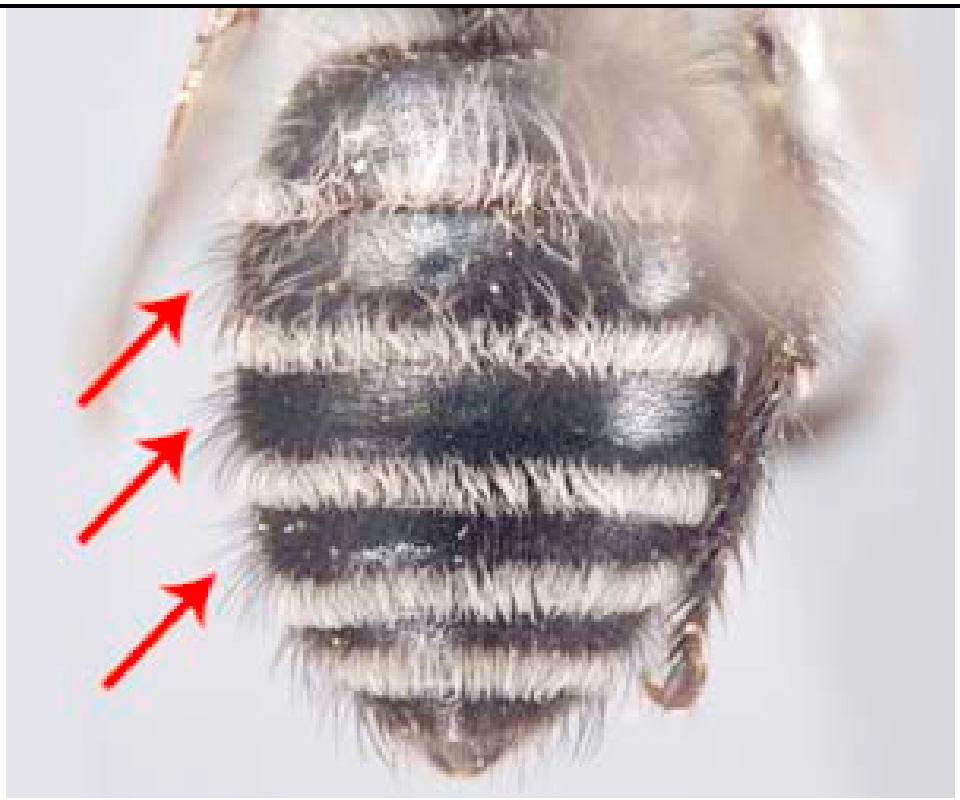
3(2). Scopa and pubescence of face and mesosoma entirely pale (fig 47a); metasoma with apical fasciae complete, or nearly so (fig 48a) 4	Figure 47a Figure 48a
Scopa entirely black, face and mesosoma with some dark hairs (fig 47b); metasoma with apical fasciae medially interrupted (fig 48b) 5	Figure 47b Figure 48b
4(3). Basal area of terga covered with pale plumose hairs, obstructing surface beneath, apical fasciae occupying about a third of tergal surface (fig 49a) (female). . . . . ***Colletes phaceliae*** **Cockerell** (App. C, Map 5)	Figure 49a

Basal area of terga with sparse erect dark hairs, not obstructing surface beneath, apical fasciae occupying only about a quarter of tergal surface (fig 49b) (female). . . . . ***Colletes hyalinus*** **Provancher** (App. C, Map 3	Figure 49b
5(3). Mesosoma with sparse erect white pubescence mostly on anterior mesoscutum, mesoscutellum and metanotum nearly bare (fig 50a); posterior surface of propodeal triangle rugose (fig 51a). (female) . . . . . ***Colletes nigrifrons*** **Titus** (App. C, Map 5)	 Figure 50a  Figure 51a

Mesosoma with dense white pubescence throughout (fig 50b); posterior surface of propodeal triangle shiny and smooth (fig 51b). . . (female) . . . . . ***Colletes consors*** **Cresson** (App. C, Map 1)	Figure 50b  Figure 51b
6(1). Malar space almost as long as broad (fig 52a) (male). . . . . ***Colletes impunctatus*** **Nylander** (App. C, Map 4)	Figure 52a

Malar space shorter than broad (fig 52b) 7	 Figure 52b
7(6). Malar space about ¾ as long as broad (fig 53a) (male) . . . . . ***Colletes phaceliae*** **Cockerell** (App. C, Map 6)	 Figure 53a

Malar space less than half as long as broad (fig 53b) 9	 Figure 53b
9(8). Terga densely and regularly punctate basally, T3-T7 with sparse shorter pale hairs (fig 54a) (male) . . . . . ***Colletes nigrifrons*** **Titus** (App. C, Map 5)	 Figure 54a

Terga finely punctate basally, T3-T7 with long black bristles (fig 54b). 10	 Figure 54b
Lateral angle of pronotum not spinose; pubescence of gena dark (fig 55a) (male) . . . . . ***Colletes consors*** **Cresson** (App. C, Map 1)	 Figure 55a
Lateral angle of	

pronotum spinose; pubescence of gena pale (fig 55b) (male) . . . . . .

Colletes hyalinus

Provancher

(App. C, Map 3)

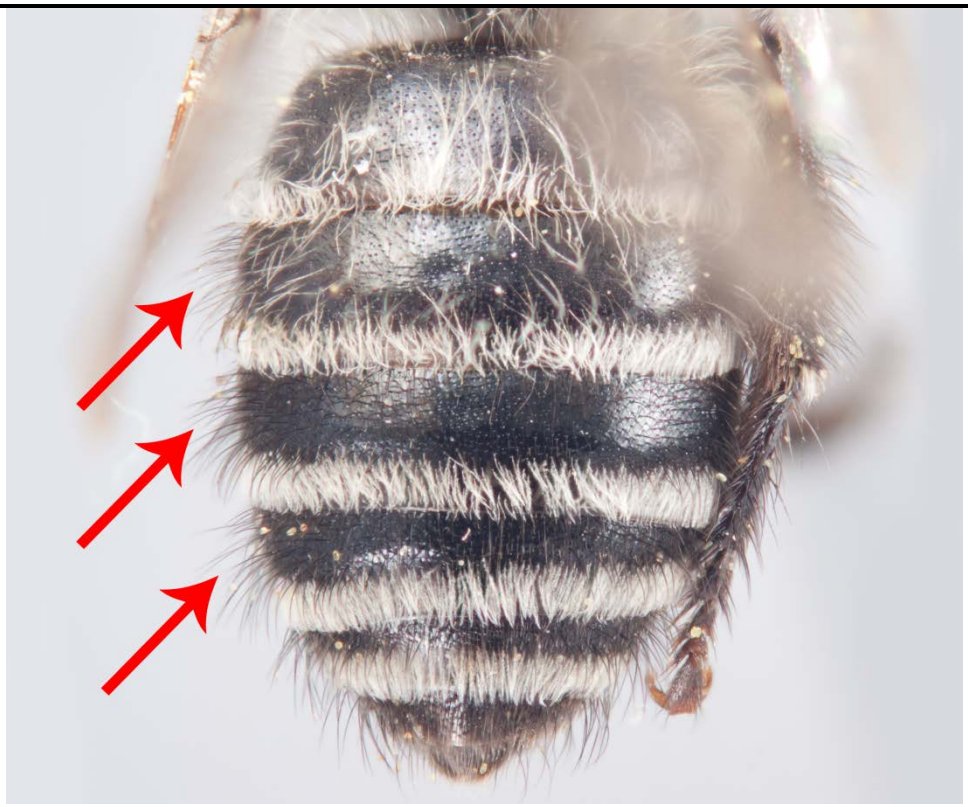
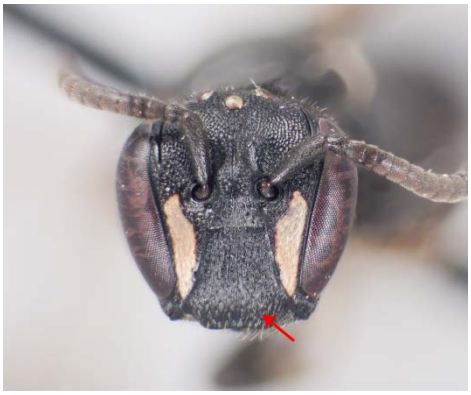
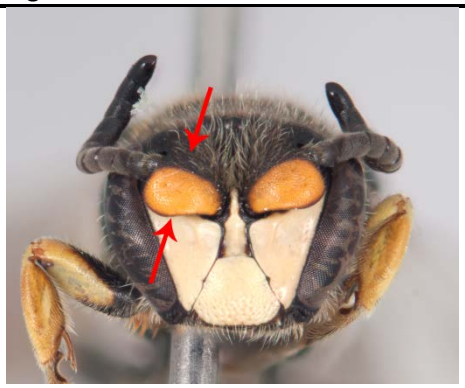


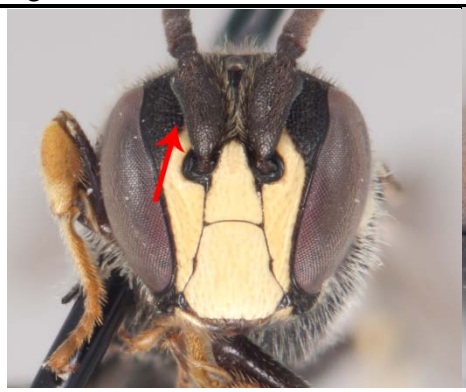
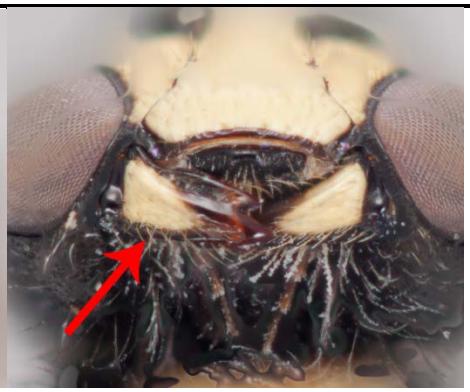
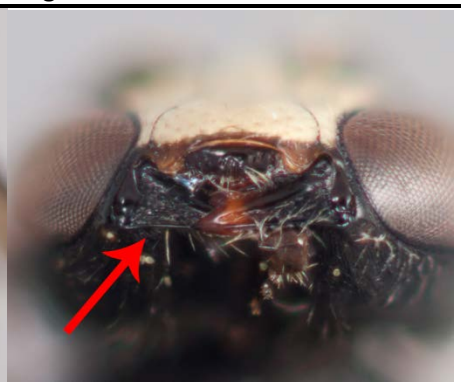
Figure 55b

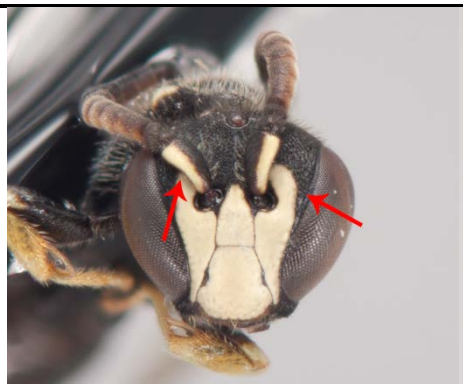
Hylaeus

1. Antennae with 12 segments (fig 56a); metasoma with 6 visible segments (fig 57a) [females] 2	Figure56a Figure 57a
Antennae with 13 segments (fig 56b); metasoma with 7 visible segments (fig 57b) [males] 5	Figure56b Figure 57b
2(1). Body entirely black including face, tubercles, and legs (fig 58a) (female) . . . . . ***Hylaeus basalis* Smith** (App. C, Map 8)	Figure 58a

Body with some yellow markings, face and tubercles usually maculated (fig 58b) . . . 3	 Figure 58b
3(2). Supraclypeal area raised and produced above (fig 59a); fore tibia maculation reduced to a basal spot, covering basal quarter at most (fig 60a) 4	 Figure 59a Figure 60a
Supraclypeal area not as above (fig 59b); fore tibia maculation covering basal half (fig 60b) (female). . . . . . ***Hylaeus mesillae*** **(Cockerell)** (no map)	 Figure 59b Figure 60b
4(3). Lower para-ocular area sparsely punctate (fig 61a); T1-T3 sparsely and finely punctate (fig 62a); clypeus with or without maculation, with lateral transverse stripe or spot (fig 63a), sometimes appearing laterally reddened. (female) . . . ……. .	 Figure 61a Figure 62a

Hylaeus annulatus **(Linnaeus)** (App. C, Map 7)	Figure 63a
Lower paraocular area densely punctate (fig 61b); T1-T3 densely punctate (fig 62b); clypeus without maculation (fig 63b), if present then reduced to medial stripe or spot.(female) . . ***Hylaeus verticalis*** **Cresson** (no map)	Figure 61b Figure 62b  Figure 63b
5(1). Scape extremely broad, its breadth exceeding its length (fig 64a) (male). . . . . ***Hylaeus basalis*** **Smith** (App. C, Map 8)	 Figure 64a

Scape to some degree longer than its apical breadth (fig 64b) 5	Figure 64b
6(5). Scape entirely black (fig 65a); mandibles with yellow (fig 66a) (male). . . . . ***Hylaeus verticallis*** **Cresson** (no map)	 Figure 65a  Figure 66a
Scape widely maculated and dilated, its apex nearly or quite equalling half its length (fig 65b); mandibles black (fig 66b) 7	Figure 65b  Figure 66b
7(6). Scape with large yellow maculation, covering nearly half anterior surface, apical breadth of scape equal to its length (fig 67a); facial maculation extending above antenna (fig 67a); tarsi dark (fig 68a) (male) . . . . *Hylaeus*	Figure 67a Figure 68a

annulatus (Linnaeus) (App. C, Map 7)	
Scape with conspicuous maculation, usually a spot or line occupying less than a third of anterior surface, apical breadth of scape less than its length (fig 67b); facial maculation curving away from eye above antenna (fig 67b); tarsi yellow (fig 68b) (male) . . *Hylaeus mesillae* **(Cockerell)** (no map)	 Figure 67b Figure 68b

B2: Key to bee species in the Andrenidae Family

Andrena

1. Antennae with 12 segments (fig 69a); collecting hairs present on hind leg (fig 70a); metasoma with 6 visible segments (fig 71a) [females] 2	 Figure 69a Figure 70a Figure 71a

Antennae with 13 segments (fig 69b); collecting hairs absent on hind leg (fig 70b); metasoma with 7 visible segments (fig 71b) [males] 18

Figure 69b

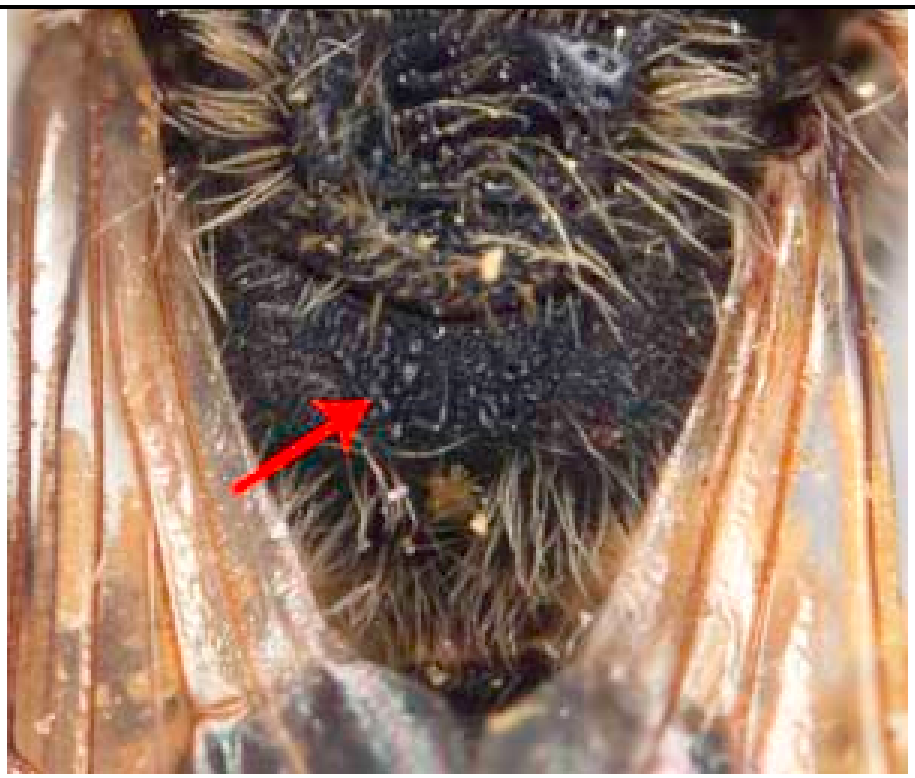
Figure 70b

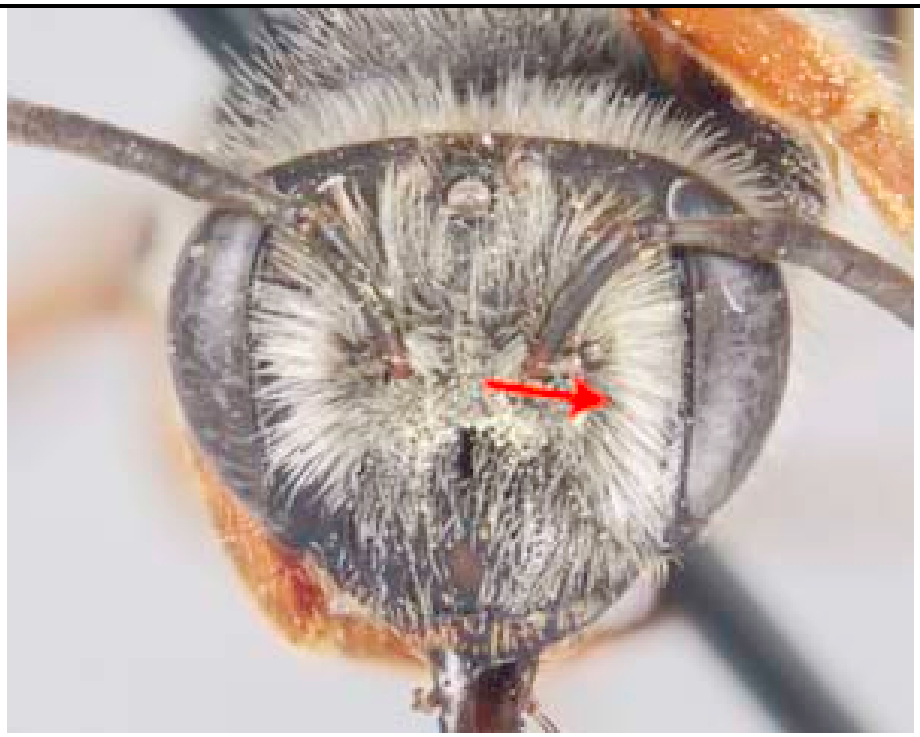
Figure 71b

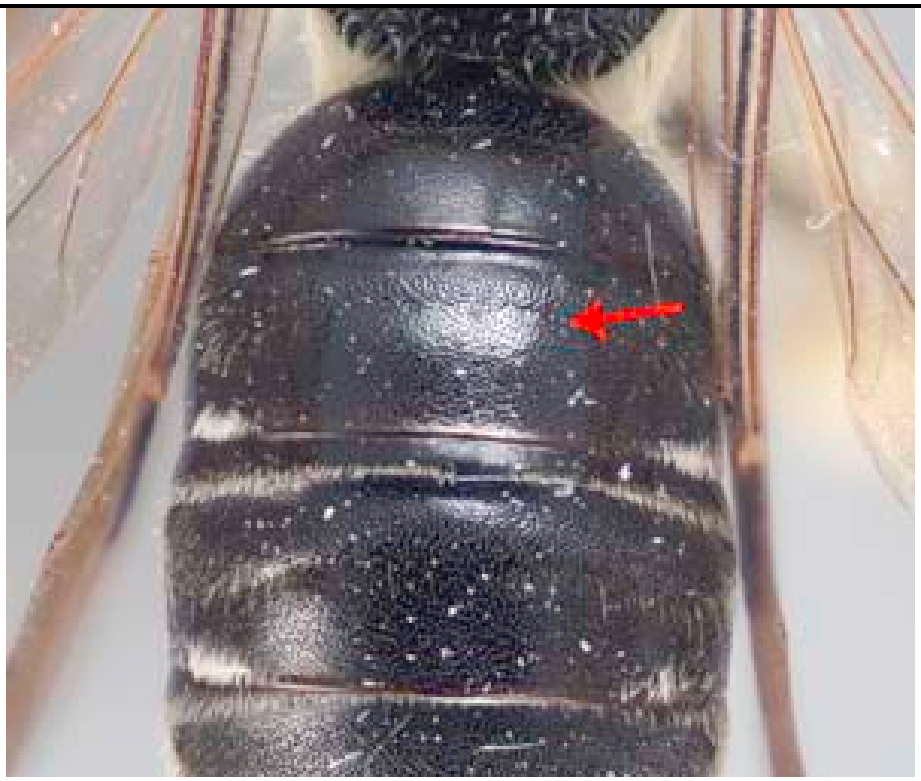
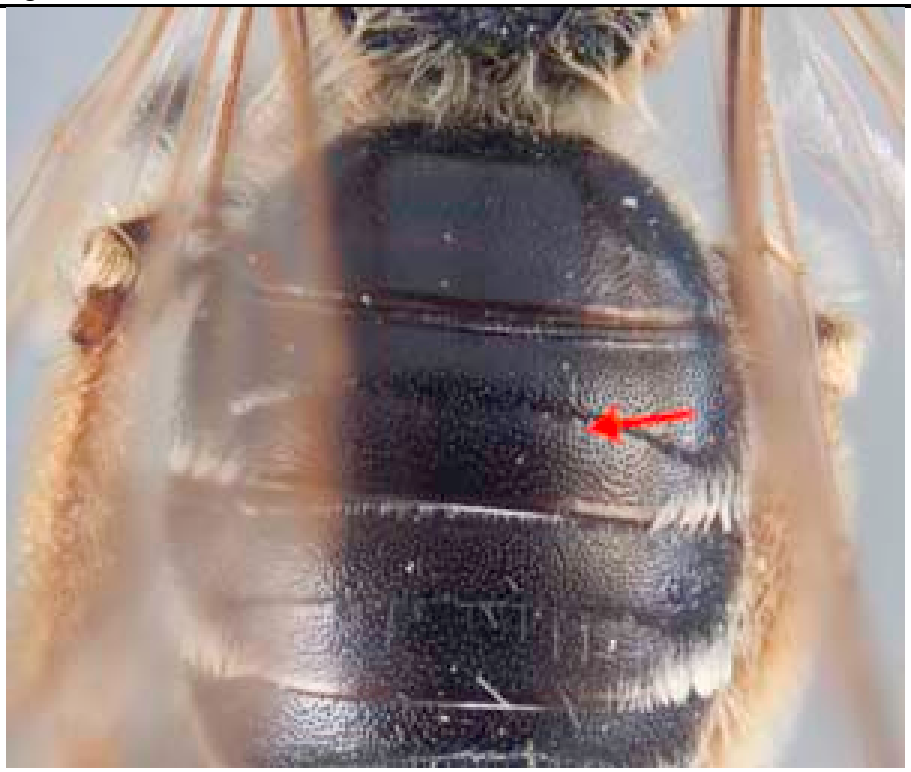
2(1). With two submarginal cells (fig 72a) (female) . . . . ***Andrena wellesleyana*** **Robertson** (App. C, Map 26)	Figure 72a
With three submarginal cells(fig -72b) 3	Figure 72b

3(2). Scopa on hind tibiae black (fig73a). . . 4	 Figure 73a
Tibial scopa largely or entirely pale, or possibly brownish, in colour (fig73b) 5	 Figure 73b

4(3). Vertex very narrow, with space between its hind margin and lateral ocelli no greater than diameter of ocelli (fig 74a) (female). . ***Andrena milwaukeensis*** **Graenicher** (App. C, Map 17)	 Figure 74a
Vertex not so narrow, space between lateral ocelli and its hind margin distinctly greater than their diameter (fig 74b) (female). . . . . . ***Andrena regularis*** Malloch (App. C, Map 22)	 Figure 74b

5(3). Dorsal triangle of propodeum coarsely rugose or striate (fig75a) 6	 Figure 75a
Dorsal triangle of propodeum either dessellate or only subrugose or granular (fig75b) 10	 Figure 75b

6(5).Facial foveae not much constricted below, and if at all so, only gradually narrowed to about half the width of the upper portion (fig 76a) (female). . . . . ***Andrena prunorum*** Cockerell (App. C, Map 21)	 Figure 76a
Facial foveae much constricted below, that part being half or less as wide as upper portion (fig76b) 7	Figure 76b

7(6). Apical impressed area of tergum 2 occupying fully two-thirds of its median length (fig 77a) (female). ***Andrena miranda*** Smith (App. C, Map 18)	 Figure 77a
Impressed area of tergum 2 not so extensive (fig77b) 8	 Figure 77b

8(7).Mesoscutum coarsely and densely punctate, punctures separated by their diameter or less (fig 78a) (female). . . . . ***Andrena sigmundi*** Cockerell (App. C, Map 24)	Figure 78a
Mesoscutum more sparsely punctate, punctures separated by more than their diameter (fig 78b). . . . 9	Figure 78b

9(8).Basitarsi and hind tibia orange (fig 79a); mesoscutum with notaulus present (represented as longitudinal depression) (fig 80a); basal abdominal tergum shining, punctures minute, irregular and sparse over most of disc (fig 81a) (female). . . . . .

Andrena hippotes

Robertson
(App. C, Map 15)

Figure 79a

Figure 80a

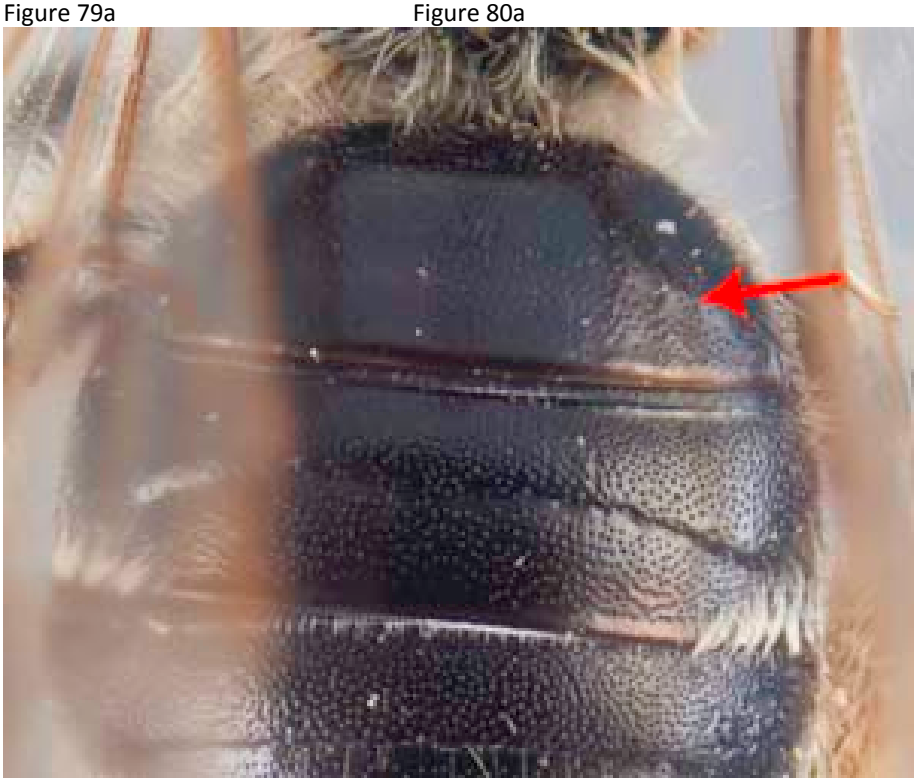


Figure 81a

Basitarsi and hind tibia brown-black (fig 79b); mesoscutum with notaulus absent (fig 80b); basal abdominal tergum shining or not, punctures deep and distinct, although fine, quite close and evenly distributed (fig 81b) (female). . . .

Andrena

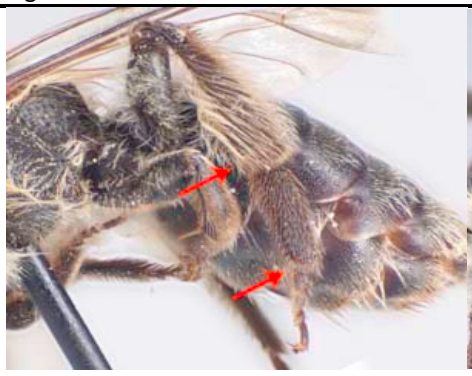
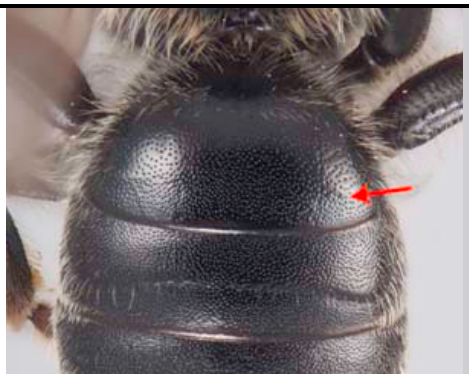


Figure 79b

Figure 80b

mariae concolor **Robertson** (App. C, Map 16, subspecies not mapped) Sometimes with abdomen bright reddish (fig 81c) (female). . . . . ***Andrena mariae mariae*** **Robertson** (App. C, Map 16, subspecies not mapped)	 Figure 81b Figure 81c
10(5). Malar space relatively extensive, length equal to one-fourth or more of the basal width of mandible (fig 82a) 11	Figure 82a

Malar space linear, if at all evident (fig 82b) 15	 Figure 82b
11(10). Facial fovea narrow, occupying only about half of space between compound eye and lateral ocellus (fig 83a) (female). . . . . **Andrena *algida*** Smith (App. C, Map 9)	 Figure 83a

Facial fovea wide, occupying most of space between compound eye and lateral ocellus (fig 83b) 12	Figure 83b
12(11). Head with at least a few black hairs along inner orbits (fig 84a) 13	Figure 84a
Pubescence of head and thorax entirely pale (fig 84b). 14	Figure 84b

13(12). Most of head, and thorax laterally and beneath, black pubescent (fig 85a) (female) . . . . . ***Andrena clarkella*** Kirby (App. C, Map 12)	Figure 85a
Pleura and middle of face covered with copious pale pubescence (fig 85b) (female) . . . ***Andrena frigida*** Smith (App. C, Map 14)	Figure 85b

14(12). Length of malar space fully one third basal width of mandible (fig 86a) (female) . . ***Andrena rufosignata*** Cockerell (App. C, Map 23)	Figure 86a
Malar space short, about one-fourth basal width of mandible (fig 86b) (female). . . . . ***Andrena thaspii*** Graenicher (App. C, Map 25)	Figure 86b

15(10).Mid basitarsus widest at midpoint (fig 87a) 16	 Figure 87a
Mid basitarsus parallel sided (fig 87b) 17	 Figure 87b

16(15).Apical pale fasciae on T1-T5 wide, covering about half of disc (fig 88a); pubescence copious yellow (fig 89a) (female).

Andrena columbiana

Viereck
(App. C, Map 13)

Figure 88a

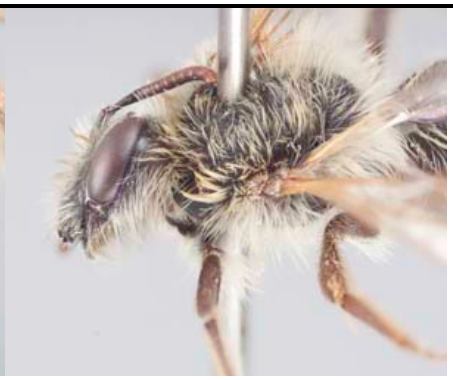


Figure 89a

Apical pale fasciae on T2-T5 narrow (fig 88b); pubescence sparser, especially on mesoscutum and mesoscutellum (fig 89b) (female)

Andrena canadensis

Dalla Torre
(App. C, Map 11)

Figure 88b

Figure 89b

17(15). Pleura strongly, angulately protuberant below, pubescence sparser below (fig 90a) (female).

Andrena persimulata

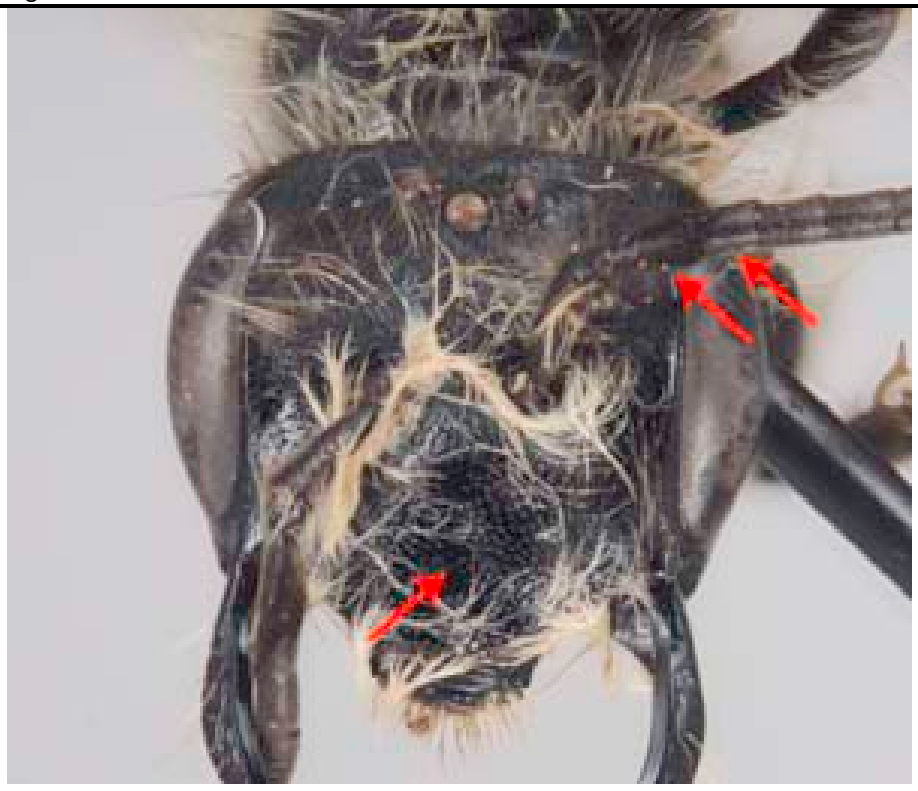
Viereck
(App. C, Map 20)

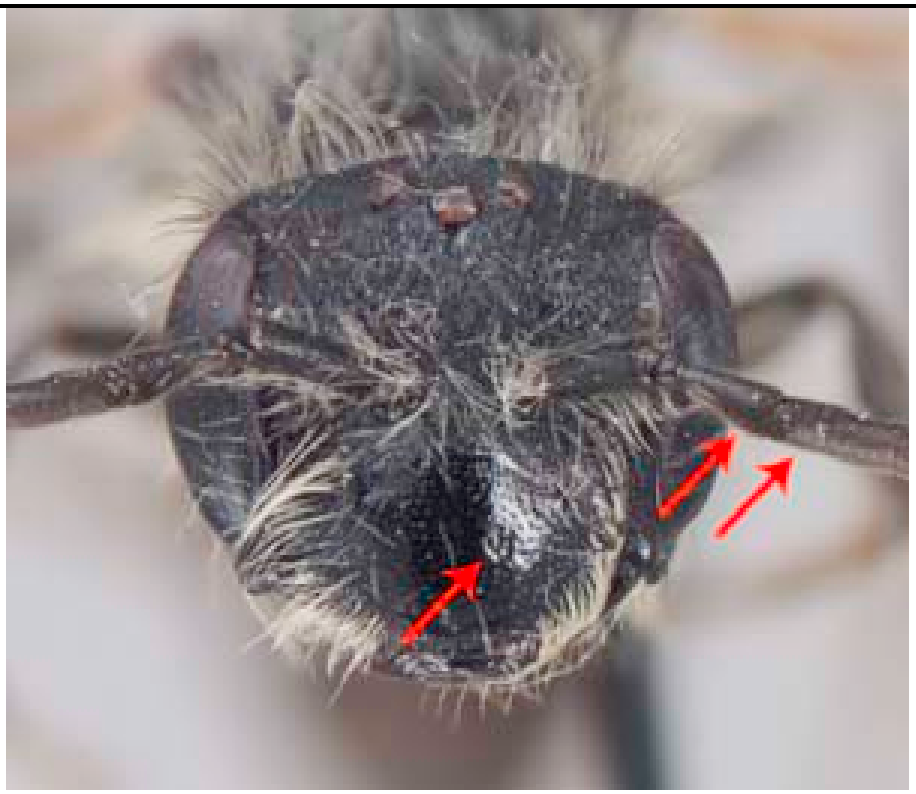
	Figure 90a
Pleura rounded below, not at all protuberant, pubescence very dense throughout (fig 90b) (female) . . . ***Andrena barbilabris*** (Kirby) (App. C, Map 10)	 Figure 90b
18(1). Clypeus with pale maculation (fig 91a). 19	 Figure 91a

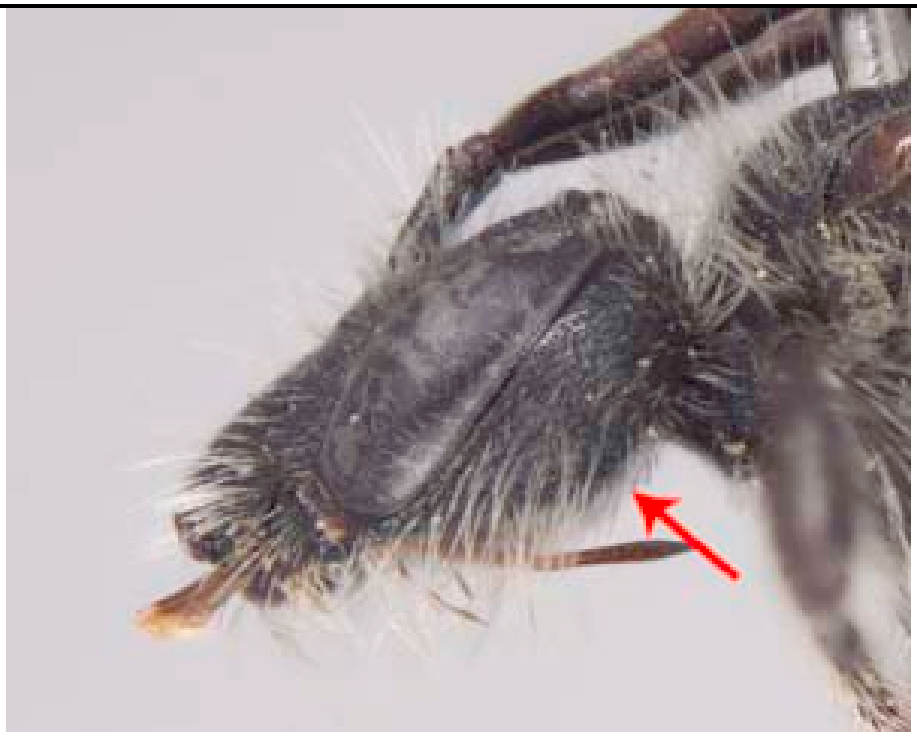
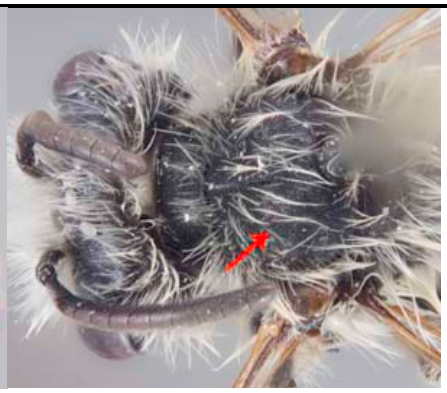
Clypeus entirely black (fig 91b). 20	 Figure 91b
19(18). With two submarginal cells (fig 92a) (male) . . . . . ***Andrena wellesleyana*** Robertson (App. C, Map 26)	 Figure 92a

With three submarginal cells (fig 92b) (male) . . . . ***Andrena prunorum*** Cockerell (App. C, Map 21)	 Figure 92b
20(18).Posterior margin of gena sharply and conspicuously carinate (fig 93a) (male) . . . . . . ***Andrena persimulata*** Viereck (App. C, Map 20)	 Figure 93a

Cheeks at most with a posterior angle, often broadly rounded, at most, subcarinate (fig 93b) 21	Figure 93b
21(20). Mandible with a distinct basal inferior angle or tooth (fig 94a) 22	Figure 94a

Mandible lacking the basal angle or tooth (fig 94b) 23	 Figure 94b
22(21).Flagellar segment 1 about as long as segment 2(fig 95a); clypeus flattened, punctures sparse medially, sometimes with impunctate line (fig 95a) (male) . . . . . ***Andrena rufosignata*** Cockerell (App. C, Map 23)	 Figure 95a

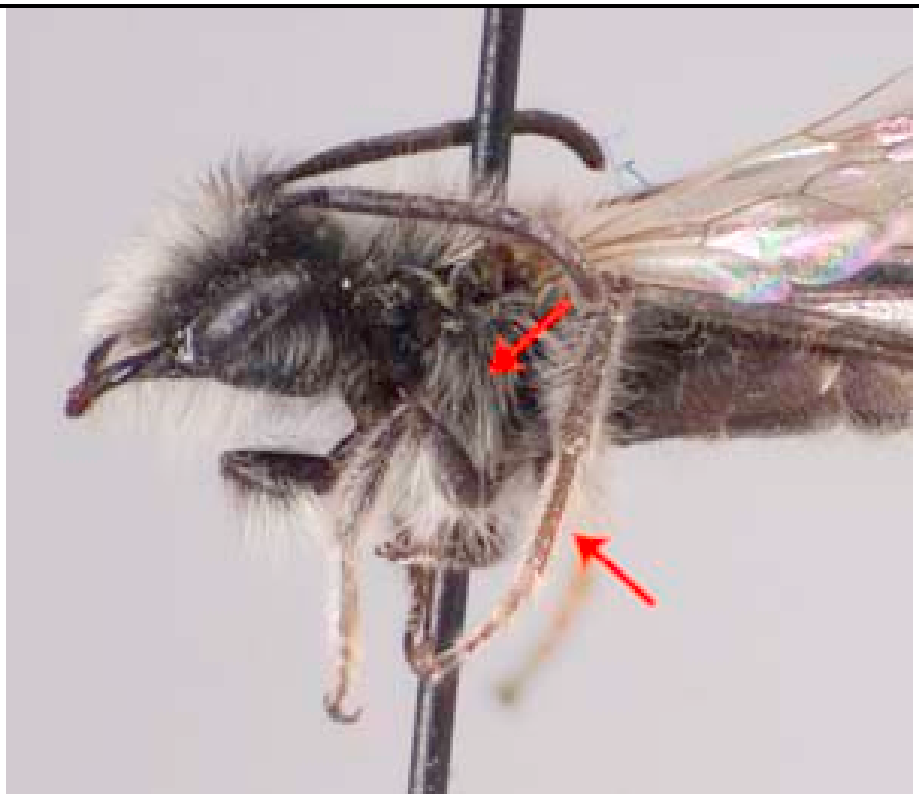
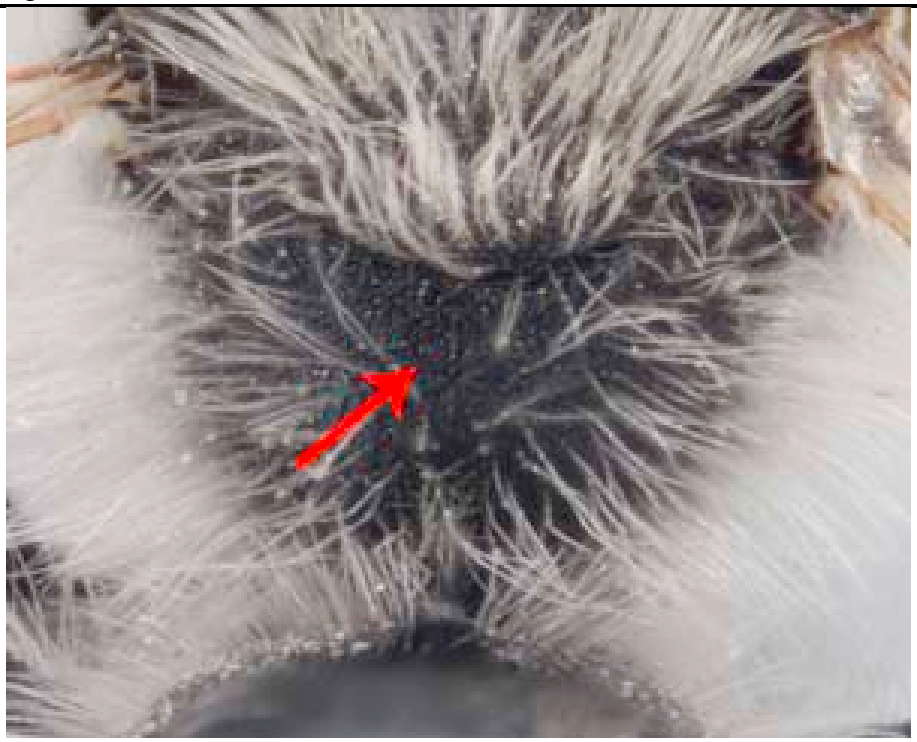
Flagellar segment 1 longer than segment 2(fig 95b); clypeus convex, punctures sparse to dense medially (fig 95b) (male) . . . . . ***Andrena milwau-keensis*** Graenicher (App. C, Map 17)	 Figure 95b
23(21).Gena very broad and flat, posterior margin to some degree angulate (fig 96a). . . . 24	Figure 96a

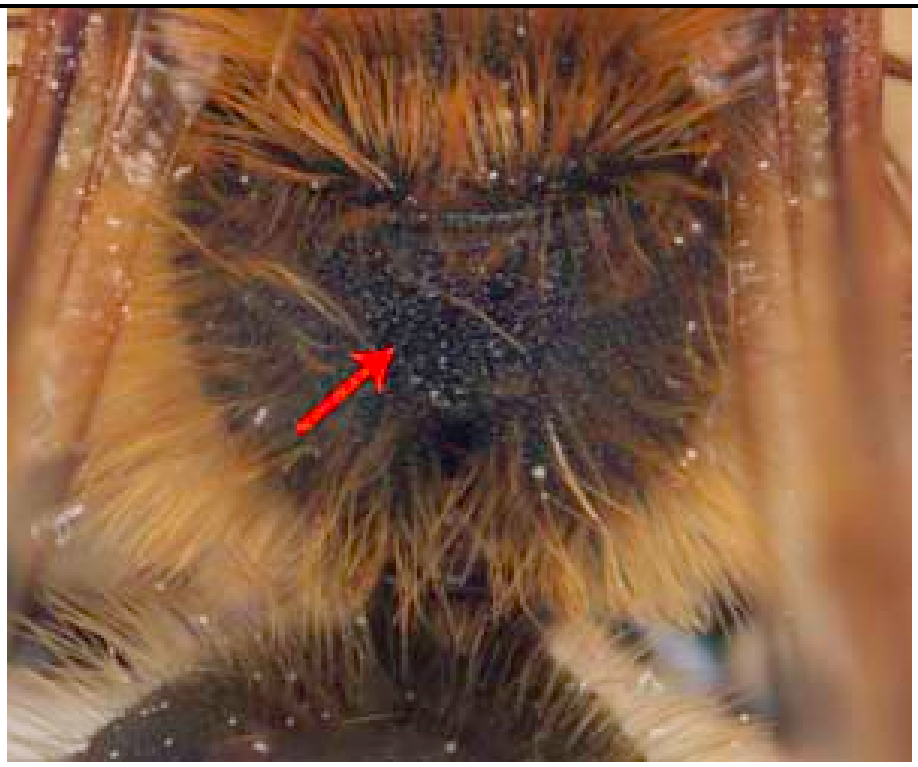
Gena more narrow, margin broadly rounded (fig 96b) 28	 Figure 96b
24(23). Abdomen, as well as head and thorax, clothed with long, erect, yellow pubescence, forming broad, distinct, apical least apically and toward sides of the fasciae (fig 97a); scutum densely tessellate and terga (fig 98a) (male). . . ***Andrena columbiana*** Viereck (App. C, Map 13)	 Figure 97a  Figure 98a

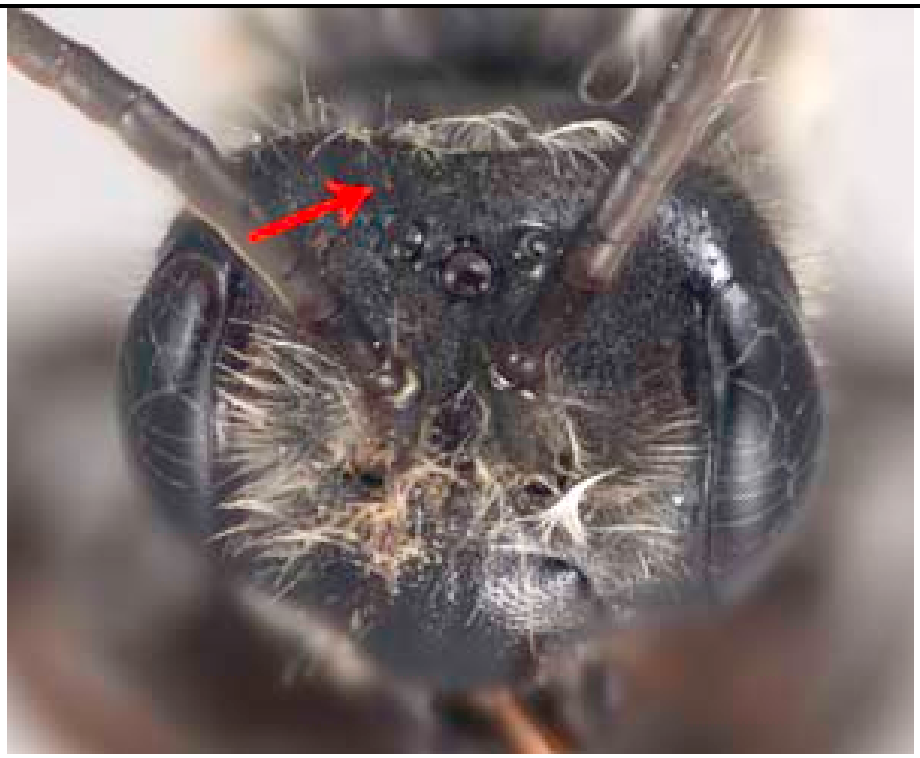
Pubescence of abdomen short and inconspicuous (fig97b); scutum to some degree punctate (fig 98b) 25	Figure 97b Figure 98b
25(24). Malar space indistinct, or lacking (fig 99a) (male) . . . . . ***Andrena canadensis*** Dalla Torre (App. C, Map 11)	Figure 99a

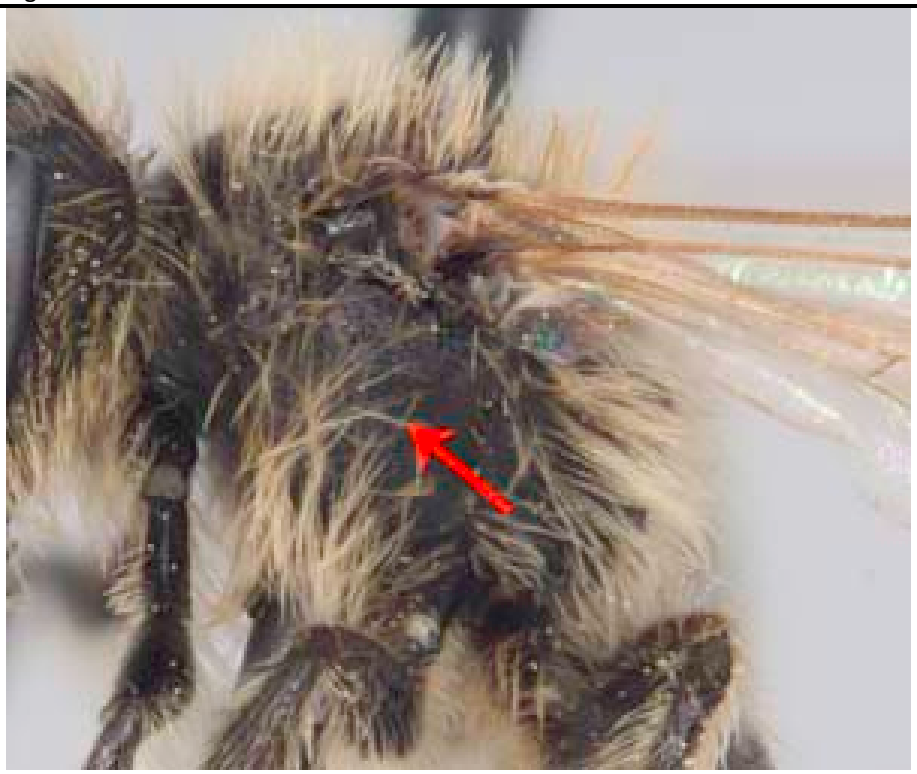
Malar space distinct (fig 99b) 26	 Figure 99b
26(25). Face and gena with mostly yellowish pubescence, only with some brown hairs along inner orbits (fig 100a) (male) . . ***Andrena thaspii*** Graenicher (App. C, Map 25)	 Figure 100a

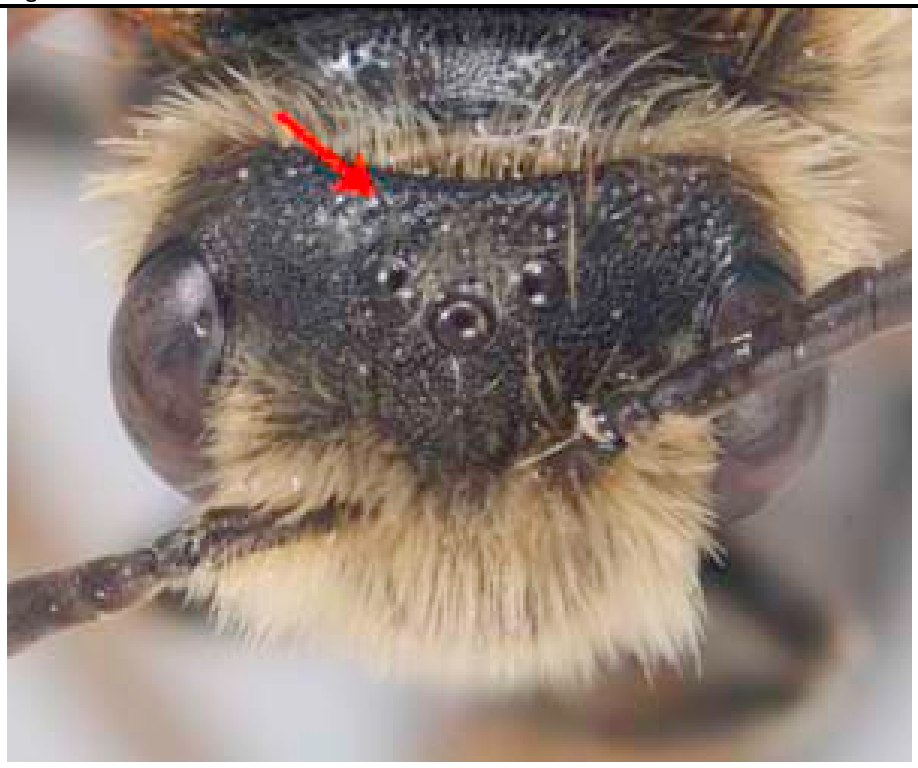
Face with very long pubescence, mostly white medially, but with black hairs along inner orbits, on gena, and generally intermixed with pale hairs on face, mesopleuron, and lateral propodeum (fig 100b) 27	 Figure 100b
27(26). Hind tibiae and tarsi ferruginous (fig 101a); mesopleuron with dark pubescence (fig 101a) (male) . . . . . ***Andrena clarkella*** Kirby (App. C, Map 12)	 Figure 101a

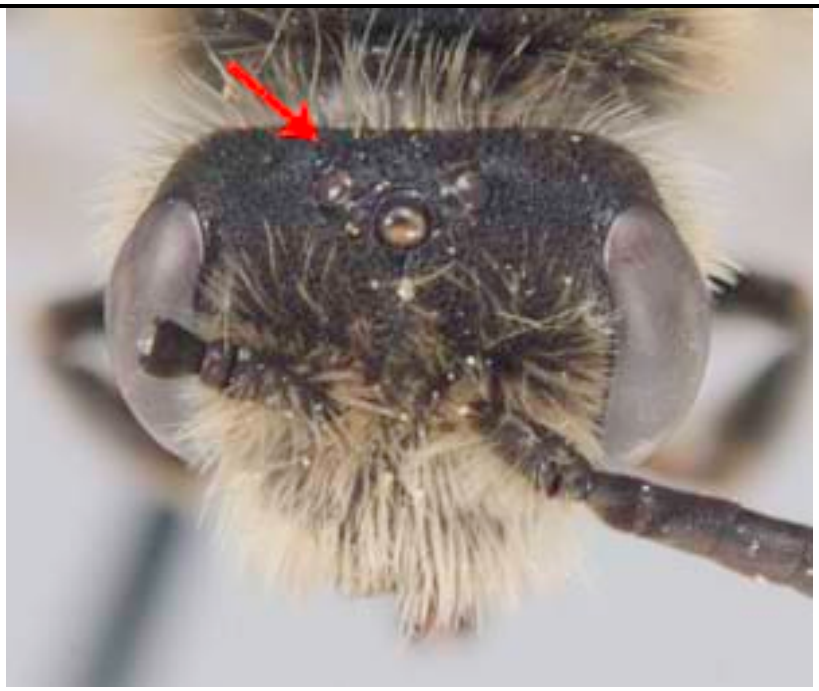
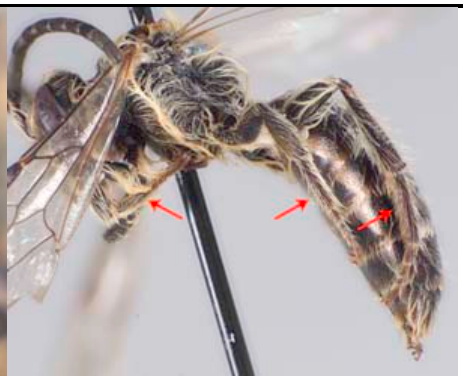
Hind tibiae and tarsi dark, concolourous with the other legs (fig 101b); mesopleuron with pale pubescence (fig 101b) (male) . . ***Andrena frigida*** Smith (App. C, Map 14)	 Figure 101b
28(23).Enclosure of propodeum usually relatively smooth (fig 102a) 29	 Figure 102a

Enclosure of propodeum coarsely rugose or striate (fig102b). 31	 Figure 102b
29(28). Diameter of lateral ocellus fully equal to space separating it from margin of vertex (fig103a) 30	 Figure 103a

Lateral ocellus separated from margin of vertex by a space greater than its diameter (fig 103b) (male) . . . . ***Andrena regularis*** Malloch (App. C, Map 22)	 Figure 103b
30(29). Face, including clypeus, with much long blackish pubescence (fig 104a) (male) . . . . . . ***Andrena algida*** Smith (App. C, Map 9)	 Figure 104a

Face usually entirely pale pubescent, but if any dark hairs present, limited to inner orbits or upper portion of head (fig 104b) (male) . . . . . ***Andrena barbilabris*** (Kirby) (App. C, Map 10)	Figure 104b
31(28). Posterior half of mesopleuron relatively smooth, more tessellate than rugose (fig 105a) (male). . ***Andrena mariae concolor*** Robertson (App. C, Map 16) Sometimes with abdomen bright ferruginous (see fig81c) (male). . . . . ***Andrena mariae mariae*** Robertson (App. C, Map 16)	 Figure 105a

Mesopleuron uniformly and coarsely rugose throughout (fig 105b) 32	 Figure 105b
32(31). Punctures of vertex rather coarse and distinct, interspaces to some degree shining (fig 106a) (male) . . . . . ***Andrena miranda*** Smith (App. C, Map 18)	 Figure 106a

Vertex dull and tessellate, punctures obscure (fig 106b) 33	 Figure 106b
33(32). Punctures of clypeus rather fine and crowded, especially over upper half (fig 107a); legs with yellow markingson tibiae and basitarsi (fig 108a) (male) . . . . . ***Andrena hippotes*** Robertson (App. C, Map 15)	 Figure 107a Figure 108a
Punctures of clypeus rather coarse, uniformly although not widely separated (fig 107b); basitarsi entirely brown-black(fig 108b) (male). . . ***Andrena sigmundi*** Cockerell (App. C, Map 24)	 Figure 107b  Figure 108b

B3: Key to bee species in the Halictidae family

Dufourea

Dufourea is a relatively uncommon genus of bees in Canada. This is the only Canadian genus in the family Halictidae with only two submarginal cells on the forewing. This species is small and black with pale whitish hairs. The head is wider than long and the antennae arise low on the face. The clypeus is therefore quite short relative to that of other bee genera. .....

Dufourea fimbriata
(App. C, Map 27)

Halictus

1. Antennae with 12 segments (fig 109a); scopa present on hind legs (fig 110a) [females] 2

Figure 109a

Figure 110a

Antennae with 13 segments (fig 109b); scopa absent on hind legs (fig 110b) [males] 4	Figure 109b Figure 110b
2(1). Body non-metallic, black (fig 111a); hind tibia and tarsi reddish(fig 112a) . (female). . . . . ***Halictus (Protohalictus) rubicundus*** (Christ) (App. C, Map 28)	Figure 111a Figure 112a
Body dull metallic green (fig111b- virgatellus); hind tibia and tarsi brownish (fig112b- virgatellus). . . . 3	Figure 111b Figure 112b

3(2). Size small (<7mm); terga with metallic reflection, densely punctate, including apical areas (fig 113a) (female). . . . . ***Halictus (Seladonia) virgatellus*** Cockerell (App. C, Map 29)	Figure 113a
Size larger (>8mm); terga without metallic reflection, more sparsely punctate, punctures much reduced on apical areas(fig 113b) (female) . . . . . ***Halictus (Seladonia) confusus*** Smith (no map)	Figure 113b

4(1).Body non-metallic, black (fig 114a); antenna entirely dark, clypeus with apical half yellow(fig 115a); S5 broadly emarginate, surface concave(fig 116a); S6 straight, without a depression(fig 117a) (male)

Halictus (Protohalictus) rubicundus

(Christ)
(App. C, Map 28)

Figure 114a

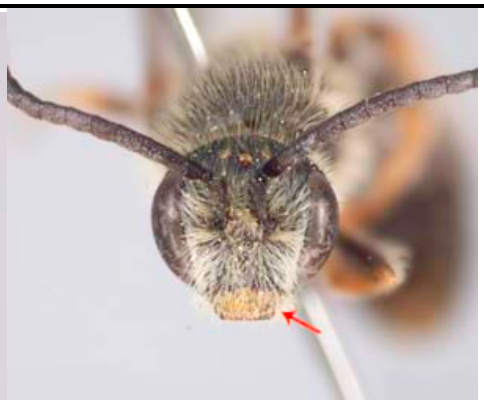


Figure 115a

Figure 116a

Figure 117a

Body dull metallic green(fig 114b); antenna bright or yellow below, clypeus sparsely punctate(fig 115b); S5 with surface not emarginated (fig 116b); S6 with a deep basomedial depression(fig 117b) 5

Figure 114b

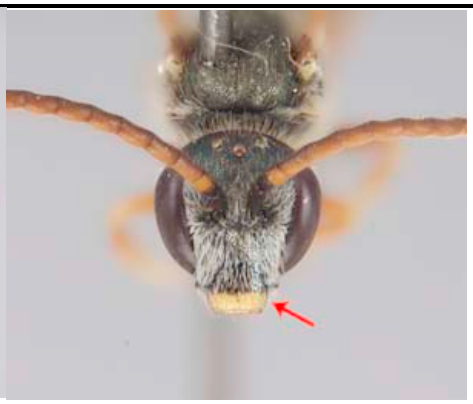


Figure 115b

	Figure 116b Figure 117b
5(4).Femor on all legs yellow(fig 118a); S5 with apical margin strongly concave(fig 119a) (male). . . ***Halictus (Seladonia) virgatellus*** (App. C, Map 29)	Figure 118a Figure 119a
Femor on all legs brown(fig 118b); S5 with apical margin straight(fig 119b) (male) ***Halictus (Seladonia) confusus*** Smith (no map)	Figure 118b Figure 119b

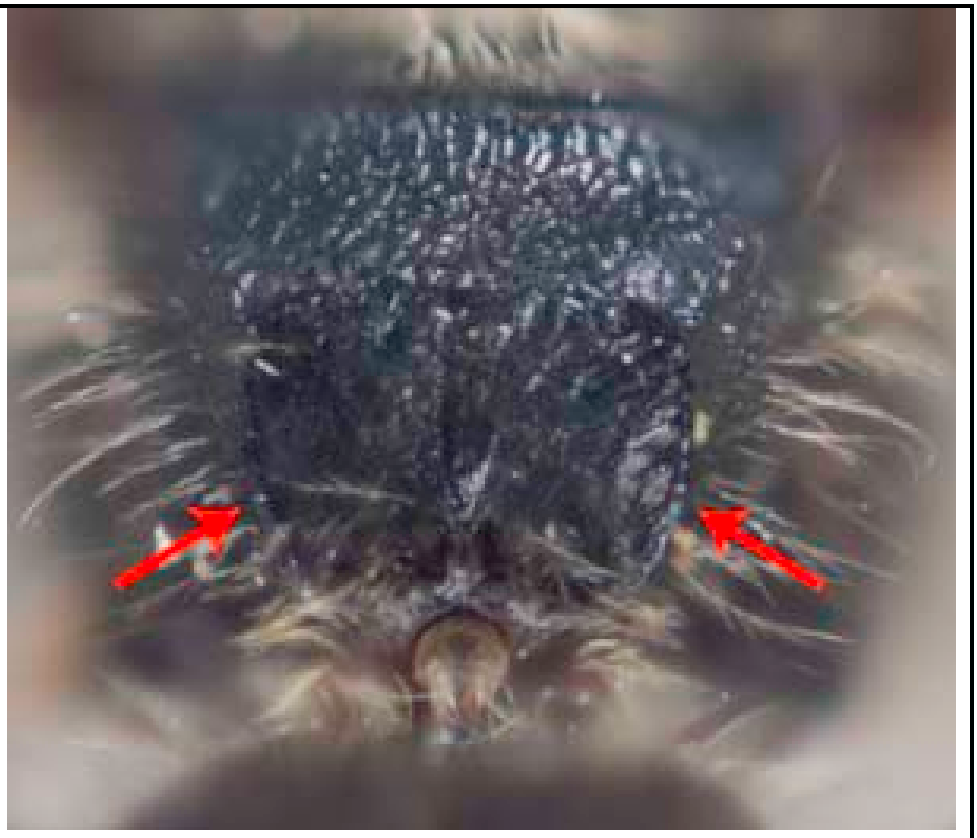
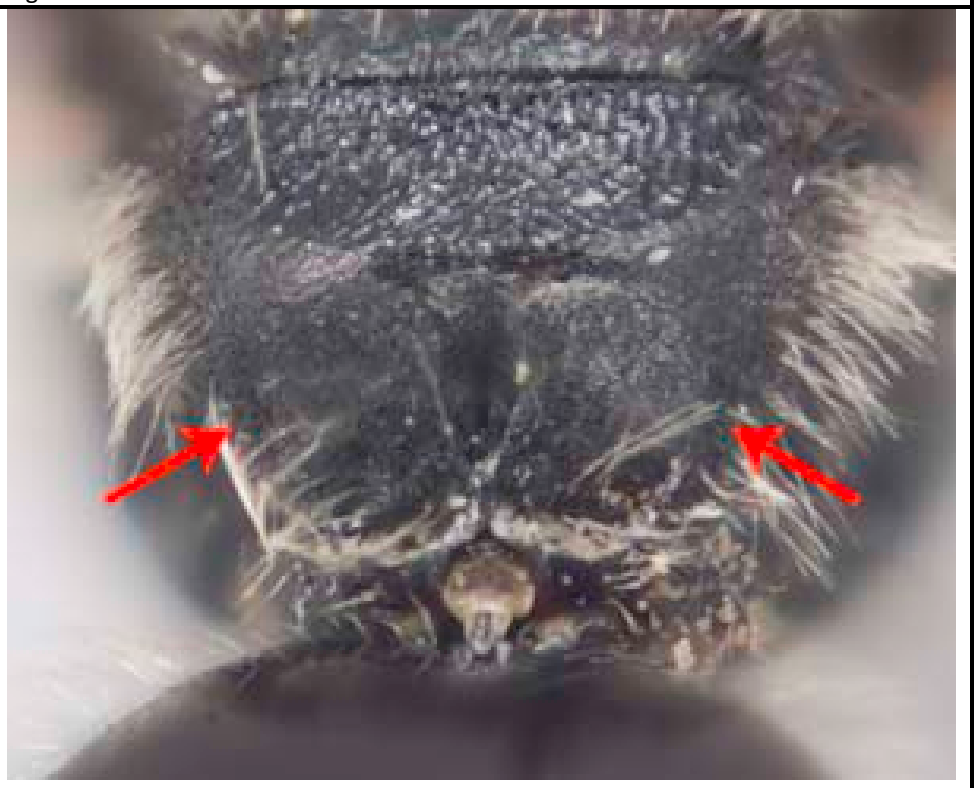
Lasioglossum

1. Antennae with 12 segments (fig120a); scopa present on hind legs (fig 121a); metasoma with 6 visible segments (fig 122a) [females] 2	Figure 120a Figure 121a

	 Figure 122a
Antennae with 13 segments (fig120b); scopa absent on hind legs (fig121b); metasoma with 7 visible segments (fig 122b) [males] 11	 Figure 120b Figure 121b

	 Figure 122b
2(1). T2-T4 with basal hair bands (fig 123a); second transverse cubital vein as strong as first, and stronger than third (fig 124a) (female). . . . . ***Lasioglossum (Lasioglossum) athabascense*** Mitchell (App. C, Map 30)	 Figure 123a Figure 124a
T2-T4 without basal hair bands (fig 123b); second transverse cubital vein weaker than first, more similar to third (fig124b) 3	 Figure 123b Figure 124b

3(2). Integument non-metallic (fig 125a) 4	 Figure 125a
Integument metallic to dull metallic (fig125b) [SG *Dialictus* in part]. 8	 Figure 125b

4(3). Propodeum with carina (fig 126a) [SG *Evylaeus*]. 5	 Figure 126a
Propodeum without carina (fig 126b) [SG *Dialictus* in part] 7	 Figure 126b

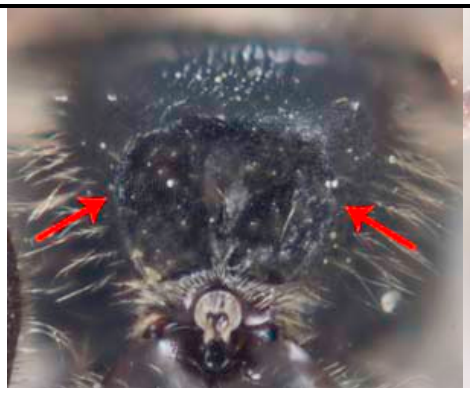
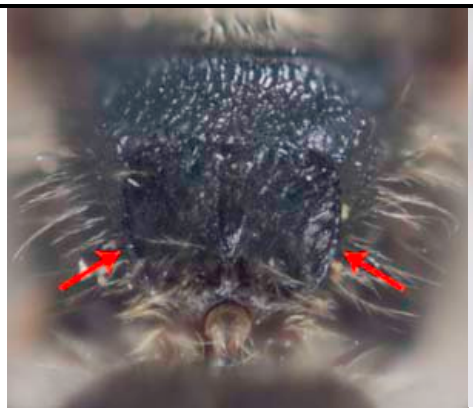
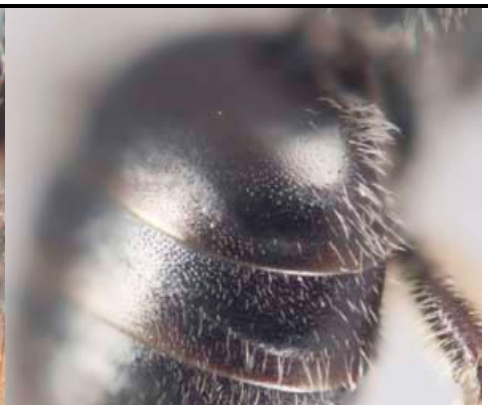
5(4).Propodeum with carina fine and obscure (fig 127a); lower paraocular area densely punctate (fig 128a) (female). . . . . ***Lasioglossum (Evylaeus) boreale*** Svensson, Ebmer and Sakagami (no map)	 Figure 127a Figure 128a
Propodeum with carina coarse and distinct (fig 127b); lower paraocular area sparsely punctate below antennal sockets (fig 128b). 6	 Figure 127b Figure 128b
6(5).Head broader than long (0.93-0.96 L:B) (fig 129a) (female). . . . . ***Lasioglossum (Evylaeus) comagenense*** (Knerer and Atwood) (App. C, Map 31)	

	Figure 129a
Head about as broad as long to slightly longer than broad (0.98-1.00 L:B) (fig 129b) (female) . . . . . ***Lasioglossum (Evylaeus) quebecense*** (Crawford) (App. C, Map 35)	Figure 129b
7(4). Mesoscutellum sparsely punctate, with shiny discs (fig 130a); T1 with lateral punctures dense, T2 with deep punctures extending beyond basal half, sometimes to apex (fig 131a) (female) . . . . . ***Lasioglossum (Dialictus) pulveris*** (Cockerell) (App. C, Map 34)	Figure 130a Figure 131a

Mesoscutellum densely punctate (fig 130b); T1 with lateral punctures sparse, T2 with shallow punctures at most restricted to basal half (fig 131b) (female). . . . . ***Lasioglossum (Dialictus) rufitarse*** (Zetterstedt) (no map)	Figure 130b  Figure 131b
8(3).Mesoscutal punctation between parapsidal lines dense, interspaces between parapsidal lines mostly or entirely less than one puncture diameter (fig 132a)(female) . . . . . ***Lasioglossum (Dialictus) pavoninum*** (Ellis) (App. C, Map 32)	Figure 132a

Mesoscutal punctation between parapsidal lines moderately sparse, interspaces typically more than one puncture diameter (fig 132b) 9	 Figure 132b
9(8).Mesepisternum with distinct punctures at 40X magnification (fig 133a), if punctures somewhat obscure then the metasomal terga with strong metallic reflections. (female) . . . . . ***Lasioglossum (Dialictus) tenax*** (Sandhouse) (App. C, Map 36)	 Figure 133a

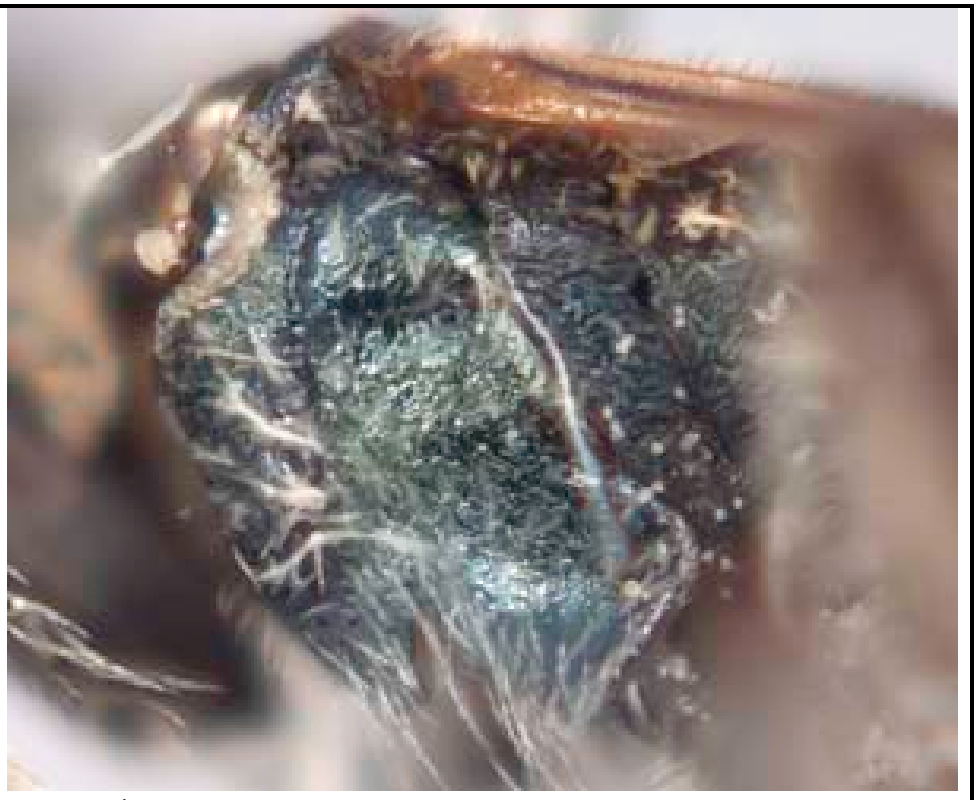
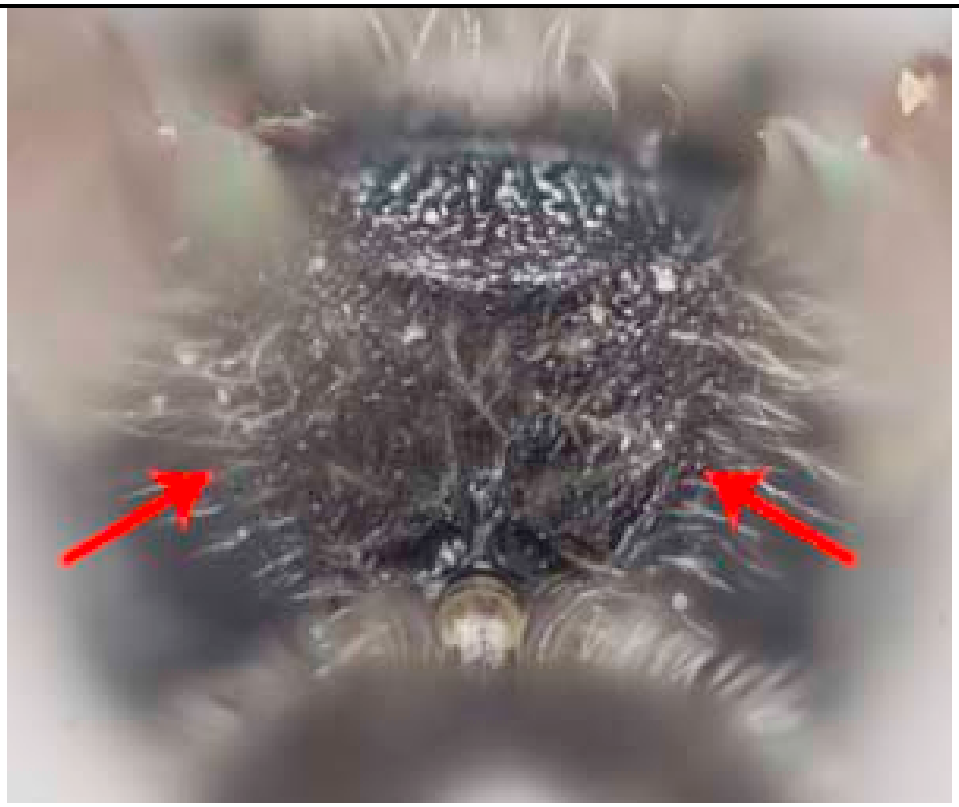
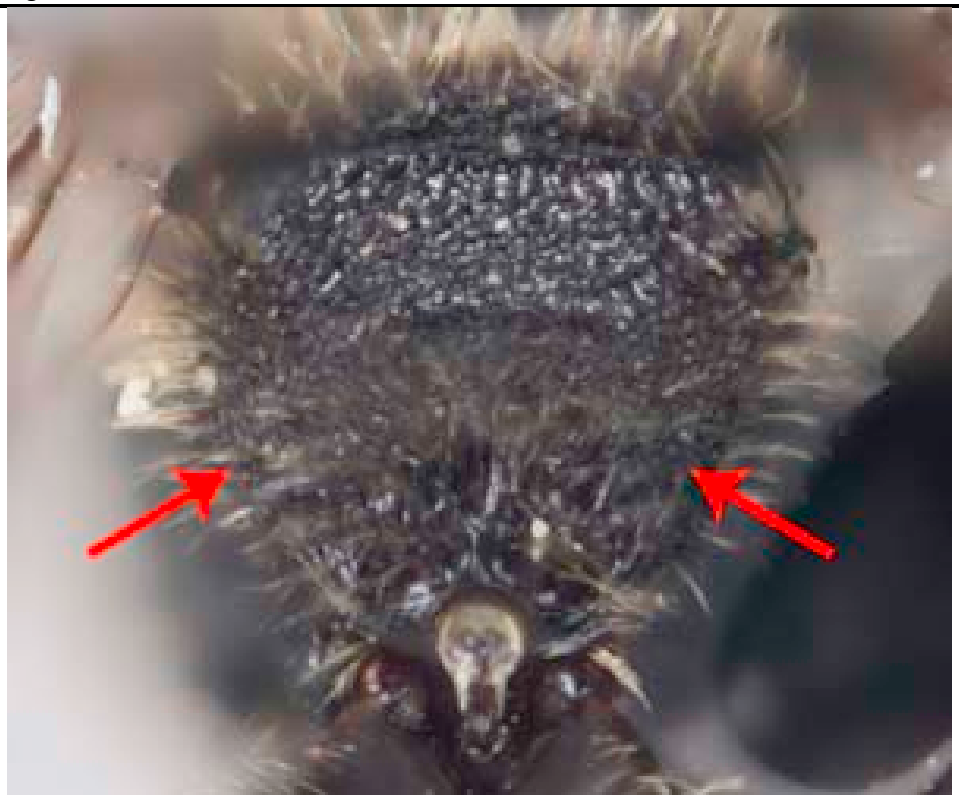
Mesepisternum without punctures (fig 133b), if any obscure punctures are present then the metasomal terga without metallic reflections (female). . . . . ***Lasioglossum (Dialictus) planatum*** (Lovell) (App. C, Map 33)	 Figure 133b
10(1). Relatively hairy, especially head and mesosoma (fig 134a); T1-T4 with basal hair bands, apical areas of T1-T3 as densely punctate as basal areas (fig 135a) (female). . . ***Lasioglossum (Lasioglossum) athabascense*** Mitchell (App. C, Map 30)	Figure 134a

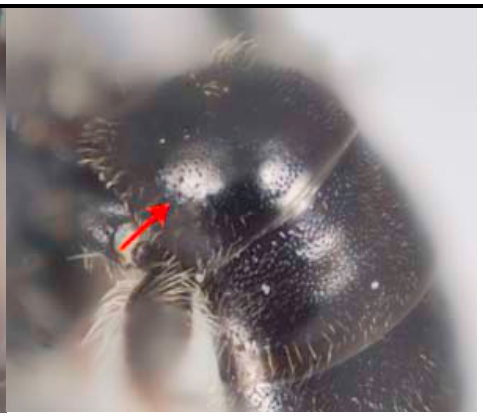
	Figure 135a
Less hairy, not as above (fig134b); T1-T4 without basal hair bands, apical areas of T1-T3 sparsely punctate to impunctate (fig135b) 11	Figure 134b Figure 135b

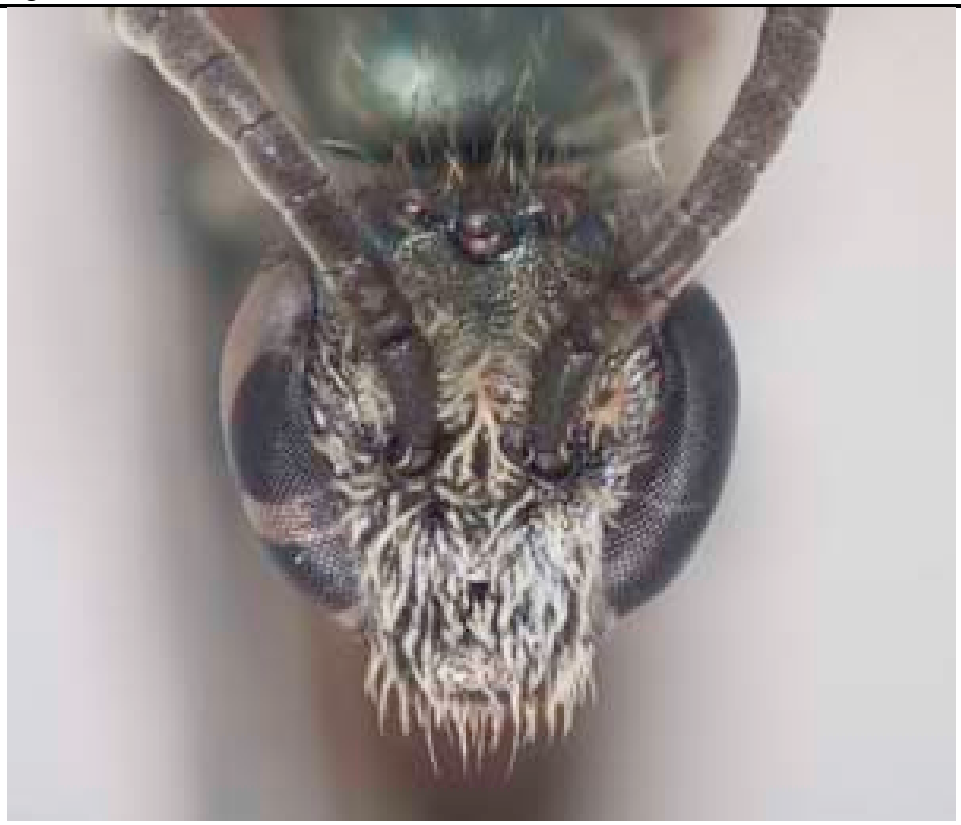
11(10). Integument non-metallic (fig 136a) 12	 Figure 136a
Integument metallic to dull metallic (fig136b) [SG *Dialictus* in part] 16	 Figure 136b

12(11). Propodeum with carina (fig137a) [SG *Evylaeus*]. 13	 Figure 137a
Propodeum without carina (fig 137b) [SG *Dialictus* in part] 15	 Figure 137b

13(12). Sterna 2-3 densely punctate, punctures deep (fig 138a) (male) . . . . . ***Lasioglossum (Evylaeus) boreale*** Svensson, Ebmer and Sakagami (no map)	Figure 138a
Sterna2-3sparsely punctate, punctures shallow (fig138b). 14	Figure 138b

14(13).Terga 1-3 very minutely punctate basally (fig 139a)(male) . . . . . ***Lasioglossum (Evylaeus) comagenense*** (Knerer and Atwood) (App. C, Map 31)	Figure 139a
Terga 1-3 densely and deeply punctate basally (fig 139b) (male). . . . . ***Lasioglossum (Evylaeus) quebecense*** (Crawford) (App. C, Map 35)	Figure 139b

15(12). Propodeum finely rugose, posterior surface smooth and punctate (fig 140a); T1 with lateral punctures dense (fig 141a) (male) . . . . . ***Lasioglossum (Dialictus) pulveris*** (Cockerell) (App. C, Map 34)	Figure 140a Figure 141a
Propodeum coarsely rugose, posterior surface roughened (fig 140b); T1 with lateral punctures sparse(fig 141b) (male). . . . ***Lasioglossum (Dialictus) rufitarse*** (Zetterstedt) (no map)	Figure 140b  Figure 141b

16(11).Clypeus with apical margin yellow (fig 142a) (male) . . . . . ***Lasioglossum (Dialictus) pavoninum*** (Ellis) (App. C, Map 32)	Figure 142a
Clypeus with apical margin brown or reddish brown (fig142b) (male) . . . . . ***Lasioglossum (Dialictus) tenax*** (Sandhouse) (App. C, Map 36)	 Figure 142b

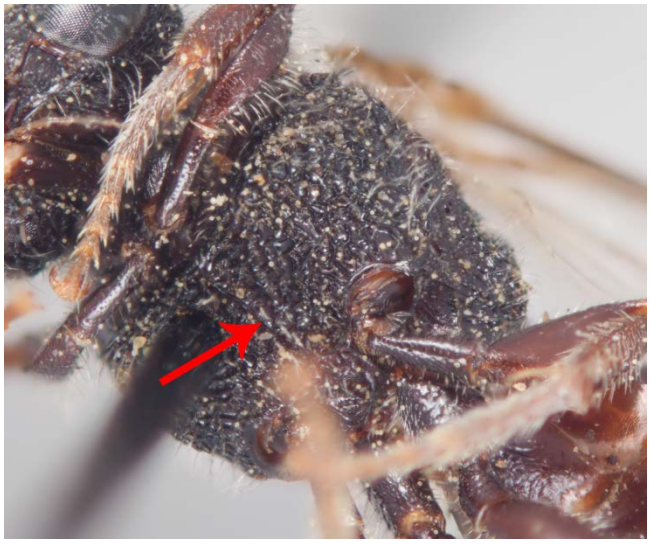
Sphecodes

1. Antennae with 10 flagellomeres (fig 143a); metasoma with 6 visible segments (fig144a) [females] . . 2	Figure 143a Figure 144a
Antennae with 11 flagellomeres (fig 143b); metasoma with 7 visible segments (fig 144b) [males] 4	Figure 143b Figure 144b
2(1).Terga deeply and densely punctate (fig 145a) (female) . . . . . ***Sphecodes prosphorus*** Lowll & Cockerell (no map)	Figure 145a

Terga finely and sparsely punctate (fig 145b) 3	 Figure 145b
3(2).Face below ocelli shining, the punctures sparse and very fine, but deep and distinct (fig 146a) (female) . . . .. ***Sphecodes solonis*** Graenicher (no map)	 Figure 146a

Face below ocelli closely punctate (fig 146b) (female) . . . . . ***Sphecodes dichrous*** Smith (no map)	Figure 146b
4(1).Segments of flagellum of the usual form, or the facets very narrow or very obscure (fig 147a) (male) . . . . . ***Sphecodes solonis*** *Graenicher* (no map)	Figure 147a

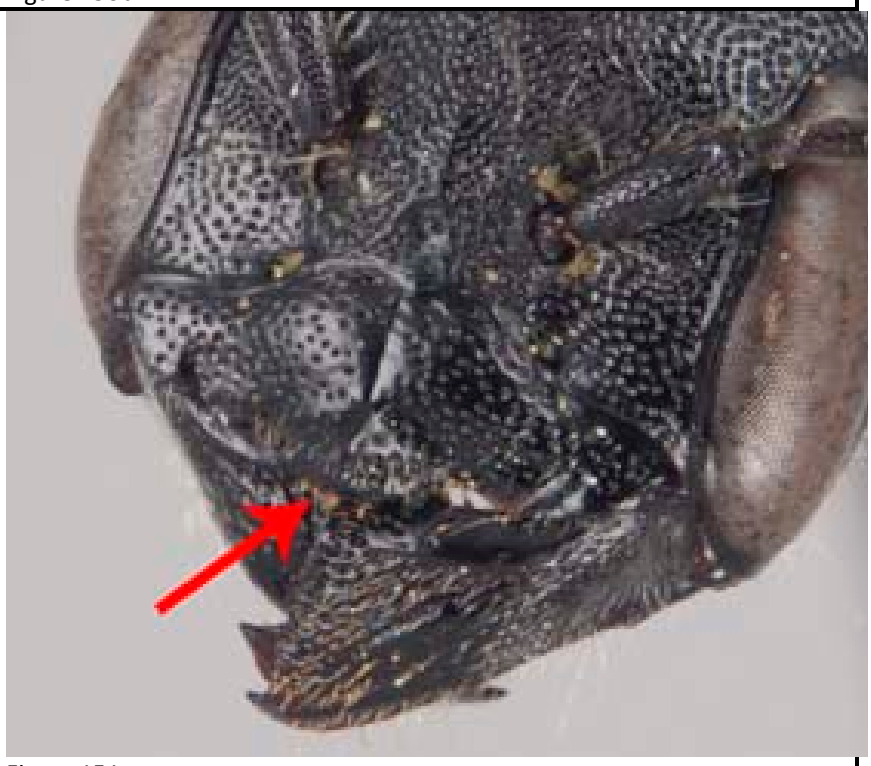
Segments of flagellum beneath with basal, densely pilose, semicircular facets (fig 147b). 5	Figure 147b
5(4). Terga reddish (usually T1-T3)(fig 148a); venter of mesosoma finely sculptured, with dense white hair (fig 149a) (male) . . . ***Sphecodes prosphorus*** Lowll & Cockerell (no map)	Figure 148a

	Figure 149a
Terga entirely dark (fig 148b); venter of mesosoma rugulose and nearly bare (fig 149b) (male) . . . . . ***Sphecodes dichrous*** Smith (no map)	Figure 148b  Figure 149b

B4: Key to bee species in the Megachilidae family

Hoplitis

1. Antennae with 12 segments (fig 150a) [females] 2	Figure 150a

Antennae with 13 segments (fig 150b) [males] 4	Figure 150b
2(1). Clypeus modified, with a conspicuous, median, erect, apical tubercle (fig 151a) (female) . . . . ***Hoplitis (Fomicapis) robusta*** Sladen (App. C, Map 38)	 Figure 151a

Clypeus little if any modified, apical margin relatively straight (fig 151b) 3	 Figure 151b
3(2). Pleura, legs and abdominal terga 4-6 black pubescent (fig 152a) (female). . . . . ***Hoplitis (Monumetha) albifrons*** Kirby (App. C, Map 37)	 Figure 152a

Abdominal terga, legs and pleura white pubescent (fig 152b)(female) . . . . ***Hoplitis (Andronicus) spoliata*** Cresson (App. C, Map 39)	Figure 152b
4(1). Abdominal tergum 7 undulate apically, having a median and a pair of lateral, shallow emarginations (fig 153a)(male).. ***Hoplitis (Formicapis) robusta*** Sladen (App. C, Map 38)	Figure 153a

Tergum 7 either rounded, truncate, or acute apically (fig 153b) 5	Figure 153b
5(4). Antennal flagellar segments 3-5 very short and broadly dilated, much broader than the other segments; apical width of scape greater than length of segment 1 (fig 154a)(male) . . . . ***Hoplitis (Andronicus) spoliata*** Cresson (App. C, Map 39)	Figure 154a

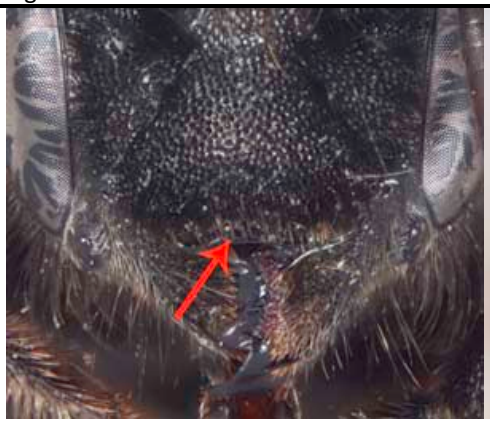
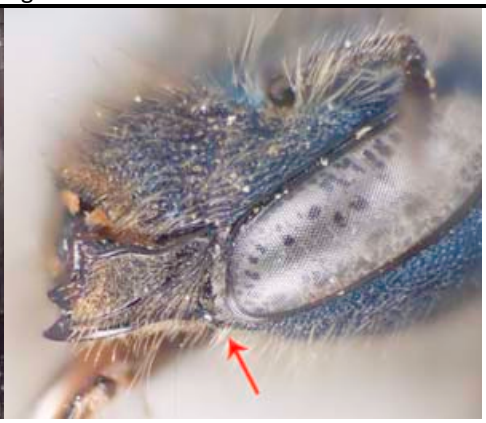
Antennal flagellar segments 3-5 little if any broader than long, not noticeably dilated; apical width of scape less than or equal to length of segment 1 (fig 154b) (male). . . .

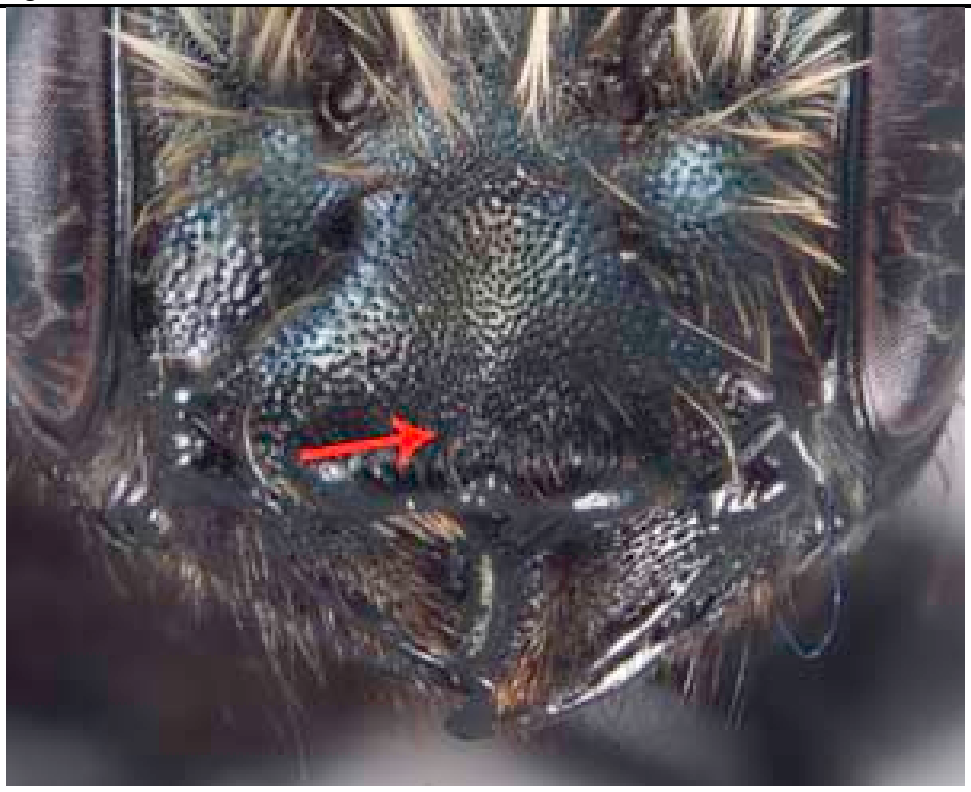
Hoplitis (Monumetha) albifrons Kirby (App. C, Map 37)

Figure 154b

Osmia

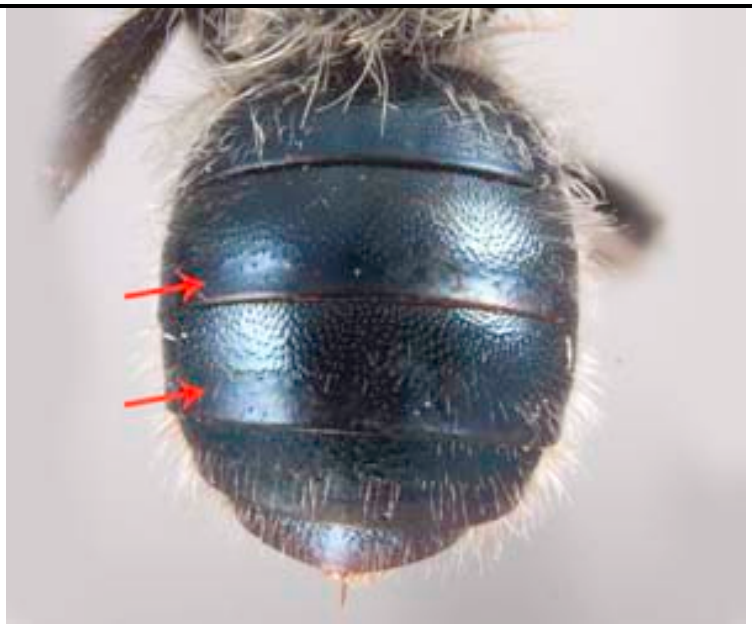
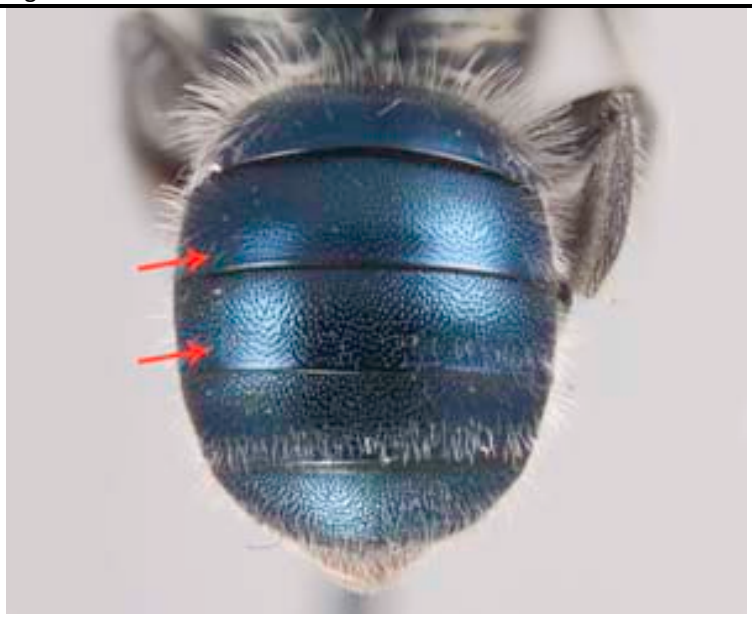
1. Antennae with 12 segments (Fig 155a) [females] 2	Figure 155a

Antennae with 13 segments (Fig 155b) [males] 15	Figure 155b
2(1). Apical margin of clypeus strongly thickened (fig 156a); malar space present (fig 157a) 3	Figure 156a Figure 157a
Apical margin of clypeus not strongly thickened (fig 156b); malar space absent (fig 157b) 4	 Figure 156b  Figure 157b

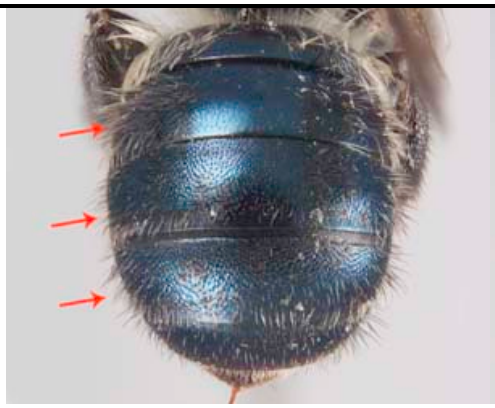
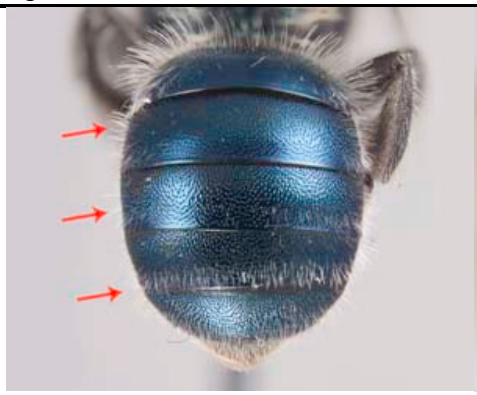
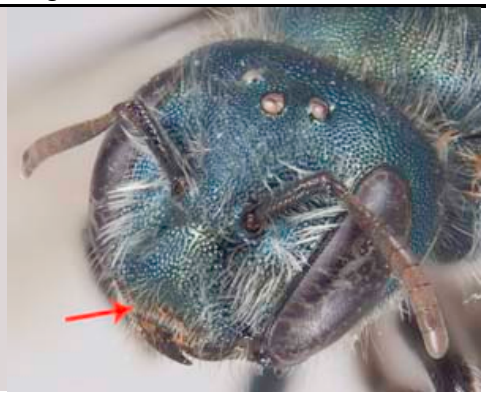
3(2). Entirely black; clypeus with a rather short, median, raised line toward apical margin, gradually thickened toward the margin (fig 158a) (female). . ***Osmia nigriventris*** (Zetterstedt) (no map)	Figure 158a
Black, with bluish-green reflections; clypeus without a median raised line, the margin abruptly thickened (fig 158b) (female) . . . . . ***Osmia bucephala*** Cresson (App. C, Map 40)	 Figure 158b

4(2). Front basitarsus compressed, outer face slightly concave (fig 159a) . (female) . . . . . ***Osmia (Monilosmia) simillima*** Smith (no map)	Figure 159a
Front basitarsus but slightly compressed, outer face not at all concave (fig 159b) . . 5	Figure 159b

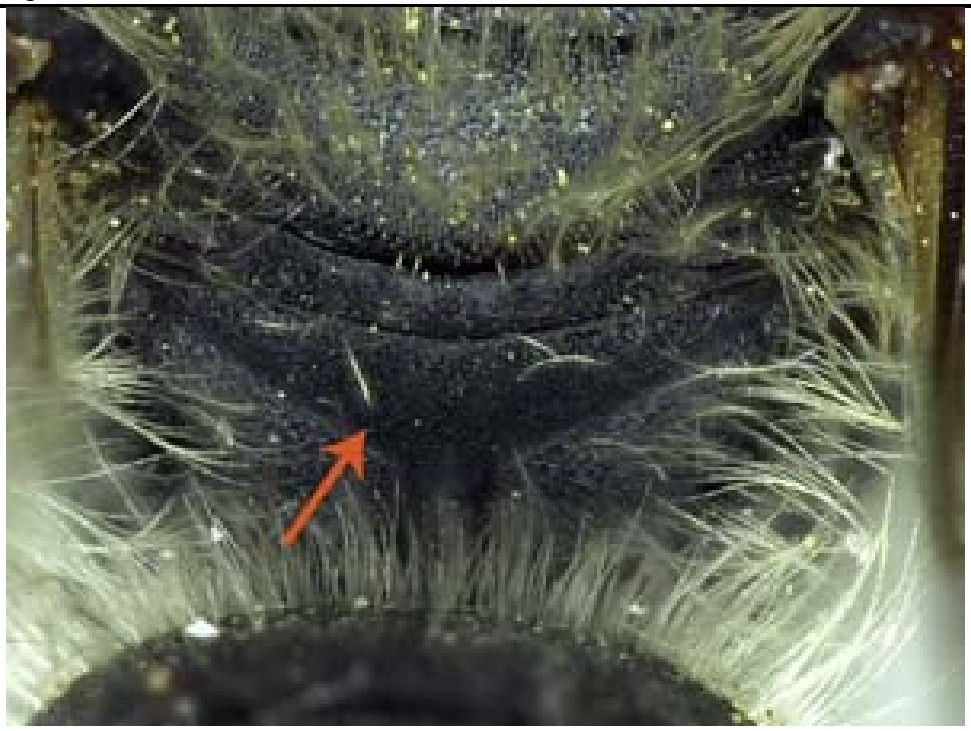
5(4). Color metallic greenish or bluish (fig 160a) 6	 Figure 160a
Black, non-metallic (fig 160b) 10	 Figure 160b

6(5). T2-T5 with broad, impunctate, apical margins about a third or fourth of total median length of the tergum (fig 161a) 7	 Figure 161a
Apical bands of terga either very narrow or to some degree invaded by punctures (fig 161b) 8	 Figure 161b

7(6). Smaller; head, pleura, legs and terga largely pale pubescent (fig 162a) (female) . . . . . ***Osmia tersula*** Cockerell (no map)	 Figure 162a
Larger; head, pleura, legs and T2-T6 conspicuously black pubescent (fig 162b) (female). . . ***Osmia (Acanthosmioi -des) integra*** Cresson (no map)	 Figure 162b

8(6) Terga 3-5 with conspicuous, erect black pubescence (fig 163a); clypeus fuscous or black pubescent (fig 164a) 9	 Figure 163a Figure 164a
Pubescence of terga and clypeus entirely pale, or with only very inconspicuous darker hairs (fig 163b, fig 164b) (female) ***Osmia atriventris*** Cresson (no map)	 Figure 163a  Figure 164b
9(8). Mandible very broad apically, the dentate margin much broader than the base (fig 165a) (female) ***Osmia (Cephalosmia) subaustralis*** Cockerell (no map)	Figure 165a

Apical dentate margin of mandible no broader than base (fig 165b) (female). . . . ***Osmia proxima*** Cresson (no map)	Figure 165b
10(5). Ventral margin of mandible with distinct tooth (fig 166a) (female) . . ***Osmia inermis*** Zetterstedt (App. C, Map 41)	Figure 166a

Ventral margin of mandible without distinct tooth (fig 166b) 11	 Figure 166b
11(10). Propodeal triangle dull and strongly granulose (fig 167a) 12	 Figure 167a

Propodeal triangle mostly shiny (fig 167b) 14

Figure 167b

12(11). T2–T3 with apical impunctate margins nearly a third of total length of tergum (fig 168a) (female).

Osmia tersula

Cockerell [in part]
(no map)

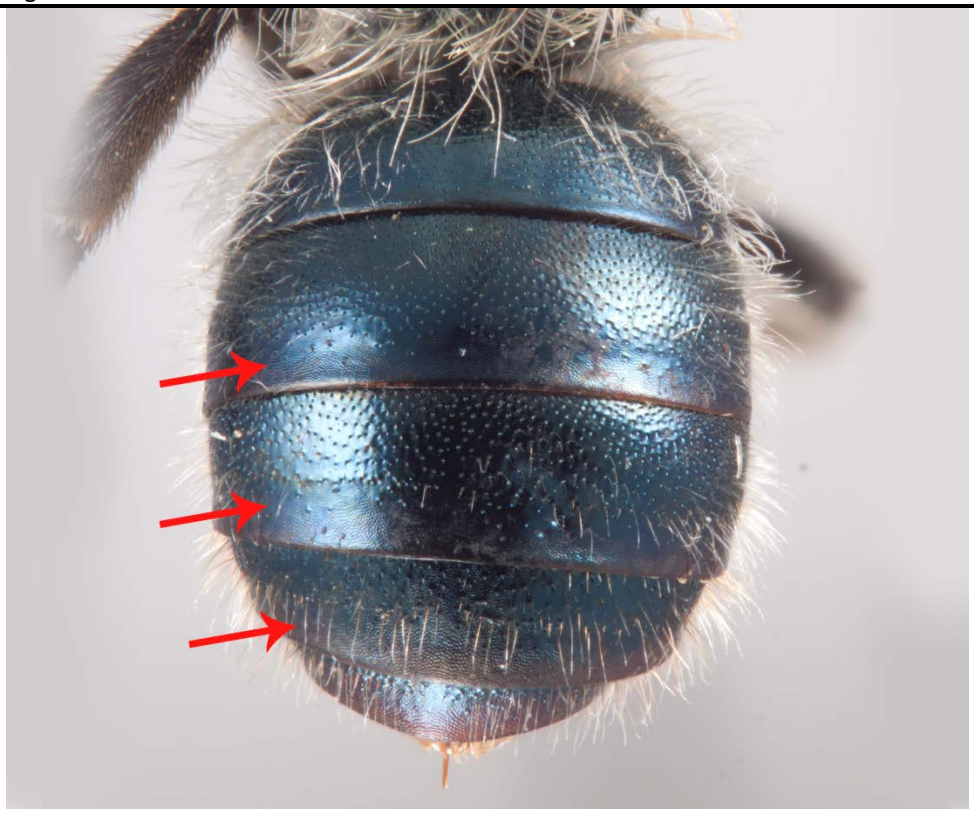
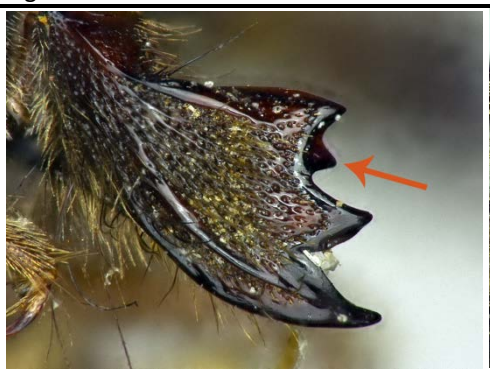
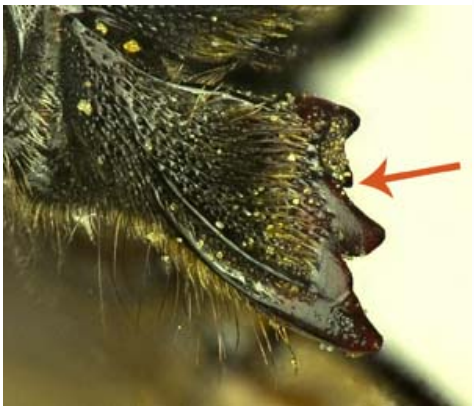
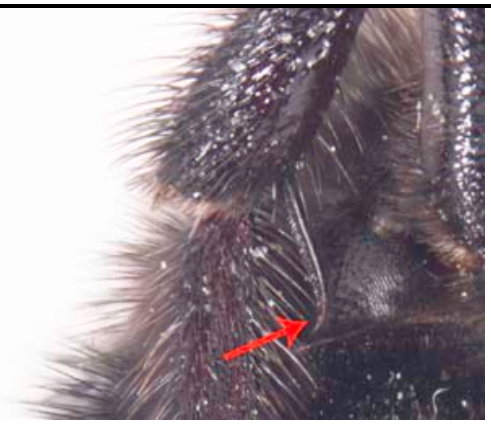
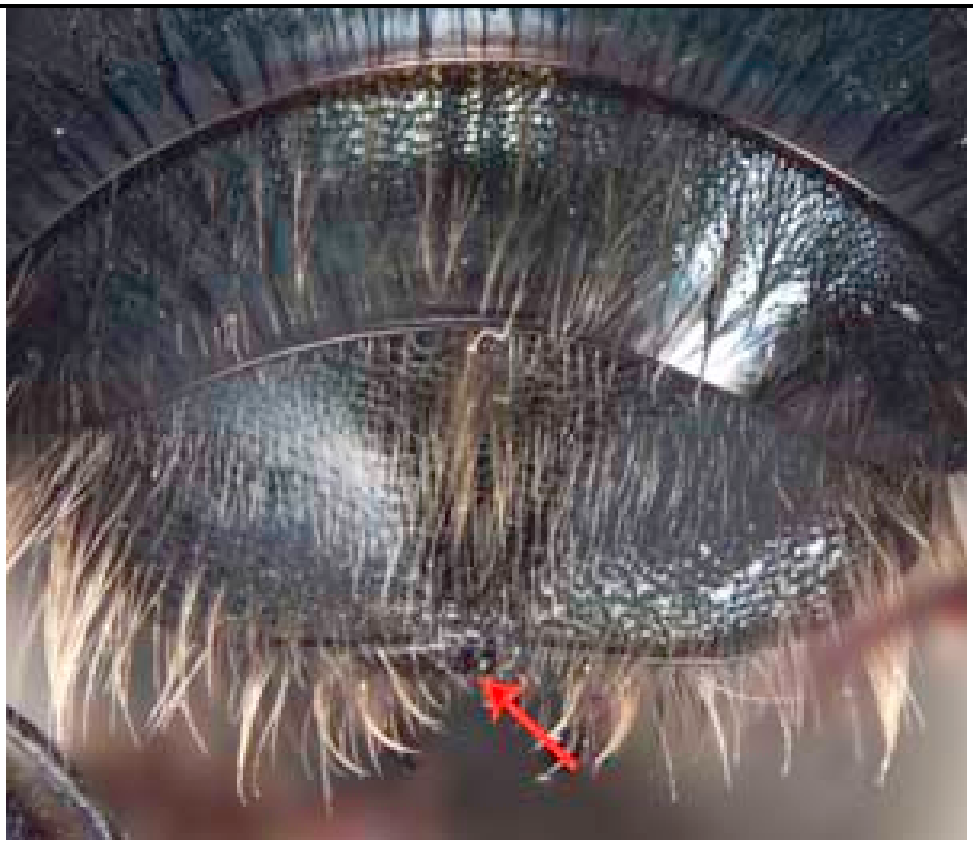
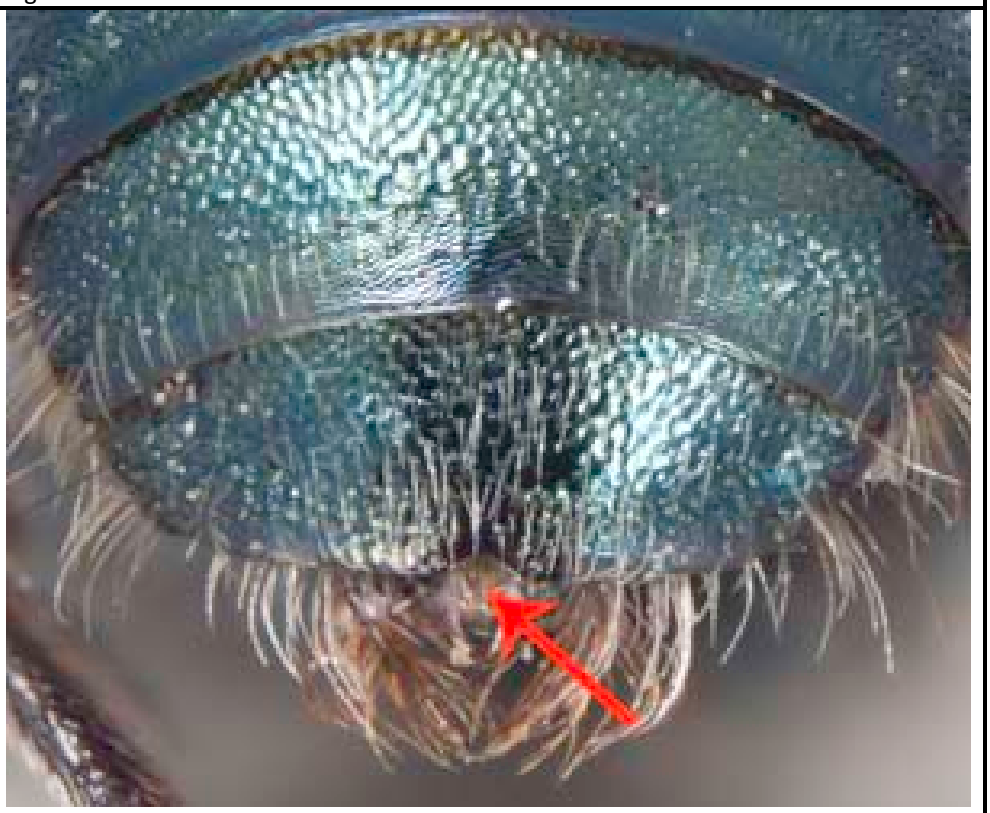


Figure 168a

T2–T3 with apical impunctate margins lacking or at most a fifth of total length of tergum (fig 168b) . . 13	 Figure 168b
13(12). Third tooth of mandible broad (fig 169a); T1 shiny and distinctly punctate (fig 170a) (female). . . . . ***Osmia laticeps*** Thomson (no map)	 Figure 169a Figure 170a
Third tooth of mandible triangular (fig 169a); T1 dull and weakly punctate (fig 170b) (female) . . . . . ***Osmia aquilonaria*** Rightmyer, Griswold, & Arduser (no map)	 Figure 169b Figure 170b

14(11). Mandible with third tooth in same plane as second and fourth teeth, lacking distinct carina separating it from second and fourth teeth (fig 171a); outer hind tibial spur weakly curved apically (fig 172a) (female). . . . . ***Osmia nearctica*** Rightmyer, Griswold, & Arduser (no map)	Figure 171a Figure 172a
Mandible with third tooth distinctly recessed between second and fourth teeth, with carina separating it from second and fourth teeth (fig 171b); outer hind tibial spur strongly curved apically (fig 172b) (female). . . . . ***Osmia maritima*** Friese (App. C, Map 42)	 Figure 171b  Figure 172b

15(1). Color largely metallic (fig 173a) 16	 Figure 173a
Color entirely black, with no metallic reflections (fig 173b). 22	 Figure 173b

16(15). Abdominal tergum 6 entire (fig 174a). 17	 Figure 174a
Tergum 6 usually with a distinct, apical, median emargination (fig 174b). 19	 Figure 174b

17(16). Mid tarsal segments dilated, more or less swollen or compressed (fig 175a) (male) . . . . . ***Osmia (Centrosmia) bucephala*** Cresson (App. C, Map 40)	Figure 175a
Mid tarsal segments slender and simple (fig 175b) 18	Figure 175b

18(17). Inner apical angle of mandible a right angle, the apical tooth long and slender (fig 176a)(male) . . .

Osmia (Acanthosmioides) integra

Cresson
(no map)

Figure 176a

Inner apical angle of mandible acute, the inner and outer angles or teeth subequal (fig 176b)(male). .

Osmia (Cephalosmia) subaustralis

Cockerell
(no map)

Figure 176b

19(16). Hind basitarsus dilated apically, nearly bare (fig 177a) (male). . . . . ***Osmia simillima*** Smith (no map)	Figure 177a
Hind basitarsus more parallel-sided, or densely setose beneath (fig 177b) 20	Figure 177b

20(19). Abdominal terga with wide, impunctate, depressed, marginal areas which occupy about one-fourth of the median length of each tergum (fig 178a) . . (male). . . . . .

Osmia tersula

Cockerell [in part]
(no map)

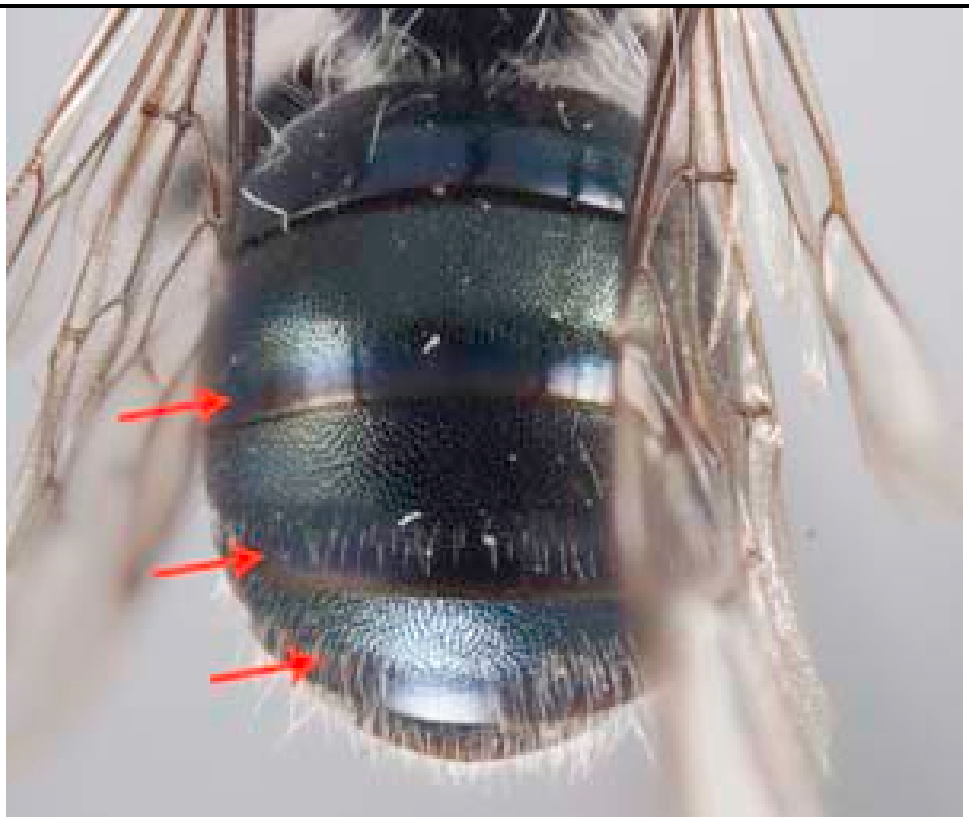


Figure 178a

Depressed apical areas of terga much narrower (fig 178b) 21

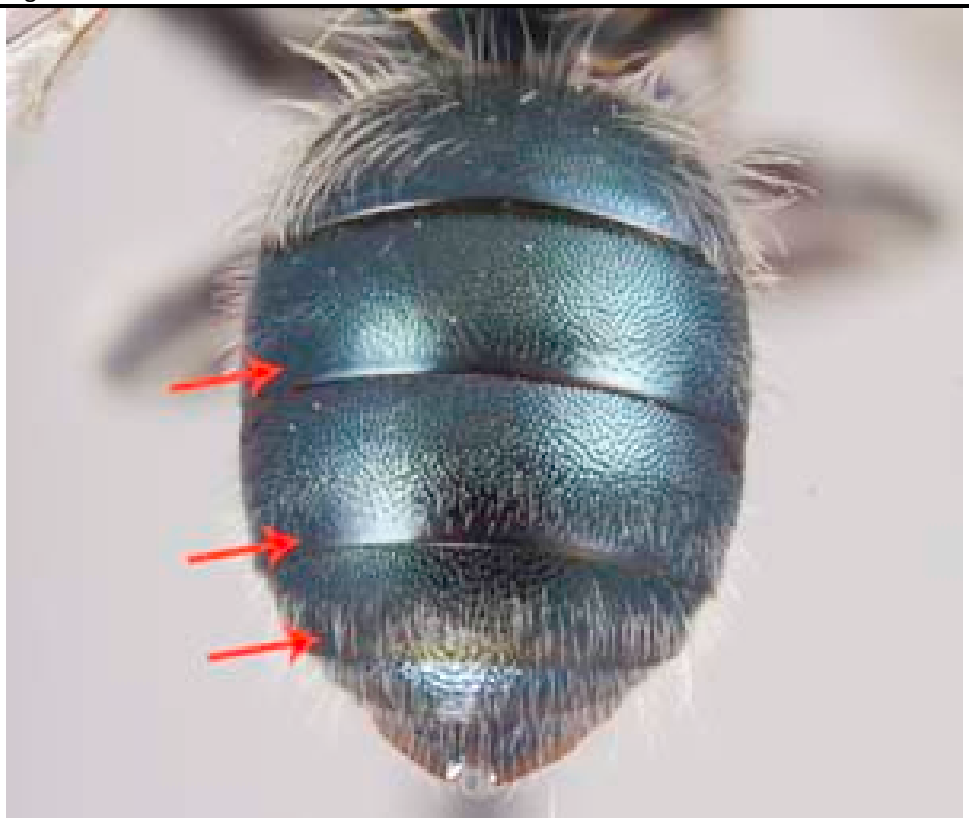
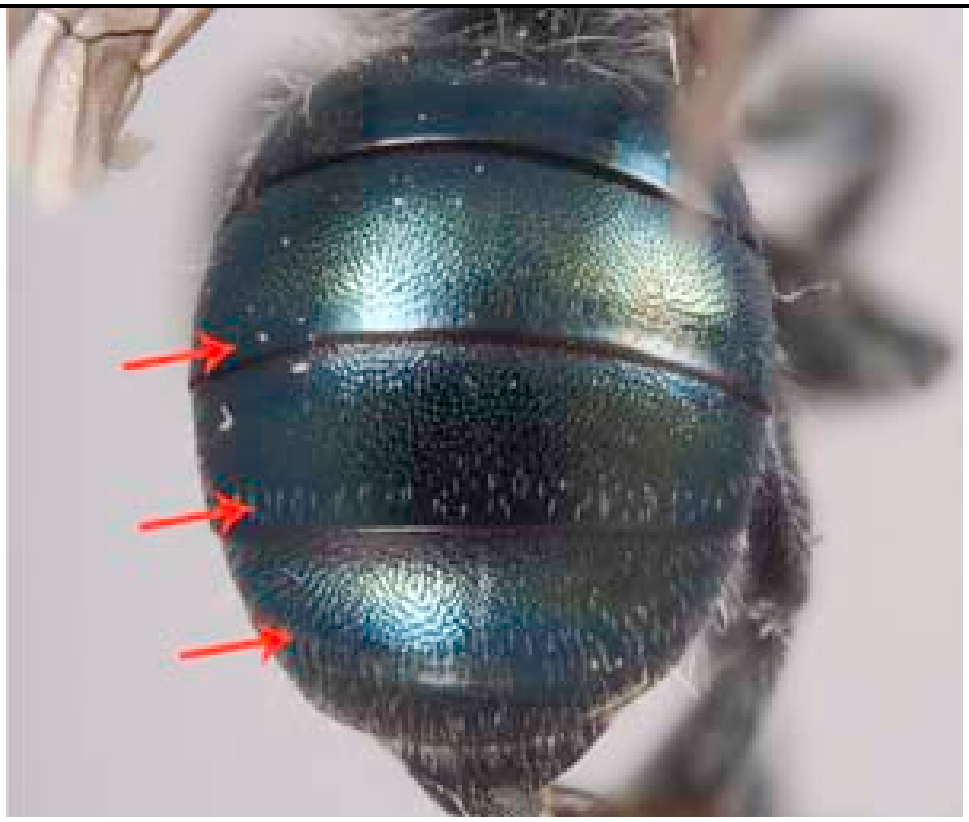
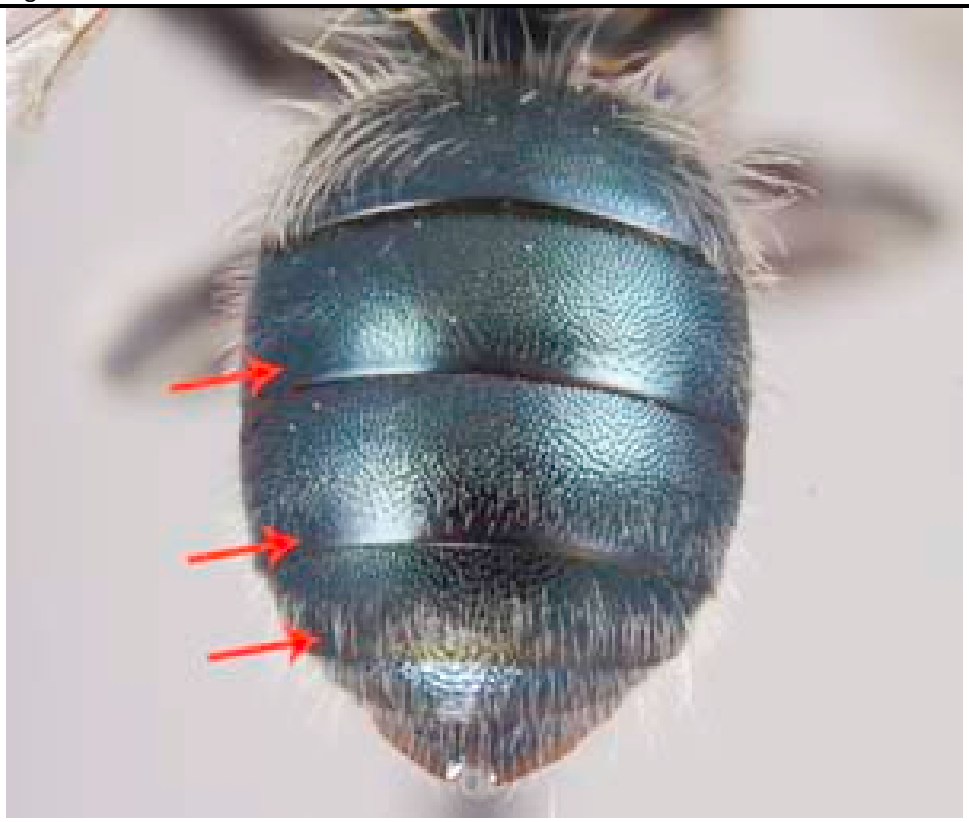
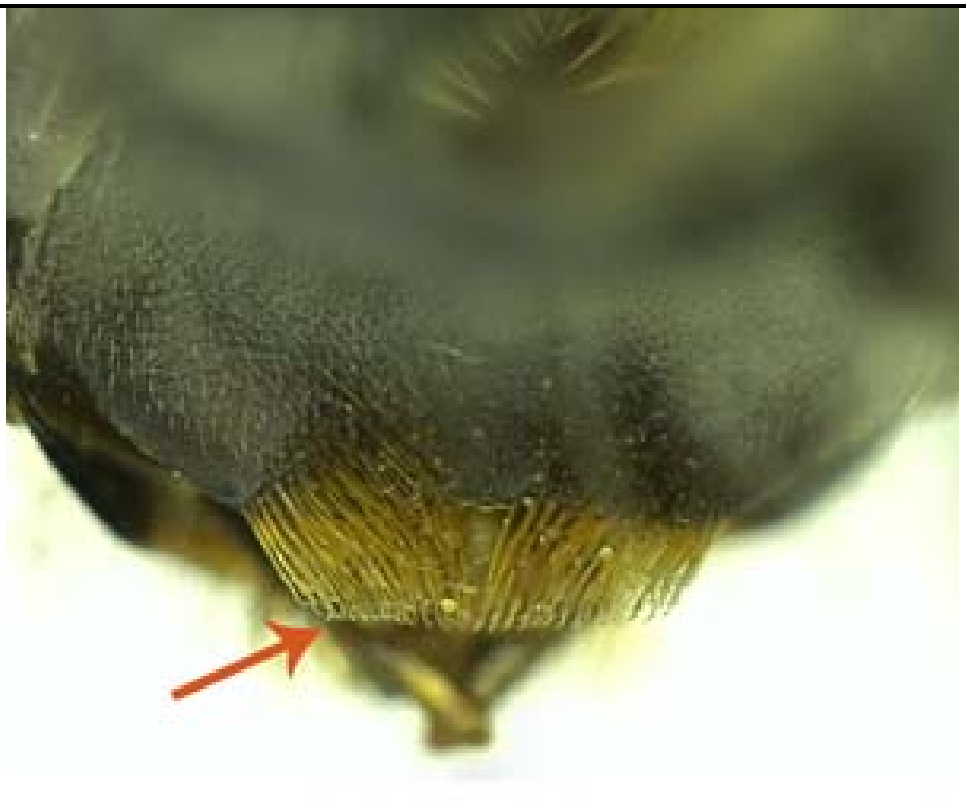
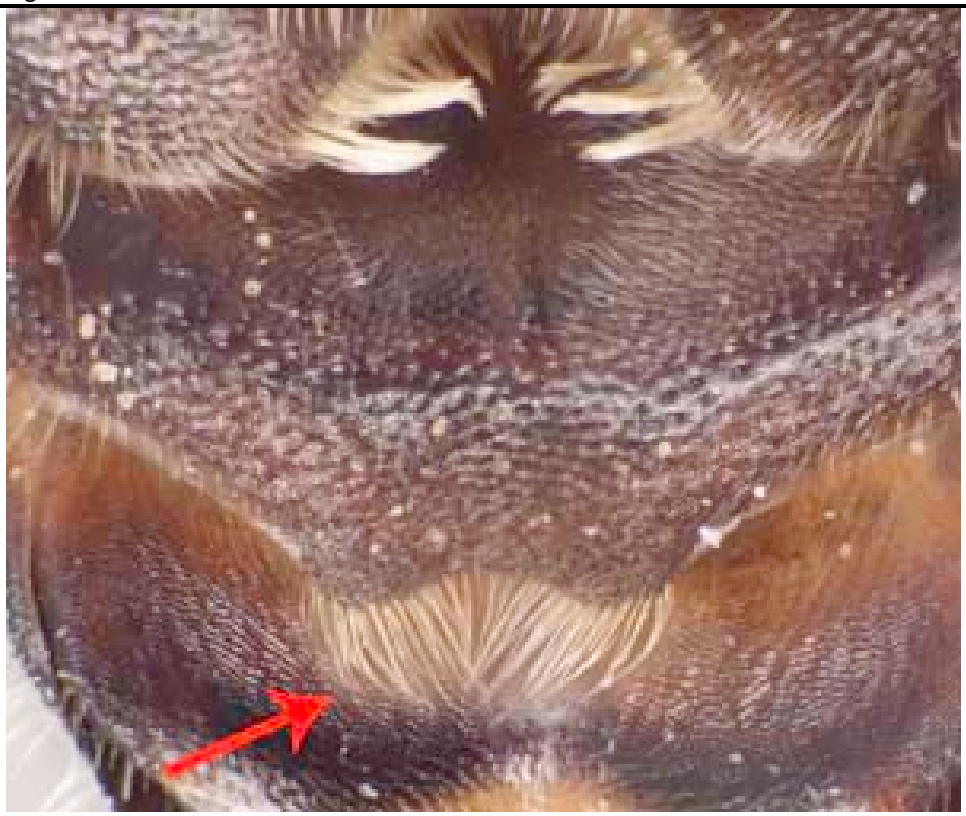


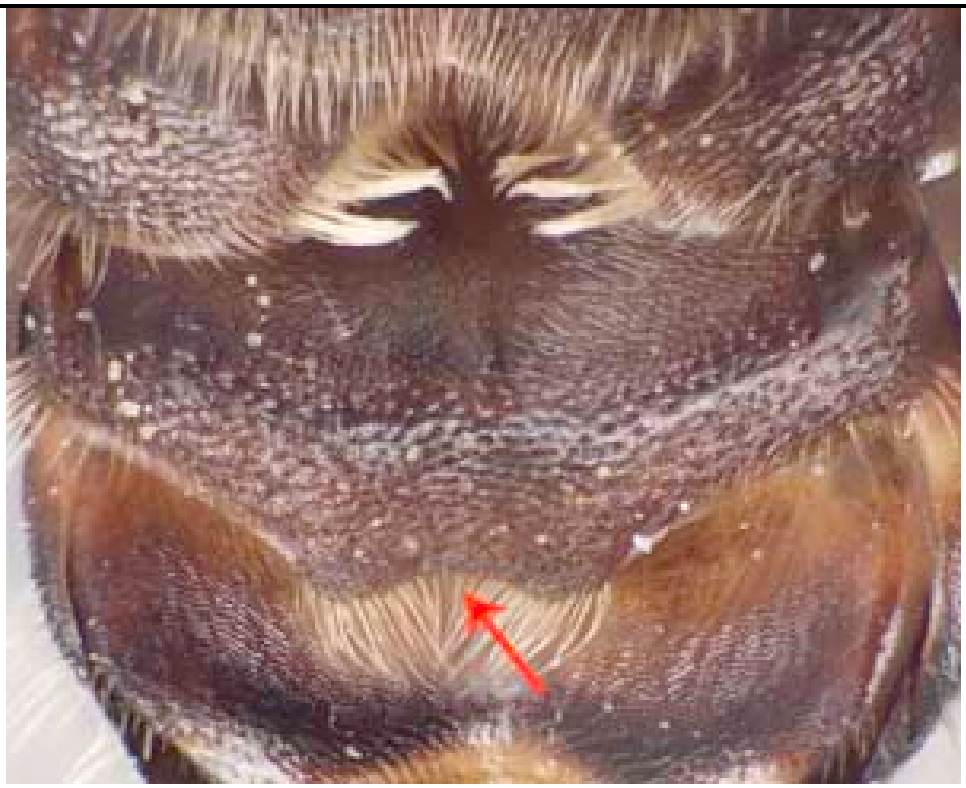
Figure 178b

21(20). Depressed, apical areas of abdominal terga largely impunctate, invaded only by the discal punctures (fig 179a) (male). . . . . ***Osmia proxima*** Cresson (no map)	 Figure 179a
Apical margins of abdominal terga only very narrowly impunctate (fig 179b) (male). . . . . ***Osmia atriventris*** Cresson (no map)	 Figure 179b

22(15). T5 and T6 with apicolateral angles strongly reflexed laterally (fig 180a) (male). . . . . . ***Osmia nigriventris*** (Zetterstedt) (no map)	 Figure 180a
T5 and T6 with apicolateral angles weakly reflexed laterally at most (fig 180b) 23	 Figure 180b

23(22). Outer margin of gonoforceps only weakly widened preapically (if at all), widening only slightly greater than narrowest width (fig 181a) 24	 Figure 181a
Outer margin of gonoforceps widened preapically, widening nearly twice narrowest width (fig 181b) 26	 Figure 181b

24(23). S4 with hooked bristles (fig 182a) (male) . . . ***Osmia aquilonaria*** Rightmyer, Griswold, & Arduser (no map)	 Figure 182a
S4 without hooked bristles (fig 182b) 25	 Figure 182b

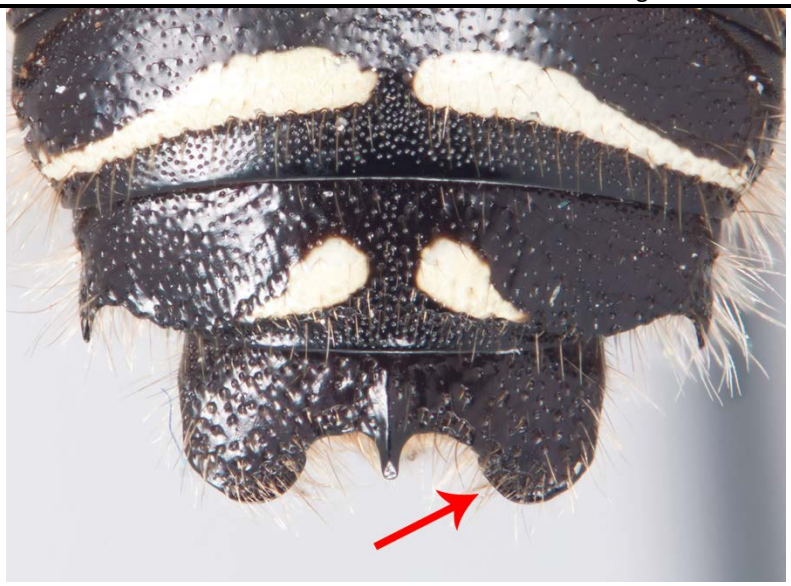
25(24). S4 with apical margin truncate, strongly emarginate medially and with lateral lobes (fig 183a) (male). . . . . . ***Osmia inermis*** Zetterstedt (App. C, Map 41)	 Figure 183a
S4 with apical margin convex, not emarginate medially and without lateral lobes (fig 183b) (male). . . ***Osmia laticeps*** Zetterstedt (no map)	 Figure 183b
26(23). Flagellar segments on ventral surface with hairs microscopic (fig 184a); S2 with midapical	Figures not available

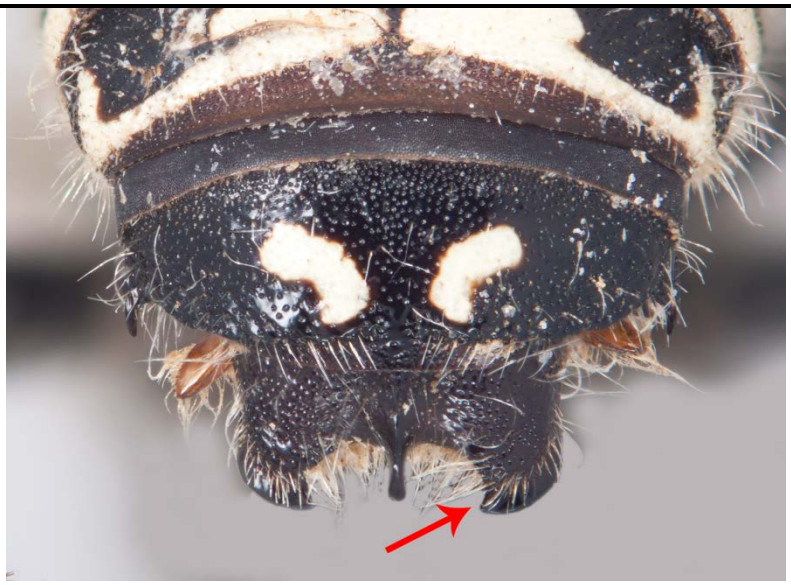
margin not emarginate (fig 185a) (male). . . . . ***Osmia nearctica*** Rightmyer, Griswold, & Arduser (no map)	
Flagellar segments on ventral surface with sparse hairs, their length about half the flagellar segment width (fig 184b); S2 with midapical edge weakly emarginate (fig 185b) (male) ***Osmia maritima*** Friese (App. C, Map 42)	Figures not available

Anthidium

1. Antennae with 12 segments (fig 186a); metasoma with 6 visible segments (fig 187a) [females] 2	Figure 186a Figure 187a
Antennae with 13 segments (fig 186b); metasoma with 7 visible segments (fig 187b) [males] 3	Figure 186b

	Figure 187b
2(1).Clypeal lip regular, with lateral teeth (fig 188a); basal areas of tibiae with yellow maculation (fig 189a) (female). . . . . . ***Anthidium tenuiflorae*** Cockerell (App. C, Map 45)	Figure 188a Figure 189a

Clypeal lip irregularly produced, with teeth throughout (fig 188b); basal areas of tibiae without yellow maculation, tibiae uniform in colour (fig 189b) (female). . . . ***Anthidium clypeodentatum*** Swenk (App. C, Map 43)	 Figure 188b Figure 189b
3(1).Tergum 7 with lateral areas divergent or straight below (fig 190a) (male) . . . . ***Anthidium tenuiflorae*** Cockerell (App. C, Map 45)	 Figure 190a

Tergum 7 with lateral areas convergent below (fig 190b) (male) . . ***Anthidium clypeodentatum*** Swenk (App. C, Map 43)	 Figure 190b

Stelis

1. Antennae with 12 segments (fig 191a); metasoma with 6 visible segments (fig 192a) [females] 2	Figure 191a Figure 192a
Antennae with 13 segments (fig 191b); metasoma with 7 visible segments (fig 192b) [males] 5	Figure 191b Figure 192b
2(1). Sternum 6 with a robust, median, terminal spine (fig 193a) 3	

	Figure 193a
Sternum 6 not spinose (fig 193b) 4	 Figure 193b
3(2). Scutum densely punctate, interspaces not exceeding diameter of punctures (fig 194a); abdominal bands narrow, separated from apex of terga by wider black areas (fig 195a) (female). . ***Stelis foederalis*** (Smith) (no map)	 Figure 194a Figure 195a
Scutum more sparsely punctate (fig 194b); abdominal bands broader, slightly exceeding width of apical black area (fig 195b) (female) . ***Stelis nitida*** (Cresson) (no map)	Figures not available

4(2). Face and mesopleuron with pale whitish hairs (fig 196a); T6 entirely black (fig 197a) (female). . . ***Stelis subemarginata*** Cresson This species was described only from one sex (Mitchell, 1960); therefore, it is absent from the key to the other sex. (App. C, Map 46)	Figure 196a Figure 197a
Face and mesopleuron with many dark hairs intermixed with pale ones (fig 196b); T6 with V-shaped yellow maculation (fig 197b)(female) . . . . . *S. sp*** This species has not yet been determined, but is distinct. Further examination is required.	Figure 196b Figure 197b
5(1). Larger (8 mm); abdominal bands broader, covering fully half of each disc at extreme sides (fig 198a); tergum 6 distinctly maculated (fig 199a); sternum 3 nearly impunctate over median area of plate (fig 200a) (male) . . . . ***Stelis nitida*** Cresson (no map)	Figures not available

Smaller (6-7 mm); abdominal bands narrower, covering less than half of disc at extreme sides (fig 198b); tergum 6 not distinctly maculated (fig 199b); sternum 3 fully punctate (fig 200b) 6

Figure 198b

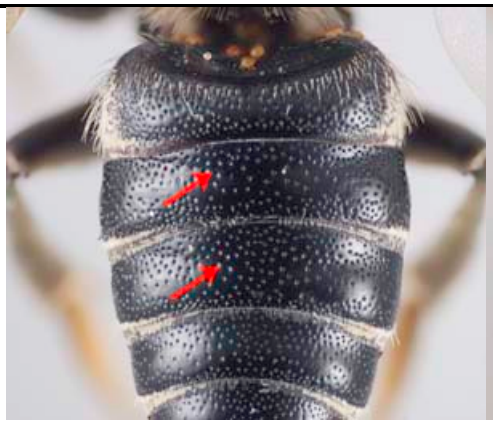
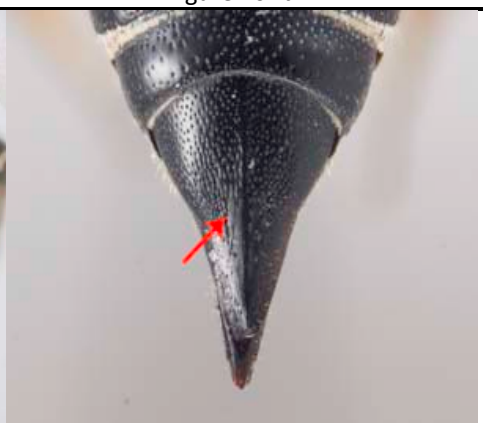
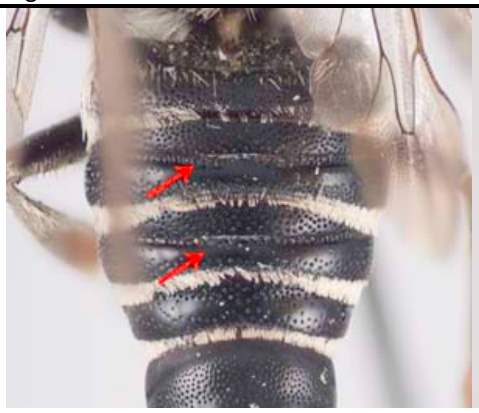
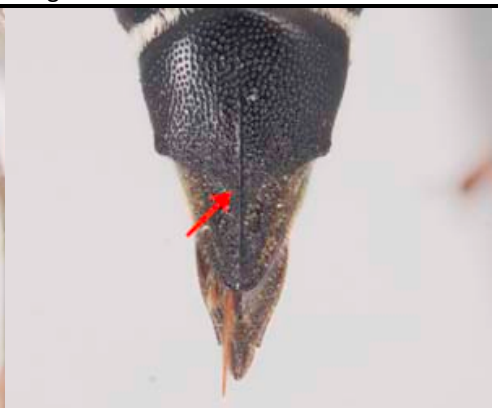
Figure 199b

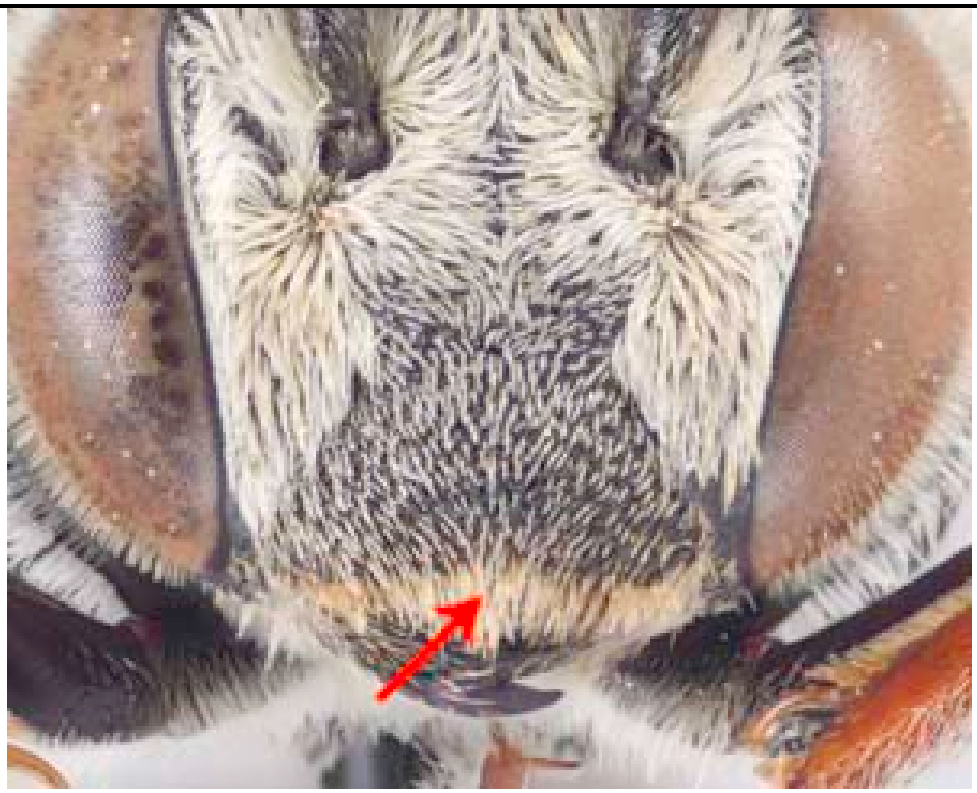
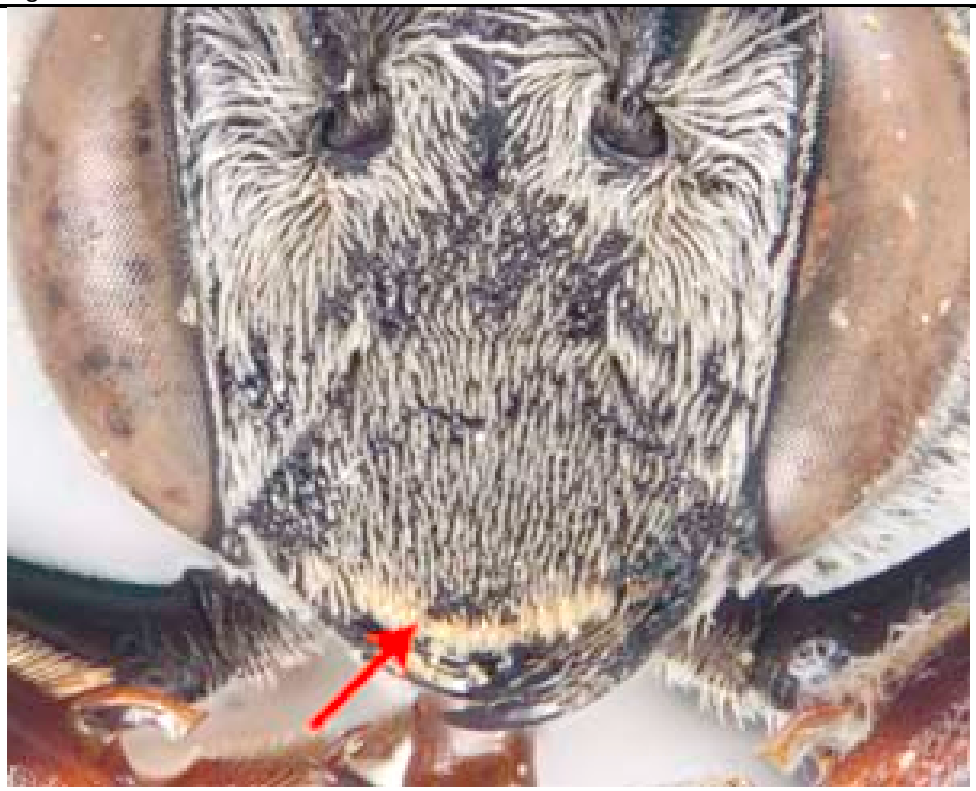
Figure 200b

6(5). Face and mesopleuron with pale whitish hairs (fig 201a) (male). . . . . ***Stelis foederalis*** Smith (no map)	Figure 201a
Face and mesopleuron with black hairs (fig 201b) (male) . . . . . *S. sp*** This species has not yet been determined, but is distinct. Further examination is required.	Figure 201b

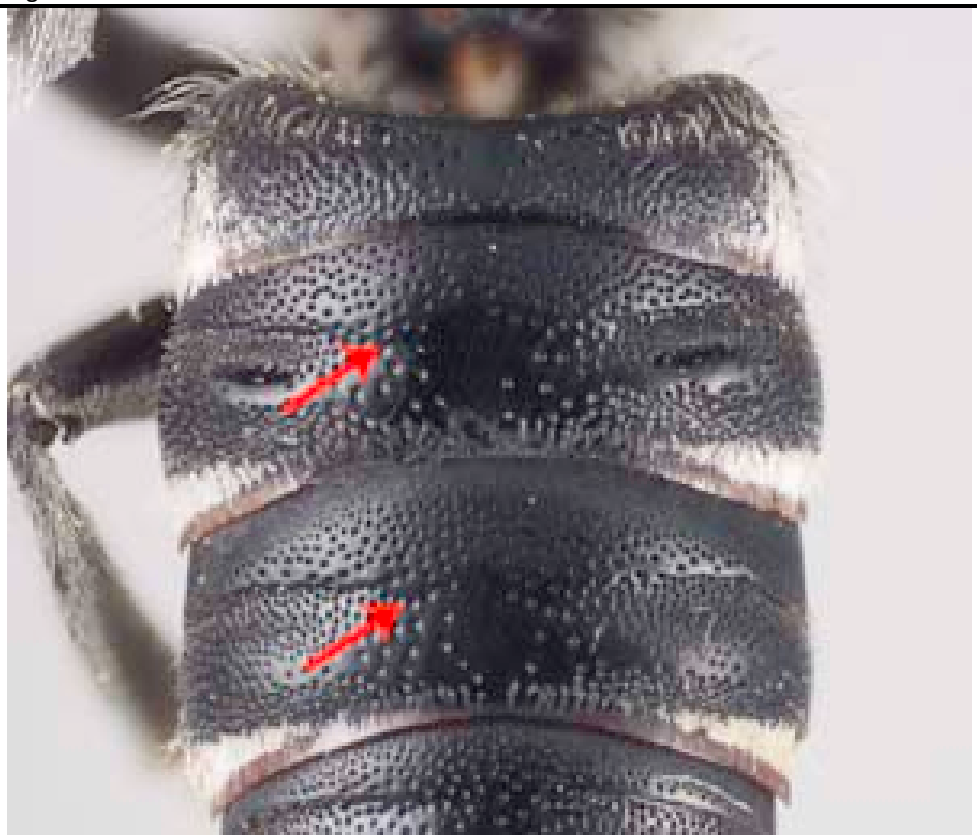
Coelioxys

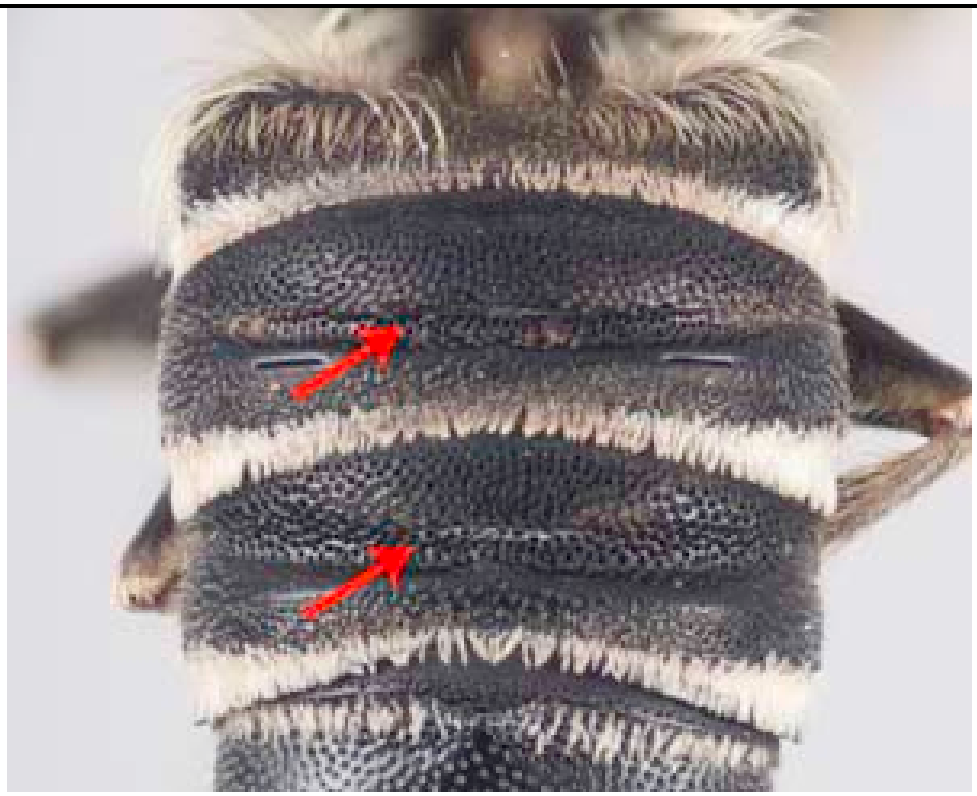
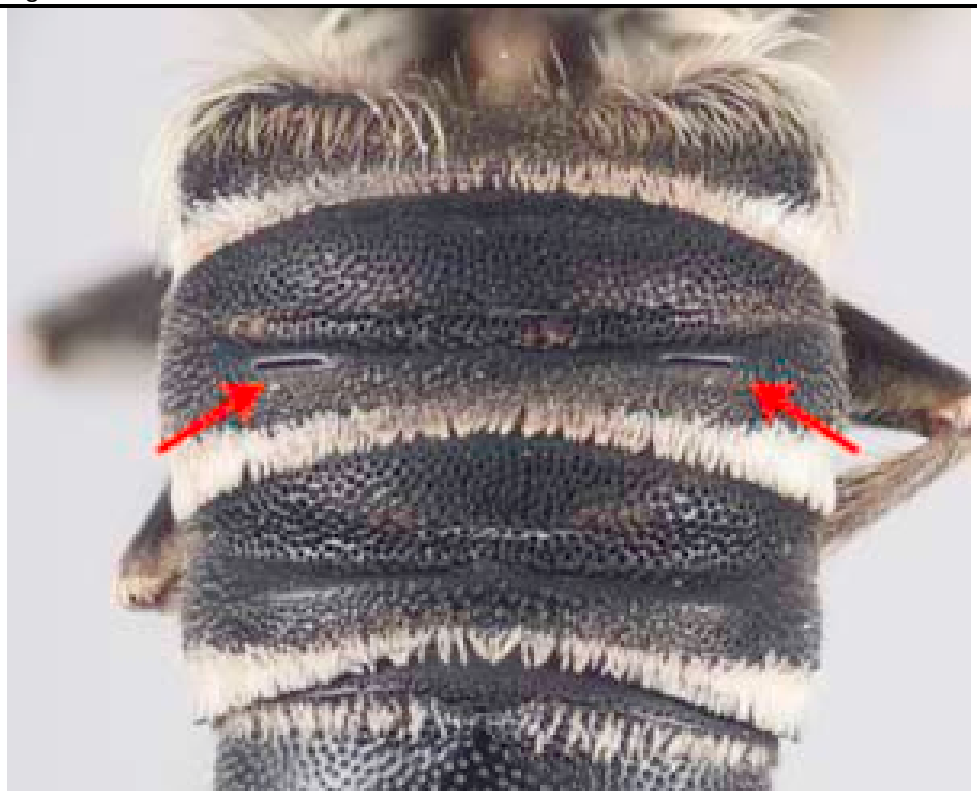
1. Antennae with 12 segments (fig 202a); metasoma with apex pointed, without spines (fig 203a) [females] 2	Figure 202a Figure 203a
Antennae with 13 segments (fig 202b); metasoma with spines on apex (fig 203b) [males] 6	Figure 202b Figure 203b
2(1). Sternum 6 sinuate laterally, without distinct notches (fig 204a) (female) . . . . . ***Coelioxys sodalis*** Cresson (App. C, Map 50)	Figure 204a

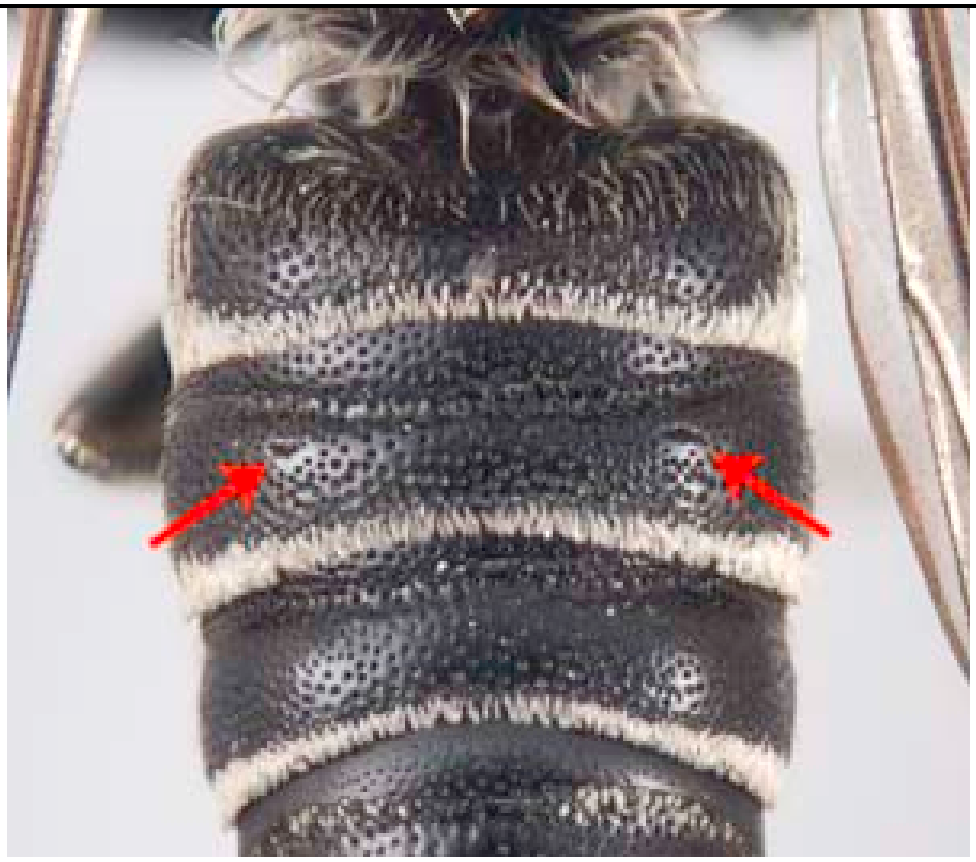
Sternum 6 with distinct, though often minute, lateral notches (fig 204b) 3	Figure 204b
3(2). Transverse grooves on T2 and T3 medially interrupted (fig 205a); T6 without transverse carina (fig 206a) (female). . . . . ***Coelioxys funeraria*** Smith (App. C, Map 47)	 Figure 205a  Figure 206a
Transverse grooves on T2 and T3 complete (fig 205b); T6 with a median transverse carina, tergum somewhat depressed on each side (fig 206b) 4	 Figure 205b  Figure 206b

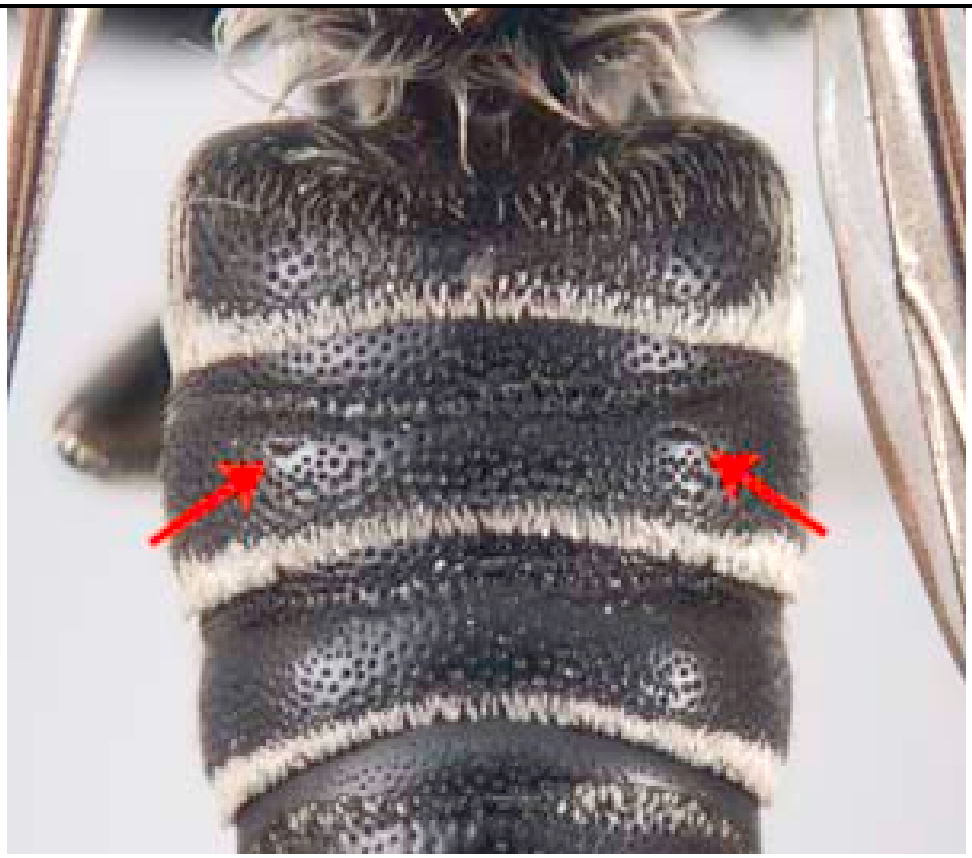
4(3).Apical margin of clypeus straight (fig 207a) (female). . . . . ***Coelioxys rufitarsis*** Smith (App. C, Map 49)	 Figure 207a
Apical margin of clypeus convex (fig 207b) 5	 Figure 207b

5(4). Clypeus flat in profile (fig 208a); S6 quite sharply downturned in lateral view (fig 209a) (female). . . . . ***Coelioxys moesta*** Cresson (App. C, Map 48)	Figure 208a Figure 209a
Clypeus concave in profile (fig 208b); S6 not sharply downturned (fig 209b) (female). ***Coelioxys banksi*** Crawford (no map)	Figure 208b Figure 209b
6(1). Tergum 2 with lateral foveae absent (fig 210a)(male) . . . . . ***Coelioxys sodalis*** Cresson (App. C, Map 50)	Figure 210a

Tergum 2 with distinct lateral foveae (fig 210b). 7	 Figure 210b
7(6).Transverse grooves on T2 and T3 medially interrupted (fig 211a) (male) . . ***Coelioxys funeraria*** Smith (App. C, Map 47)	 Figure 211a

Transverse grooves on T2 and T3 complete (fig 211b) 8	 Figure 211b
8(7).Tergum 2 with a pair of deep, very much elongated foveae, each groove about 15 times longer than its width (fig 212a) (male). . . . . ***Coelioxys rufitarsis*** Smith (App. C, Map 49)	 Figure 212a

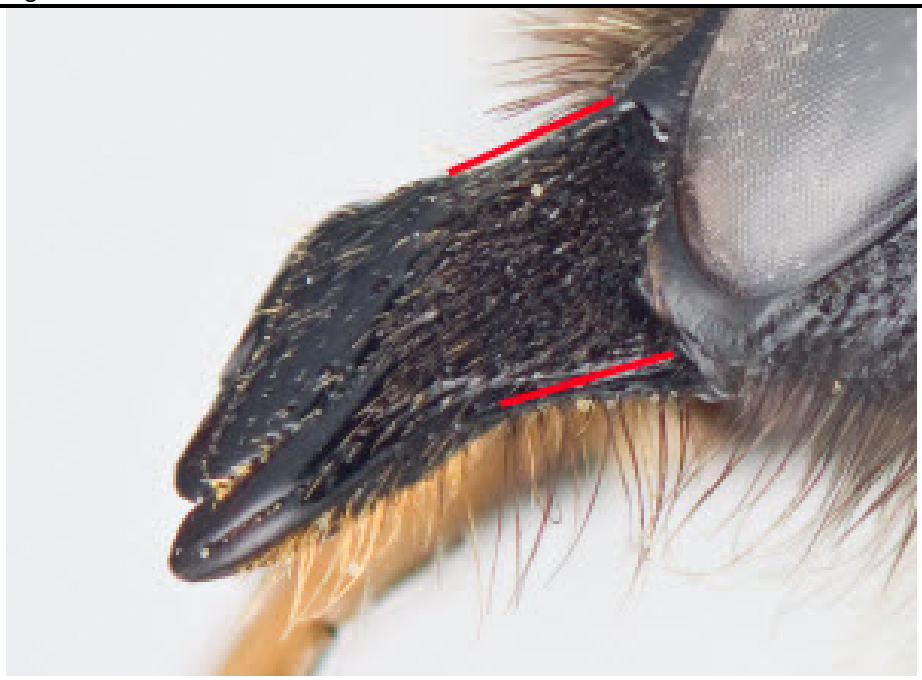
Foveae of tergum 2 relatively short or shallow (fig 212b) 9	 Figure 212b
9(8).Lateral foveae on T2 large and shallow (fig 213a) (male) . . . . . ***Coelioxys banksi*** Crawford (no bank)	 Figure 213a

Lateral foveae on T2 small and deep (fig 213b) (male). . . . . ***Coelioxys moesta*** Cresson (App. C, Map 48)	 Figure 213b

Megachile

1. Antennae with 12 segments (fig 214a); metasoma with six exposed sterna bearing a dense brush of scopal hairs (fig 215a)[females] 2	Figure 214a Figure 215a
Antennae with 13 segments (fig 214b); metasoma with up to four exposed sterna, bearing moderately short, slender hairs (fig 215b)[males] 10	Figure 214b Figure 215b
2(1). Gena in posteroventral view with a prominent robust process protruding downward (fig 216a) (female) . . . . . ***Megachile (Sayapis) pugnata*** Say (App. C, Map 58)	Figure 216a

Gena in posteroventral view uniformly convex, without process (fig 216b) 3	 Figure 216b
3(2). Terga without white apical fasciae, terga 1 and 2 usually covered with dense, white pubescence, conspicuously contrasting with the entirely black pubescence on terga 3–6 (fig 217a) 4	 Figure 217a

Terga with pale apical fasciae (fig 217b), sometimes reduced and limited to lateral edges of more apical terga, but terga 3-6 not entirely black (fig 217c) 6	 Figure 217b
4(3). Mandible in lateral view parallel from base to a length subequal to width, then tapering to apex (fig 218a); inner mandibular tooth broadly truncate (fig 219a) (female). . . . . ***Megachile (Xanthosarus) gemula*** Cresson (App. C, Map 53)	 Figure 218a

Mandible in lateral view tapering gradually but continuously from base to apex (fig 218b); inner mandibular tooth rounded and narrower (fig 219b) AND/OR with a small excision at its apex(fig 219c) 5	 Figure 219b
5(4). Mesosoma ventrally and coxae with pubescence entirely pale (fig 220a); clypeus with a well-defined, median impunctate line for its entire length (fig 221a); inner mandibular tooth without a small excision at apex (fig 222a) (female). . . . ***Megachile (Xanthosarus) circumcincta*** (Kirby) (App. C, Map 51)	 Figure 220a

	 Figure 221a Figure 222a
Mesosoma ventrally and coxae with pubescence dark (fig 220b); clypeus without (fig 221b), or usually with a poorly defined median impunctate line sometimes more pronounced (fig 221c); inner mandibular tooth with a small excision at apex (fig	

222b)(female) . . . . . .

Megachile (Xanthosarus) melanophaea Smith
(App. C, Map 56)

Figure 220b

Figure 221b

Figure 221c

Figure 222b

6(3). Mandible 5-dentate, with the 4th tooth approximately parallel-sided throughout its length (fig 223a); oblique emargination between 3rd and 4th teeth much deeper than emargination between 2nd and 3rd teeth (fig 223a) (female) . . . .

Megachile (Xanthosarus) perihirta Cockerell
(App. C, Map 57)

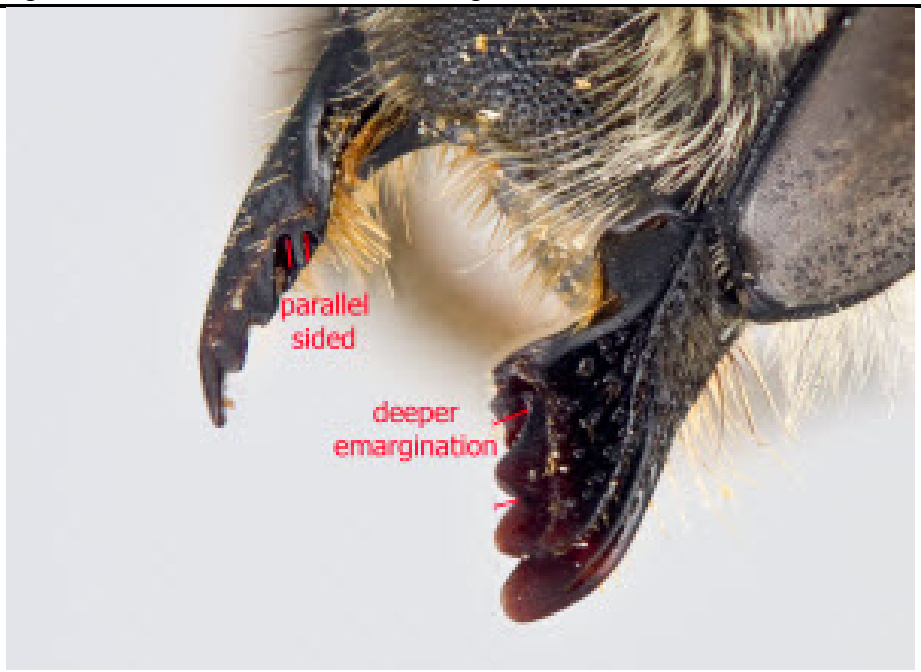
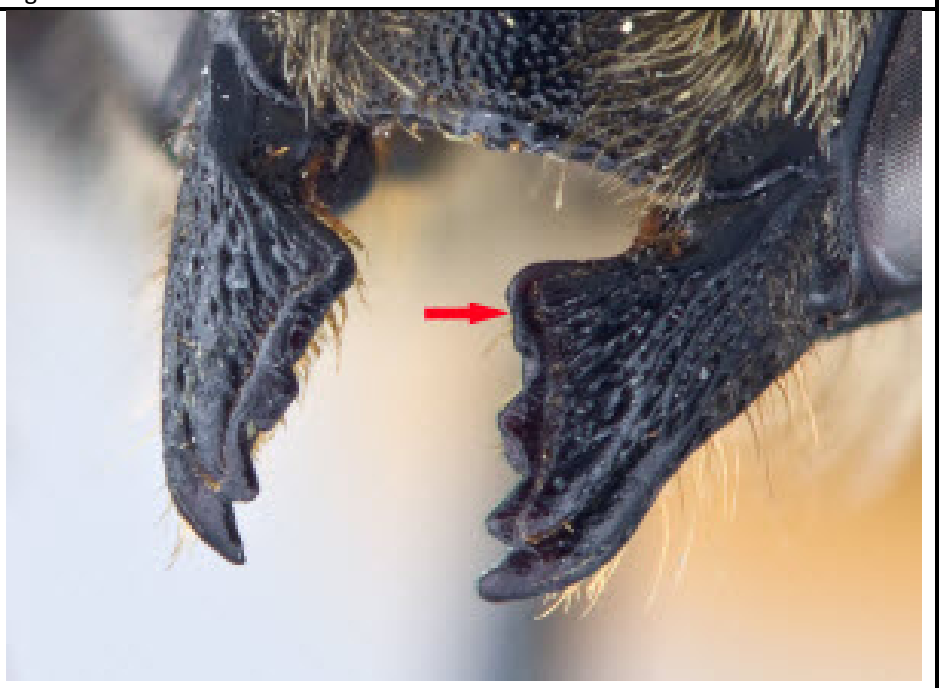


Figure 223a

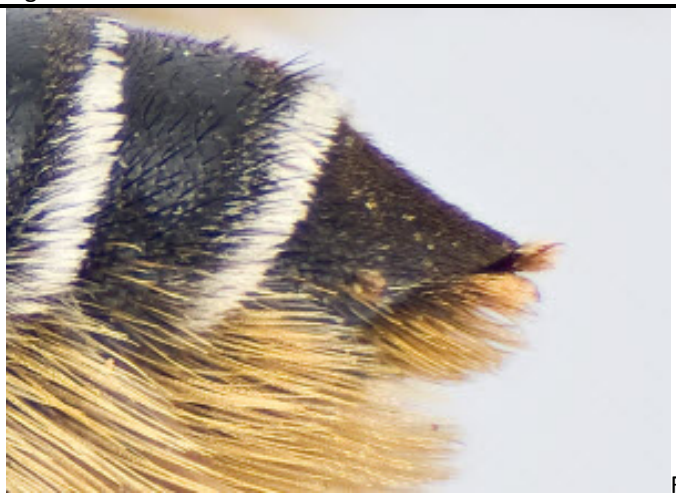
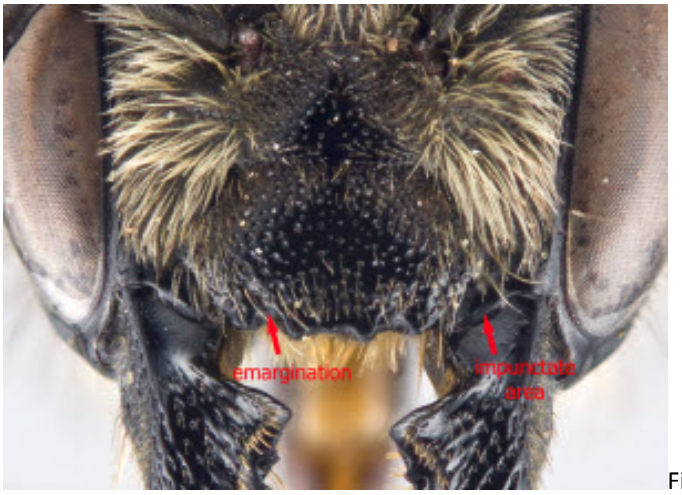
Mandible 3- (fig 223b), 4- (fig 223c) or 5-dentate (fig 223d), BUT if 5-dentate,then 4th tooth strongly tapered from base to apex; the emargination between 3rd and 4th teeth subequal to or more shallow than emargination between 2nd and 3rd teeth (fig 223b) 7

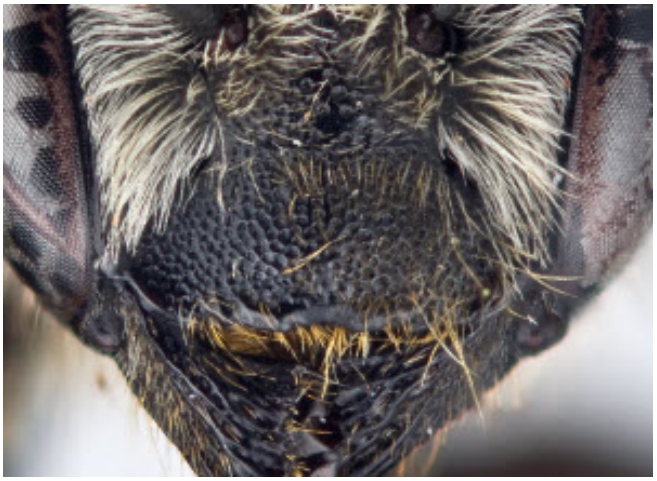
Figure 223b

Figure 223c

	 Figure 223d
7(6). Inner mandibular tooth broadly truncate (fig 224a) (female). . . . . . ***Megachile (Xanthosarus) frigida*** Smith (App. C, Map 52)	 Figure 224a

Inner mandibular tooth rounded or acutely angulate (fig 224b) 8	Figure 224b
8(7). Sternum 6 with black scopal hairs, contrasting with the pale scopal hairs on sterna 15 (fig 225a) (female). . . . . ***Megachile (Megachile) lapponica*** Thomson (App. C, Map 55)	Figure 225a

Sterna with uniformly pale hairs throughout (except occasionally at the extreme apical rim of sternum 6) (fig 225b) 9	Figure 225b
9(8). Tergum 6 with short, uniformly appressed brown hairs throughout its median length (fig 226a); clypeal margin with semicircular emarginations on each side of the broad median protuberance and small sublateral tubercle (fig 227a); clypeus laterally with well-defined, polished and impunctate areas along apical margin (fig 227a) (female). . . . ***Megachile (Megachile) inermis*** Provancher (App. C, Map 54)	 Figure 226a  Figure 227a

Tergum 6 with numerous long, erect hairs over entire surface scattered among the appressed hairs (fig 226b); clypeus with apical margin approximately truncate to weakly emarginate medially, without sublateral emarginations (fig 227b), and without polished impunctate areas on lateral margins (fig 227b) (female). . . . . . ***Megachile (Megachile) relativa*** Cresson (App. C, Map 59)	 Figure 227b  Figure 226b
10(1). Front leg unmodified, with basitarsus slender and simple, usually uniformly black (fig 228a) 11	 Figure 228a

b) Front leg greatly modified, with basitarsus dilated and excavated along anterior margin, usually conspicuously coloured white to yellowish (fig 228b) [except *M. gemula* in which basitarsus mostly black (fig 228c) 13	Figure 228b Figure 228c
11(10). Front coxa without spine (fig 229a); clypeus OFTEN with a single small median tubercle on apical margin beneath the pubescence (fig 230a) [excluding *M. centuncularis* which lacks median tubercle (fig 230b) 12	Figure 229a

	Figure 230a Figure 230b
Front coxa with a small spine surmounted by a dense but short tuft of setae (fig 229b); clypeus without a small median tubercle on apical margin beneath the pubescence, although a larger median protuberance may be present (fig 230c) (male). . . ***Megachile (Megachile) inermis*** Provancher (App. C, Map 54)	Figure 229b

Figure 230c

12(11). First submarginal cell with vein r subequal to vein Rs of the second submarginal cell (fig 231a); hypostomal tubercle short (fig 232a); hypostomal concavity shallow and not well defined (fig 233a) (pubescence must be removed to see the last two features) (male) . . . . . .

Megachile (Megachile) relativa Cresson (App. C, Map 59)

Figure 231a

Figure 232a

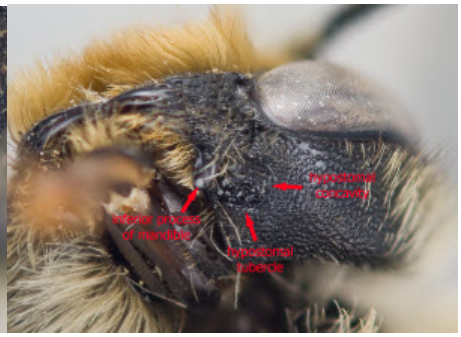


Figure 233a

First submarginal cell with vein r shorter than vein Rs of the second submarginal cell (fig 231b); hypostomal tubercle more prominent and wider at base (fig 232b); hypostomal concavity deeper and well defined (fig 233b) (male) . . . . . .

Megachile (Megachile) lapponica Thomson (App. C, Map 55)

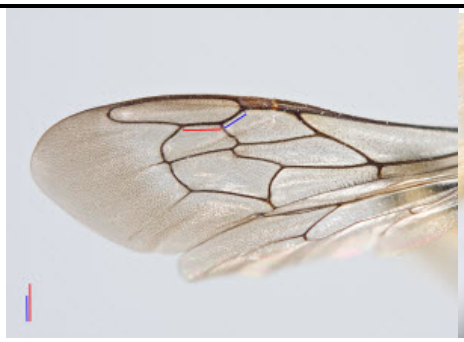


Figure 231b

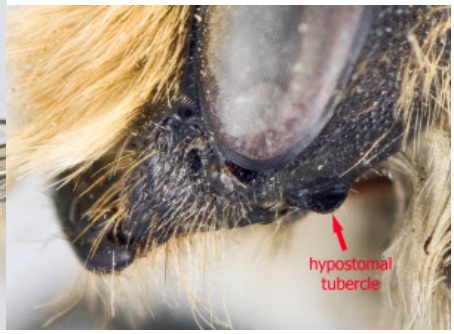


Figure 232b

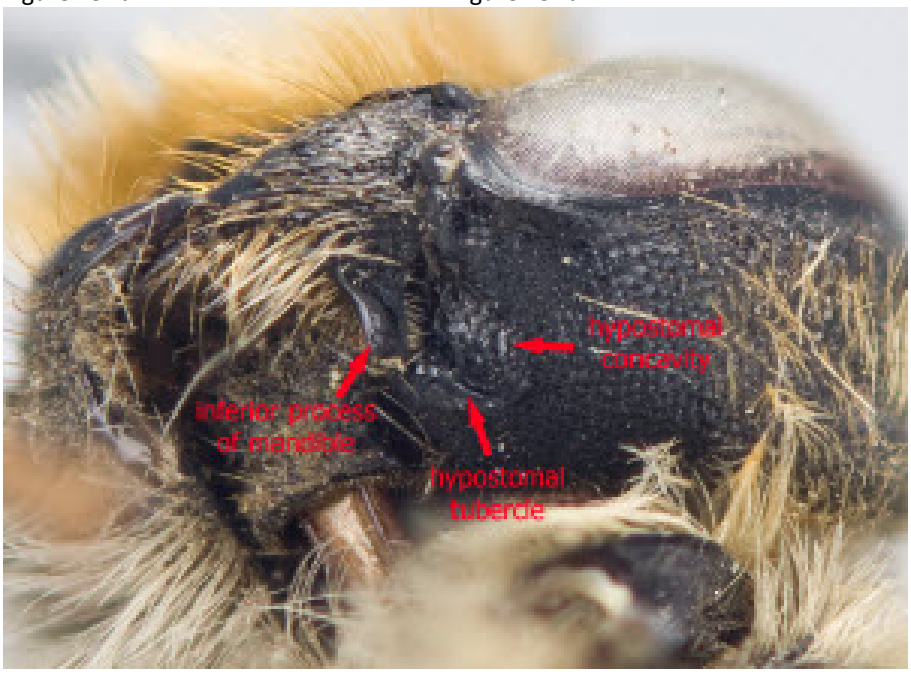


Figure 233b

13(10). Middle basitarsus with ventral surface strongly protuberant and polished (fig 234a); middle tibia without an apical spur (fig 234a) (male). . . . . ***Megachile (Xanthosarus) perihirta*** Cockerell (App. C, Map 57)	 Figure 234a
Middle basitarsus with ventral surface unmodified, not enlarged ventrally and uniformly covered with a brush of bristles (fig 234b); middle tibia with an apical spur (fig 234b) 14	 Figure 234b

14(13). Mandible 4-dentate (fig 235a); tarsal claw rounded basally, without a small basal tooth (fig 236a); metasoma robust, USUALLY lacking apical fascia on tergum 5 (fig 237a) 15

Figure 235a

Figure 236a

Figure 237a

b) Mandible 3-dentate (fig 235b); tarsal claw with a small basal tooth or angulation (fig 236b); metasoma elongate, USUALLY with well-developed fasciae on terga 2–5 (fig 237b) (male). . . . . **_Megachile (Sayapis) pugnata_** Say (App. C, Map 58)

Figure 235b

Figure 236b

Figure 237b

15(14). Front femur with apical third with a sharp, longitudinal, dorsolateral carina (fig 238a), anterior surface of basal half with two longitudinal brown bars on yellowish background (fig 239a); tergum 5 without pale apical fascia, tergum 6 with carina deeply and widely emarginate (fig 240a) (male). . . . . .

Megachile (Xanthosarus) frigida Smith
(App. C, Map 52)

Figure 238a

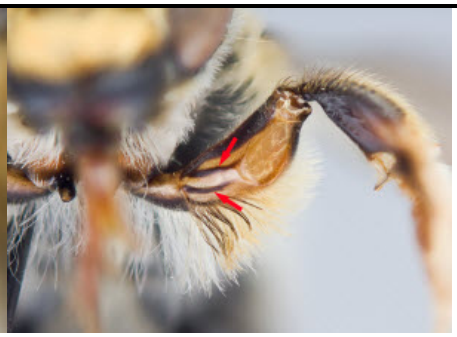
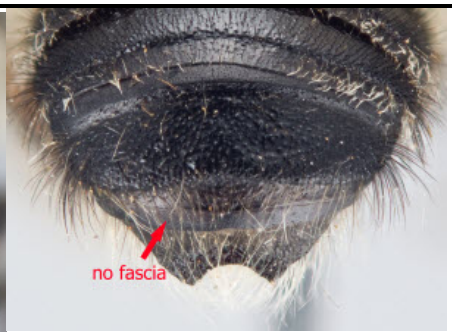


Figure 239a

Figure 240a

b) Front femur with apical third lacking dorsolateral carina (fig 238b), anterior surface of basal half without any longitudinal brown bars, uniformly pale (fig 239b) OR, if occasionally a single brown bar present (fig 239c) (some specimens of *M. circumcincta*) THEN tergum 5 with white apical fascia AND carina of tergum 6 with median emargination small (fig 240b). 16	Figure 238b Figure 239b Figure 239c Figure 240b
16(15). Apical rim of front tibia with a strongly flattened and rounded tubercle projecting posteriorly (fig 241a) (male) ***Megachile (Xanthosarus) melanophaea*** Smith (App. C, Map 56)	Figure 241a

b) Apical rim of front tibia with a short and strongly tapered spine (fig 241b) 17	Figure 241b
17(16). Front tarsus mostly brown to black (fig 242a); tergum 5 without apical fascia (fig 243a) (male) . . . . . ***Megachile (Xanthosarus) gemula*** Cresson (App. C, Map 53)	Figure 242a  Figure 243a
b) Front tarsus entirely yellow (fig 242b); tergum 5 with apical fascia (fig 243b) . (male) . . . . . ***Megachile (Xanthosarus) circumcincta*** (Kirby) (App. C, Map 51)	Figure 242b Figure 243b

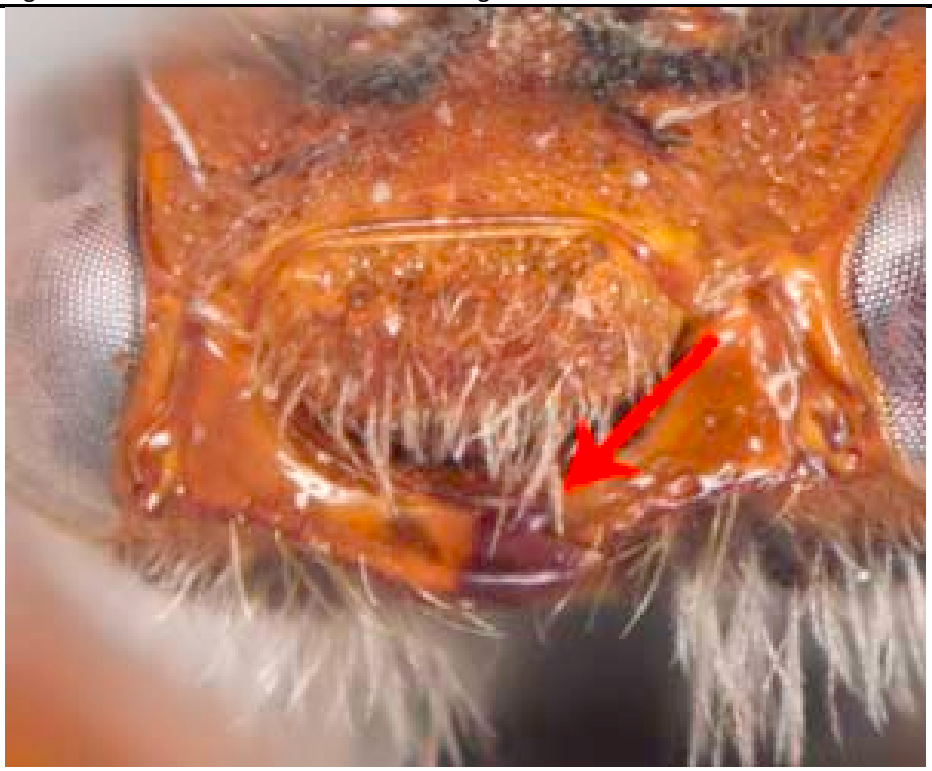
B5: Key to bee species in the Apidae family

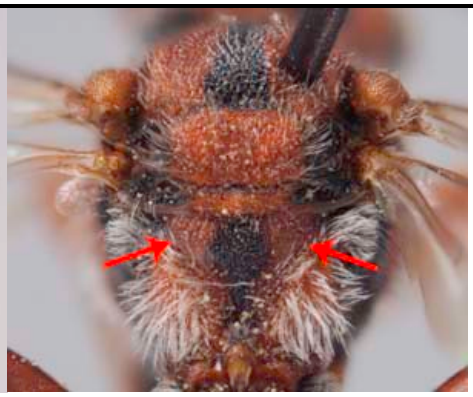
Epeolus

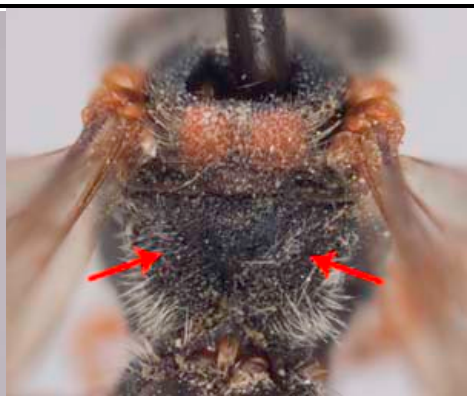
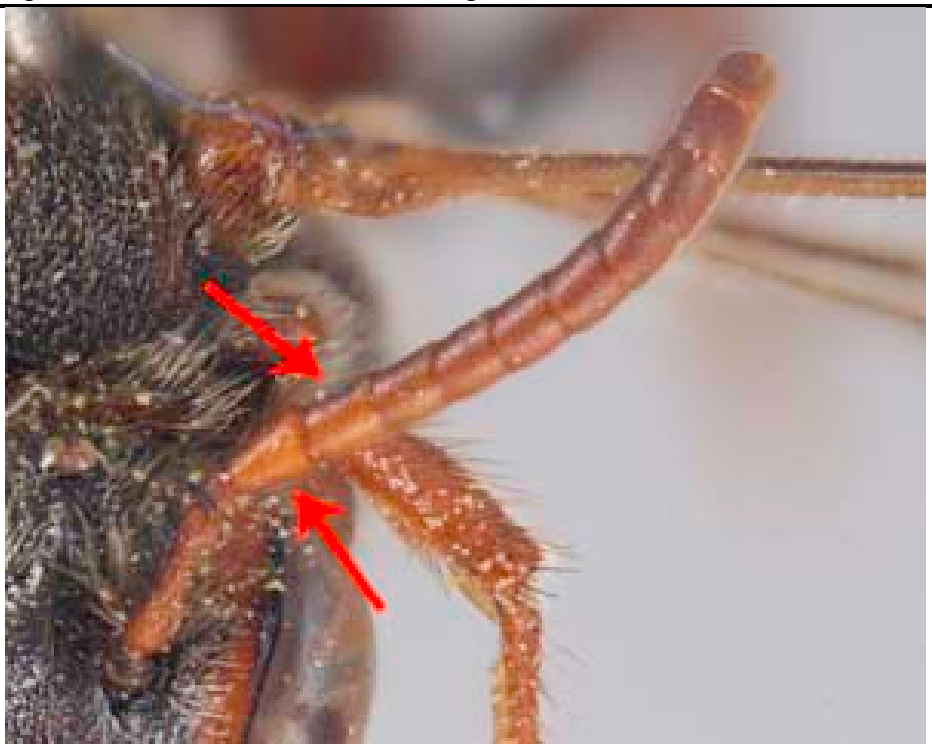
These bees do not collect pollen so they tend to be less hairy and usually wasp-like in appearance. Epeolus species generally have appressed hairs on the thorax and abdomen, which may sometimes appear as maculation at a glance. ..... ***Epeolus minimus*** *© L Packer 2014* *(App. C, Map 60)*	 © L Packer 2014

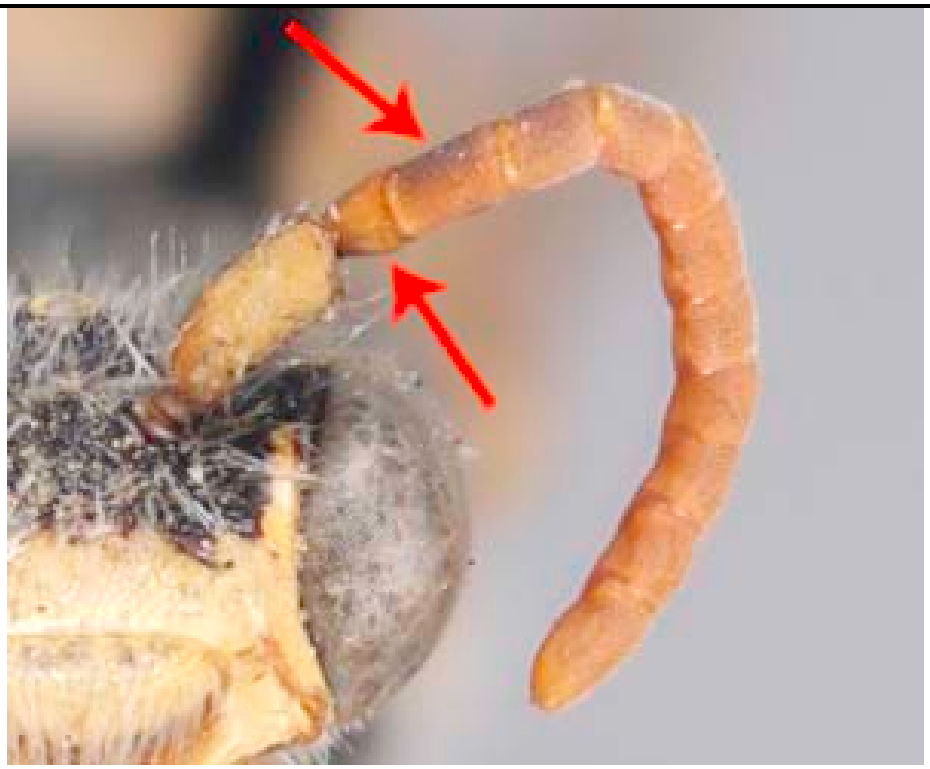
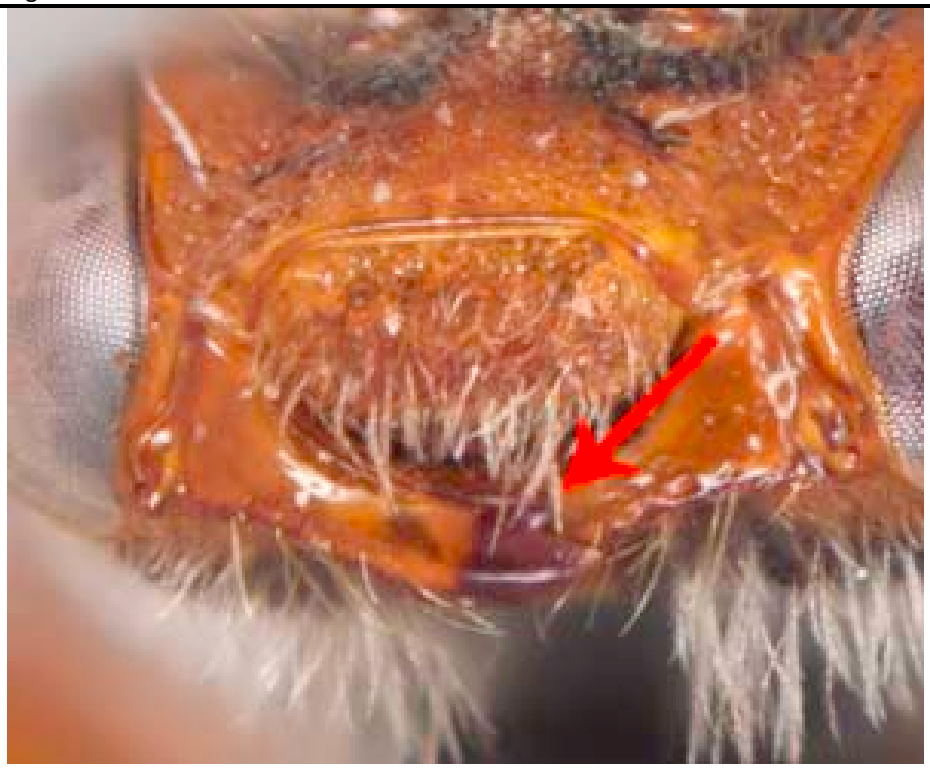
Nomada

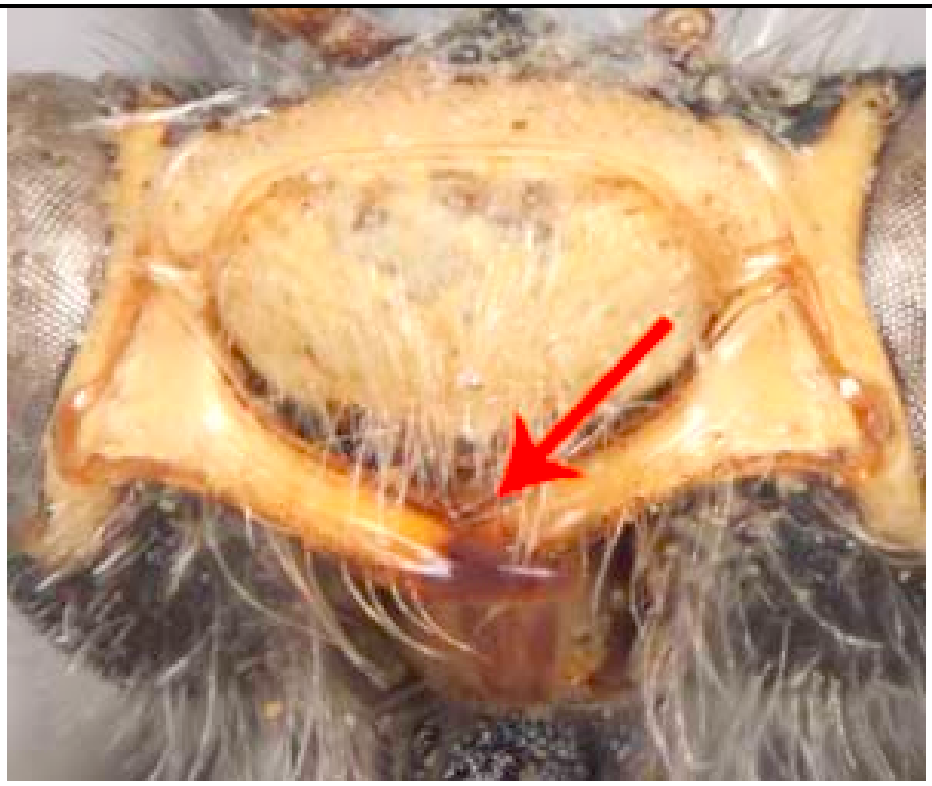
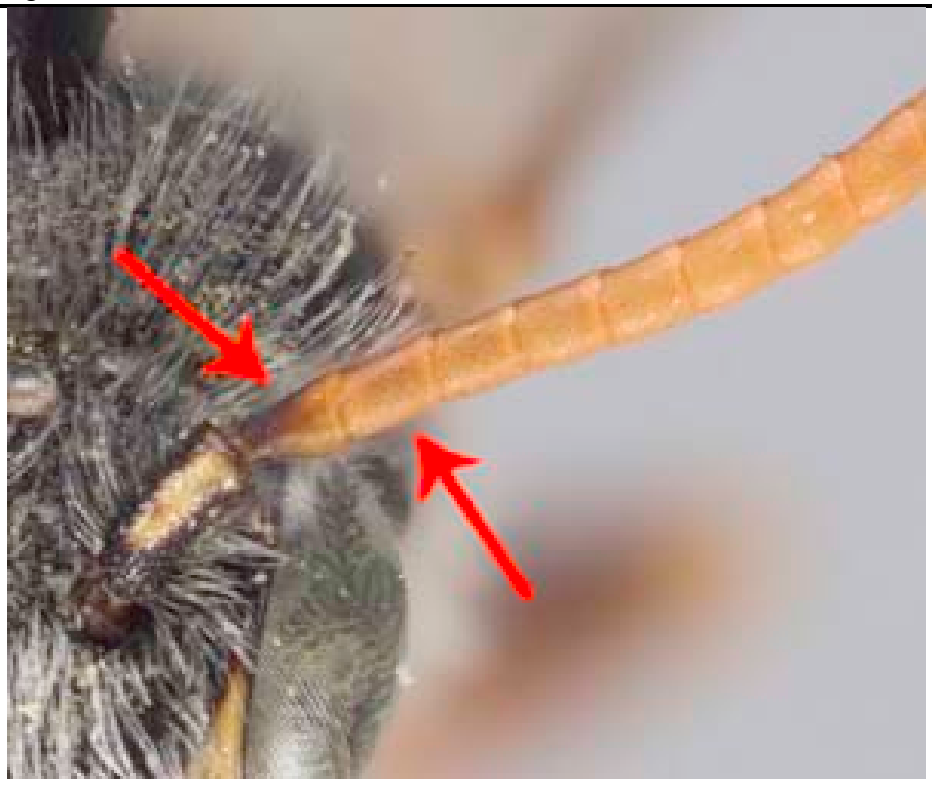
1. Antennae with 12 segments (fig 244a); metasoma with 6 visible segments (fig 245a) [females] 2	 Figure 244a Figure 245a

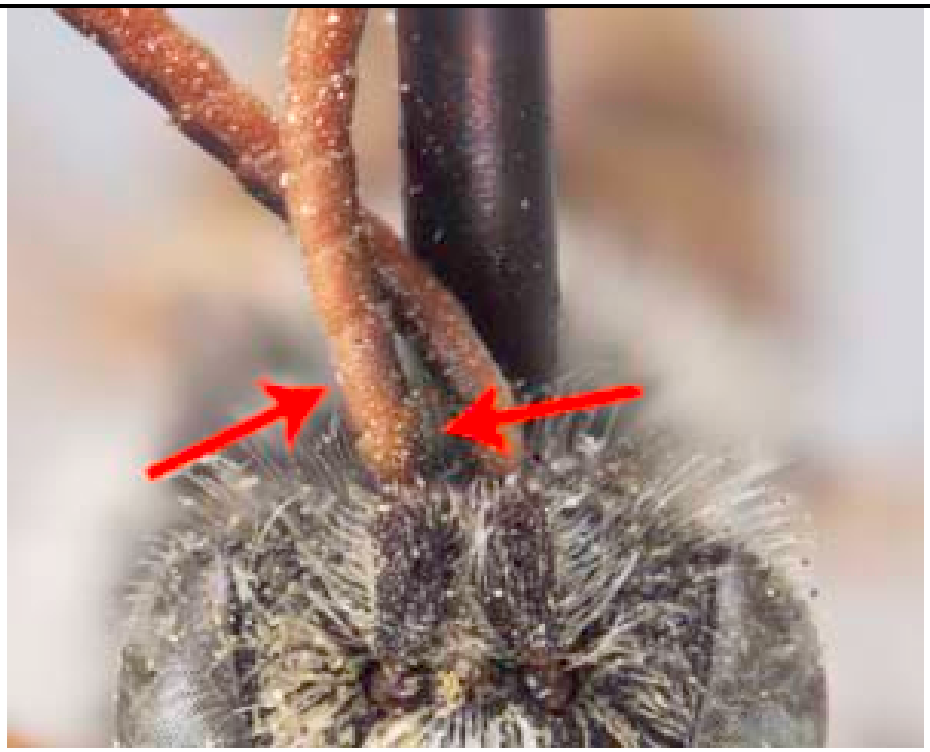
Antennae with 13 segments (fig 244b); metasoma with 7 visible segments (fig 245b) [males] 5	Figure 244b Figure 245b
2(1). Mandible bidentate, with subapical tooth (fig 246a) 3	 Figure 246a

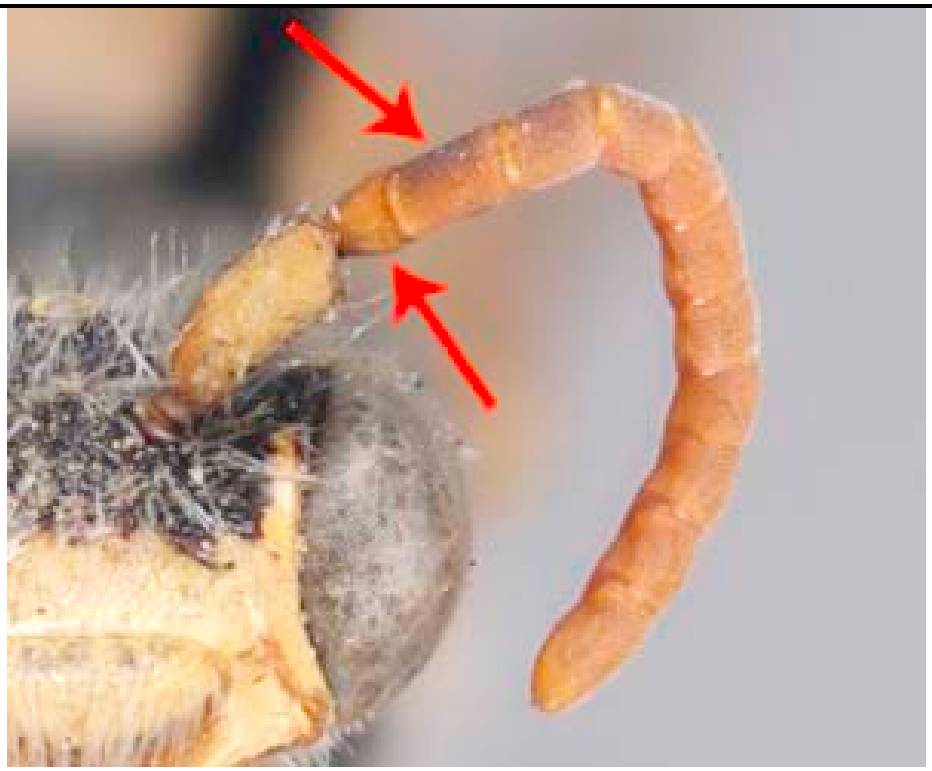
Mandible simple, without subapical tooth (fig 246b) 4	 Figure 246b
3(2). Head and mesosoma mostly red (fig 247a) (face with black area between antennae); propodeum with red (fig 248a) (female) . . . . ***Nomada cuneata*** (Robertson)* This species is described only from one sex (Mitchell, 1960); therefore, they are absent from the key to the other sex. (App. C, Map 62)	 Figure 247a  Figure 248a

Head and mesosoma mostly black (fig 247b); propodeum usually entirely black (fig 248b) (female) . . . . . . ***Nomada perplexa*** Cresson (App. C, Map 64)	 Figure 247b  Figure 248b
4(2).Shorter side of F1 equal to F2 (fig 249a) (female). . . . . . ***Nomada aquilarum*** Cockerell (no map)	 Figure 249a

Shorter side of F1 shorter than F2 (fig 249b) (female) . . . . . ***Nomada valida*** Smith* This species is described only from one sex (Mitchell, 1960); therefore, they are absent from the key to the other sex. (no map)	 Figure 249b
5(1). Mandible bidentate, with subapical tooth (fig 250a) 6	 Figure 250a

Mandible simple, without subapical tooth (fig 250b) 7	 Figure 250b
6(5). Longer side of F1 as long as F2 (fig251a) (male) . . . . . . ***Nomada bella*** Cresson* This species is described only from one sex (Mitchell, 1960); therefore, they are absent from the key to the other sex. (App. C, Map 61)	 Figure 251a

Longer side of F1 shorter than F2 (fig251b) (male) . . . . . ***Nomada perplexa*** Cresson (App. C, Map 64)	 Figure 251b
7(5). Shorter side of F1 equal to or longer than F2 (fig 252a) (male) . . . ***Nomada aquilarum*** Cockerell (no map)	Figure 252a

Shorter side of F1 shorter than F2 (fig252b) (male). . . . . . ***Nomada ochlerata*** Mitchell* This species is described only from one sex (Mitchell, 1960); therefore, they are absent from the key to the other sex. (App. C, Map 63)	 Figure 252b

Anthophora

1. Antennae with 12 segments (fig 253a); collecting hairs present on hind leg (fig 254a); metasoma with 6 visible segments (fig 255a) [females] 2	 Figure 253a

	Figure 254a Figure 255a
Antennae with 13 segments (fig 253b); collecting hairs absent on hind leg (fig 254b); metasoma with 7 visible segments (fig 255b) [males] 3	Figure 253b

Figure 254b

Figure 255b

2(1). Pygidial plate pointed (fig 256a); mandibles tri-dentate apically (fig 257a) (female). . . .

Anthophora terminalis

Cresson
(App. C, Map 66)

Figure 256a

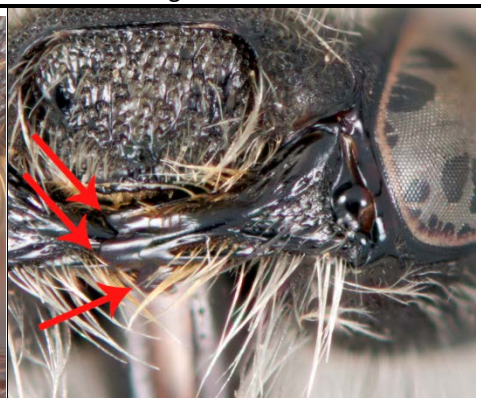
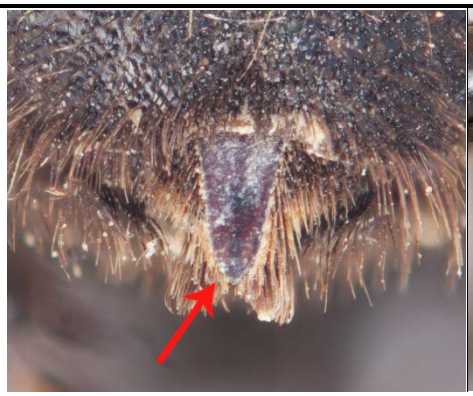
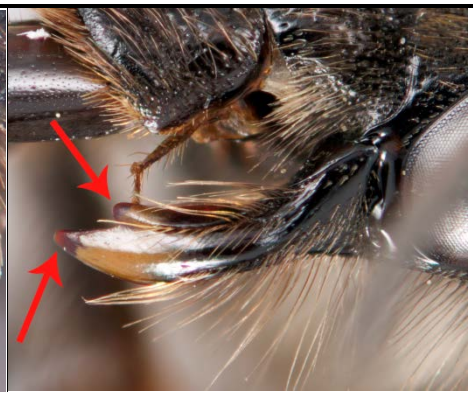


Figure 257a

Pygidial plate rounded (fig 256b); mandibles bi-dentate at apex (fig 257b) (female) . . . . . ***Anthophora bomboides*** Kirby (App. C, Map 65)	 Figure 256b  Figure 257b
3(1). Hind basitarsi straight and simple, not at all angulate (fig 258a) (male) . . . . . ***Anthophora terminalis*** Cresson (App. C, Map 66)	Figure 258a
Hind basitarsi conspicuously angulate on anterior margin (fig 258b) (male). . . . . ***Anthophora bomboides*** Kirby (App. C, Map 65)	Figure 258b

Bombus

1. Antennae with 10 flagellomeres (fig 259a); metasoma with 6 visible segments (terga), the last terga triangular and coming to a point (fig 260a) [females]. 2	Figure 259a Figure 260a
Antennae with 11 flagellomeres (fig 259 b); metasoma with 7 visible segments (terga), the last terga broadly rounded (fig 260b)] [males]. 32	Figure 259b Figure 260b
2. Hind tibia with corbicula – outward surface expanded, concave, shiny, naked, with elongate hairs on posterior margin (fig 261a); sternum 6 without carinae (fig 262a). 3	Figure 261a Figure 262a
Hind tibia without corbicula – outward surface not expanded, convex, opaque, uniformly hairy with posterior hairs no longer than outward facing hairs (fig 261b); sternum 6 with carina (fig 262b) [cuckoo bumble bees, subgenus *Psithyrus*].	

. 29	Figure 261b Figure 262b
3. Tergum 2 and/or 3 almost completely covered with reddish or orange hair (fig 263a-c). 4	Figure 263a Figure 263b Figure 263c
Tergum 2 and/or 3 with pile yellow, black, or with only traces of reddish or orange hair (fig 263d-f). . . . 8	Figure 263d

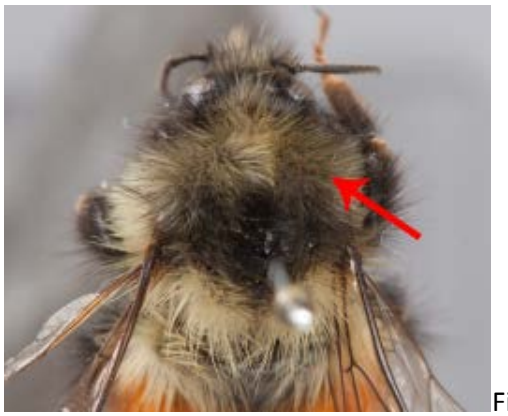
	Figure 263e Figure 263f
4. Scutum anterior to tegula with black and yellow hairs intermixed, giving the surface a clouded appearance (fig 264a-c). 5	Figure 264a  Figure 264b

	Figure 264c
Scutum anterior to tegula with pile yellow only, appearance not clouded (fig 264d). 7	Figure 264d
5. Scutellum with medial "V-shaped" area of black hair extending to posterior margin, thus separating the hair into two patches (fig 265a) (female). . . . . ***Bombus (Pyrobombus) bifarius*** [in part] (App. C, Map 68)	Figure 265a

Scutellum with hair all yellow or, at least posterior half not interrupted with black hair (fig 265b). 6	Figure 265b
6. Tergum 2 with hair mostly yellow hair, some dark hairs may be present medially (fig 266a) (female). . . . . ***Bombus (Pyrobombus) flavifrons*** [in part] (App. C, Map 71)	Figure 266a
Tergum 2 with hair reddish or orange (fig 266b) (female). . . . . ***Bombus (Pyrobombus) melanopygus*** [in part] (App. C, Map 77)	Figure 266b

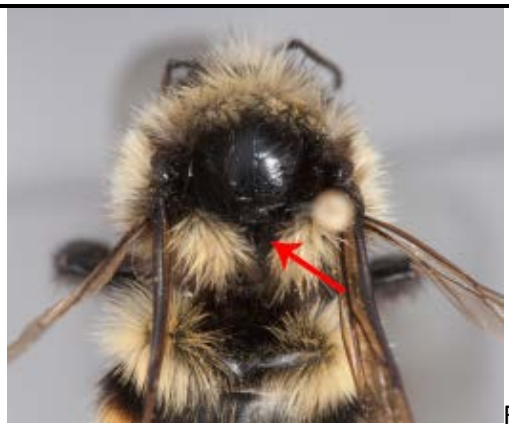
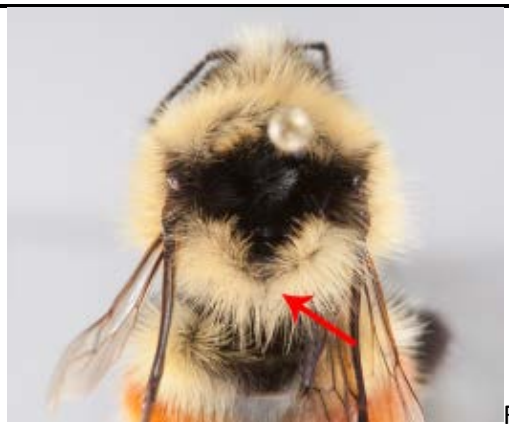
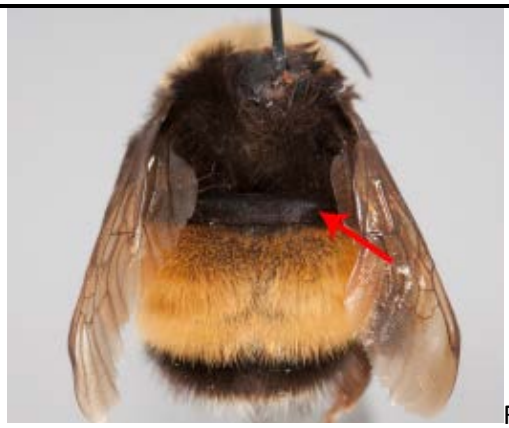
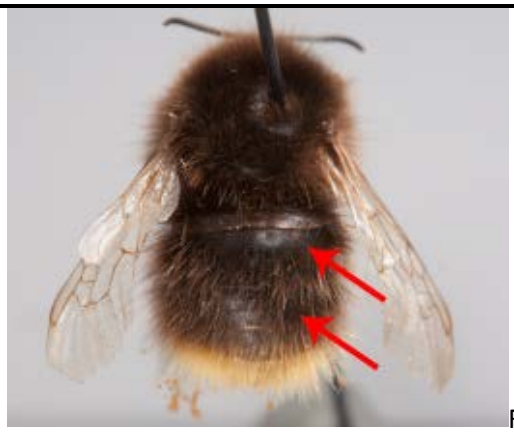
7. Scutellum with medial "V-shaped" area of black hair extending to posterior margin, thus separating the hair into two patches (fig 267a) (female). . ***Bombus (Pyrobombus) bifarius*** [in part] (App. C, Map 68)	 Figure 267a
Scutellum with hair mostly yellow, or if black hair present anteriorly at least posterior half not interrupted with black hair (fig 267b) (female). . . . ***Bombus (Pyrobombus) sylvicola*** [in part] *(App. C, Map 85)*	 Figure 267b
8. Tergum 1 with hair entirely black (fig 268a-b). 9	 Figure 268a

	Figure 268b
Tergum 1 with mostly yellow hair (fig 268c). 12	Figure 268c
9. Terga 2 and 3 with hair all or mostly yellow (fig 269a). . . . . ***Bombus (Bombus) terricola*** (App. C, Map 86)	Figure 269a
Either one (fig 269b-c) or both (fig 269d) of terga 2 or 3 black. 10	Figure 269b

	 Figure 269c Figure 269d
10. Terga 2 and 3 black (fig 270a) (female). . . . . . ***Bombus (Alpinbombus) polaris*** (App. C, Map 82)	 Figure 270a

Either tergum 2 (fig 270b) or 3 (fig 270c) yellow. 11	Figure 270b Figure 270c
11. Tergum 2 with hair yellow, tergum 3 black (fig 271a) (female). . . . . ***Bombus (Bombus) cryptarum*** (App. C, Map 70)	Figure 271a
Tergum 2 with hair black, tergum 3 black or yellow (fig 271b) (female) . . . . . ***Bombus (Bombus) occidentalis*** (App. C, Map 80)	Figure 271b

12. Pleuron with hair in lower half (and ventrally) mostly black (fig 272a).. 13	Figure 272a
Pleuron with at least upper ½ covered with yellow hair (fig 272b). 17	Figure 272b
13. Malar space short, as long as broad or very slightly longer (fig 273a). 14	Figure 273a
Malar space elongate, much longer than broad (fig 273b). 16	Figure 273b

14. Dorsal surface of thorax mostly yellowish brown with very few if any dark hairs intermixed; top of head (vertex) with yellow hairs (fig 274a) (female) . . . . . ***Bombus (Pyrobombus) perplexus*** (App. C, Map 81)	Figure 274a
Dorsal surface of thorax with a distinct black band; top of head (vertex) usually black or with some yellow hairs intermixed (fig 274b). 15	Figure 274b
15. Vertex area mostly with dark hair (fig 275a); outer (corbicular) surface of the hind tibia rough and dull (fig 276a), terga 4 and 5 with hairs black, yellow or occasionally reddish (fig 277a) (female) . . . . . ***Bombus (Alpinbombus) polaris*** (App. C, Map 82)	Figure 275a

	Figure 276a Figure 277a
Vertex area with abundant yellow hair (fig 275b); outer (corbicular) surface of the hind tibia smooth and shiny (fig 276b); terga 4 and 5 with hairs white (fig 277b) (female). . . . . . ***Bombus (Pyrobombus) jonellus*** (App. C, Map 76)	Figure 275b Figure 276b

	Figure 277b
16. Terga 1-4 yellow (fig 278a); mid basitarsus with a sharp spine or angulation on the disto-posterior corner (fig 279a) (female). ***Bombus (Subterra-neobombus) borealis*** (App. C, Map 70)	Figure 278a Figure 279a

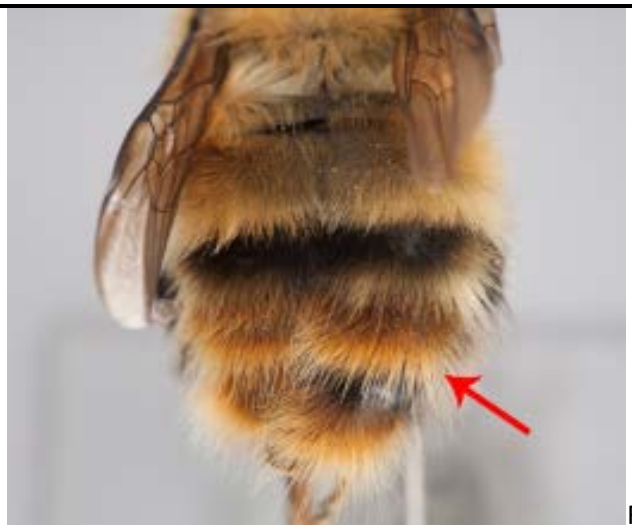
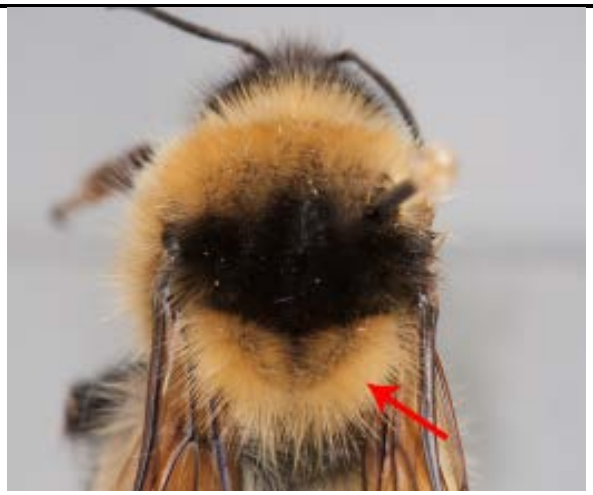
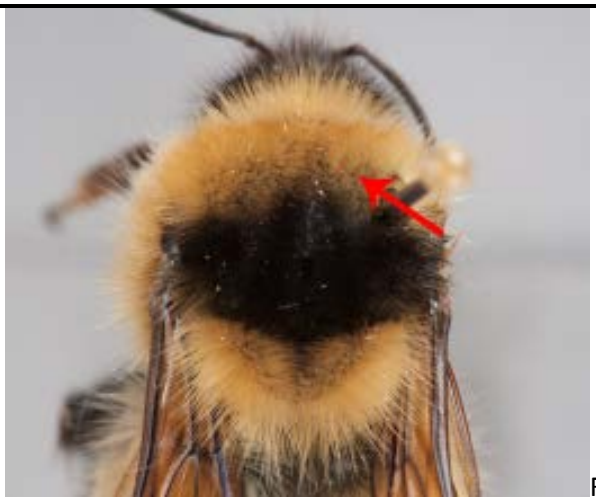
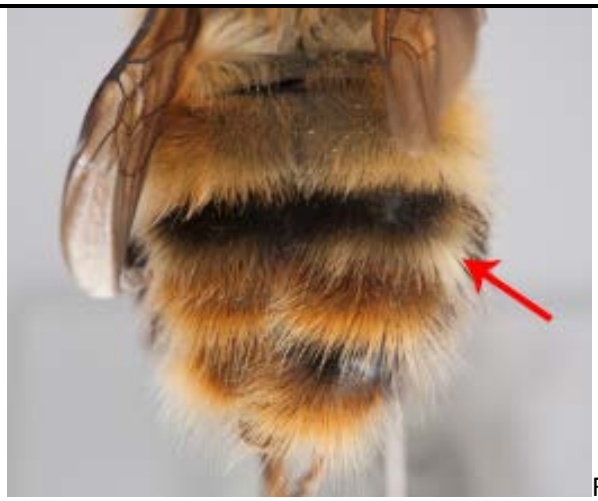
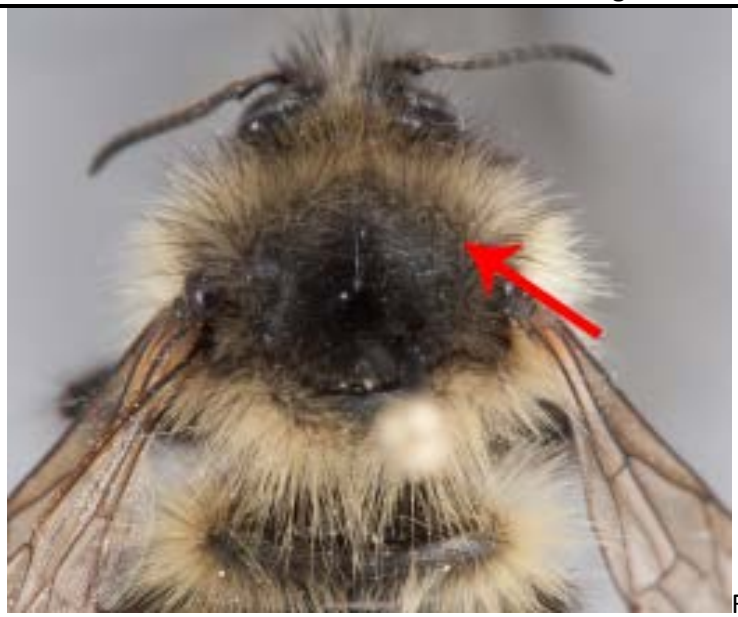
At most, terga 1-3 yellow (fig 278b); mid basitarsus rounded, without a sharp spine or angulation on the disto-posterior corner (fig 279b). . . . . ***Bombus (Alpinbombus) hyperboreus*** (App. C, Map 74) and ***Bombus (Alpinbombus) neoboreus*** (App. C, Map 79) At the present, it is difficult to distinguish these species. *Bombus hyperboreus* has no worker caste, and terga 1-2 are yellowish-brown, remaining hairs of abdomen black. In *B. neoboreus*, terga 1-3 predominantly yellow, with tergum 3 usually with only scattered black hairs.	 Figure 278b Figure 279b
17. Tergum 5 and/or 6 with hairs mostly reddish orange (fig 280a-b) [if black hairs present, then with strong admixture of reddish orange hairs]. 18	 Figure 280a

	Figure 280b
Terga 5 and 6 with hair either mostly black (fig 280c), white (fig 280d), or yellow (fig 280e), or in combinations of these, though faint traces of reddish hair may be present) (fig 280f). 22	Figure 280c Figure 280d

	Figure 280e Figure 280f
18. Scutellum with hairs black, or with admixture of yellow hairs giving a cloudy appearance (fig 281a-b). 19	Figure 281a

	Figure 281b
Scutellum with abundant pale hair, though some black hair may be present on medioanterior face (fig 281c). 20	 Figure 281c
19. Tergum 2 entirely yellow, at least in apical half (fig 282a) (female) . ***Bombus (Pyrobombus) flavifrons*** [in part] (App. C, Map 72)	Figure 282a

Tergum 2 mostly with mostly black hair, yellow hairs restricted to medial area (fig 282b) (female). . . ***Bombus (Pyrobombus) mixtus*** [in part] (App. C, Map 78)	Figure 282b
20. Scutum anterior to tegula having admixture of black and yellow hair, giving clouded appearance (fig 283a) (female) . . . . . ***Bombus (Pyrobombus) mixtus*** [in part] (App. C, Map 78)	Figure 283a
Scutum anterior to bases of tegula with yellow hair, appearance not clouded (fig 283b). 21	 Figure 283b

21. Tergum 3 with some yellow hairs present apically and/or laterally (fig 284a) (female). . . . . ***Bombus (Alpinbombus) balteatus*** [in part] (App. C, Map 67)	 Figure 284a
Tergum 3 entirely black (fig 284b) (female) . . . . . ***Bombus (Pyrobombus) frigidus*** (App. C, Map 73)	Figure 284b
22. Scutum anterior to tegula having admixture of black and yellow hair, giving clouded appearance (fig 285a). 23	 Figure 285a

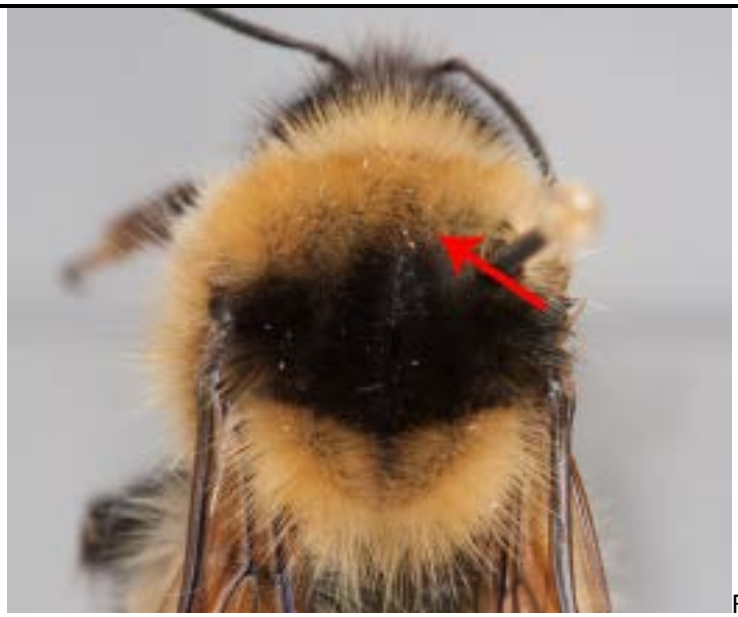
Scutum anterior to bases of tegula with yellow hair, appearance not clouded (fig 285b). 25	 Figure 285b
23. Terga 3 and 4 black (fig 286a), or with faint traces of reddish hair (fig 286b) (females). . . . . ***Bombus (Pyrobombus) flavifrons*** [inpart] (App. C, Map 72)	Figure 286a

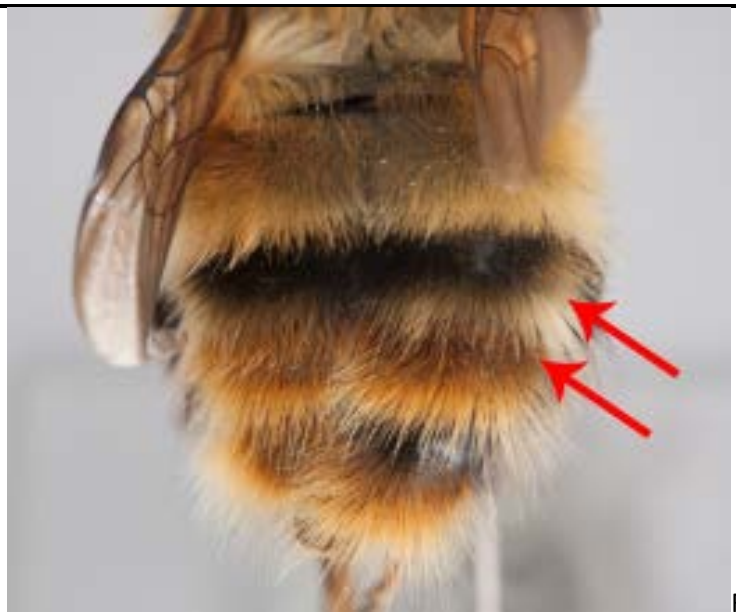
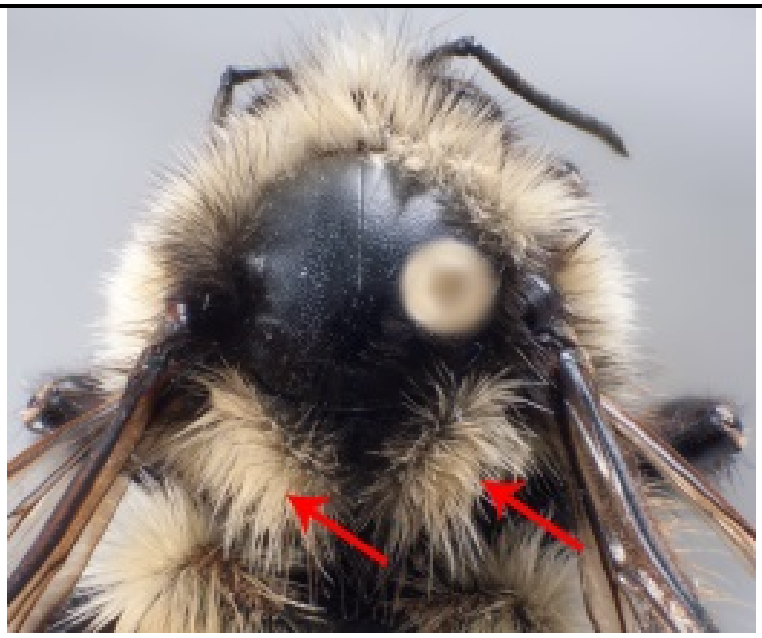
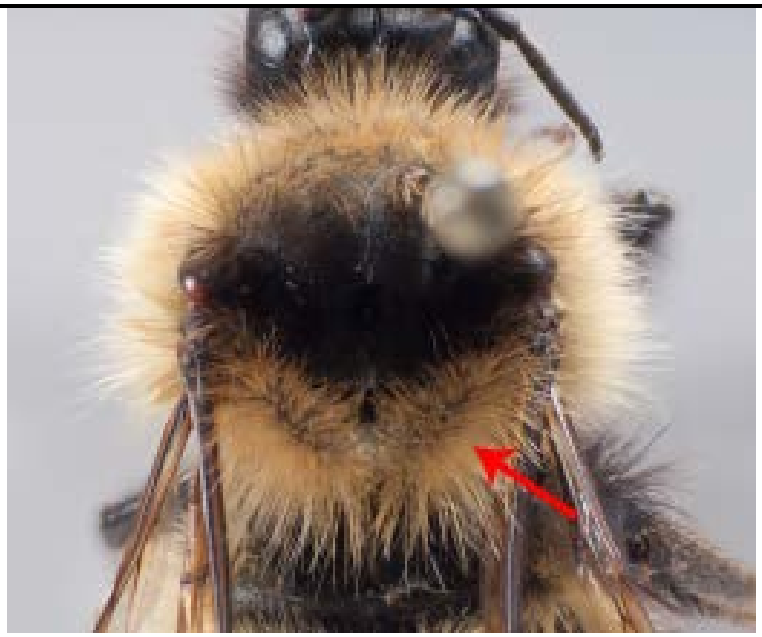
	Figure 286b
Tergum 3 and/or 4 not entirely black, tergum 4 with all or mostly pale yellow or reddish hair (fig 286c-d). 24	 Figure 286c

	Figure 286d
24. Tergum 4 entirely yellow; tergum 5 black (fig 287a) (female). . . . . ***Bombus (Pyrobombus) melanopygus*** [in part] (App. C, Map 77)	Figure 287a (not available)
Tergum 4 yellow, with black hairs present laterally in basal half; tergum 5 yellow (fig 287b) (female). . . . ***Bombus (Pyrobombus) mixtus*** [in part] (App. C, Map 78)	Figure 287b (not available)

25. Malar space elongate, much longer than broad (fig 288a) (female). . . . . ***Bombus (Alpinbombus) balteatus*** [in part] (App. C, Map 67)	Figure 288a
Malar space shorter, at most as long as broad (fig 288b). 26	Figure 288b

26. Scutellum with yellow hairs divided laterally into two patches, with medial "V-shaped" area of black hair extending to posterior margin (fig 289a) (female). ***Bombus (Pyrobombus) bifarius*** [in part] (App. C, Map 68)	 Figure 289a
Scutellum entirely yellow, or if black hairs present, then not dividing yellow hair into two distinct patches (fig 289b). 27	 Figure 289b

27. Terga 4 and 5 with hairs white (fig 290a) (female). . . . . ***Bombus (Pyrobombus) jonellus*** (App. C, Map 76)	Figure 290a
Tergum 4 black or yellow, tergum 5 colour variable – black, yellow or occasionally white (fig 290a-b). 28	Figure 290a Figure 290b
28. Tergum 4 black (fig 291a), malar space short, slightly broader than long or at most, as broad as long (fig 291b) (female). . .	Figure 291a (not available) Figure 291b (not available)

Bombus (Pyrobombus) sandersoni (App. C, Map 83)	
Tergum 4 yellow (fig 291c), malar space as long as broad or longer (fig 291d) (female). . . . . ***Bombus (Pyrobombus) sylvicola*** [in part] (App. C, Map 85)	Figure 291c (not available) Figure 291d (not available)
29. Vertex area with predominantly black hair (fig 292a). 30	Figure 292a
Vertex area with predominantly yellow hair (fig 292b). 31	Figure 292b

30. Pleuron with hair entirely yellow (fig 293a); sternum 6 with lateral elevations (carina) greatly produced, projecting slightly laterad (fig 294a), visible even in dorsal view (fig 295a) (female). . . . . .

Bombus (Psithyrus) suckleyi

(App. C, Map 84)

Figure 293a

Figure 294a

Figure 295a

Pleuron with hair in lower half largely black (fig 293b); sternum 6 with lateral elevations (carina) moderately produced, scarcely projecting laterad (fig 294b) and not visible in dorsal view (fig 295b) (female). . . . . .

Bombus (Psithyrus) ashtoni

(App. C, Map 69)

Figure 293b

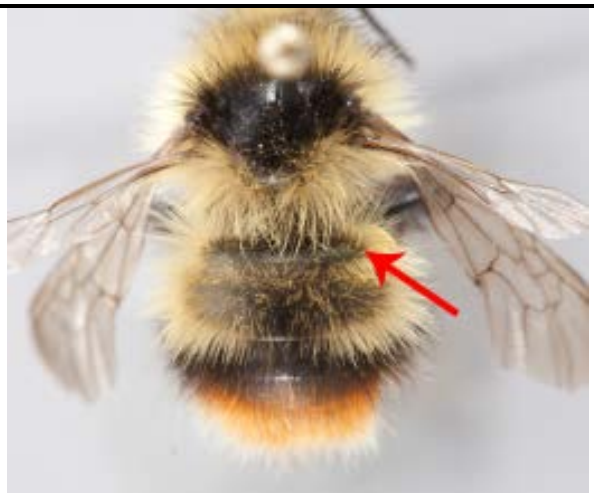
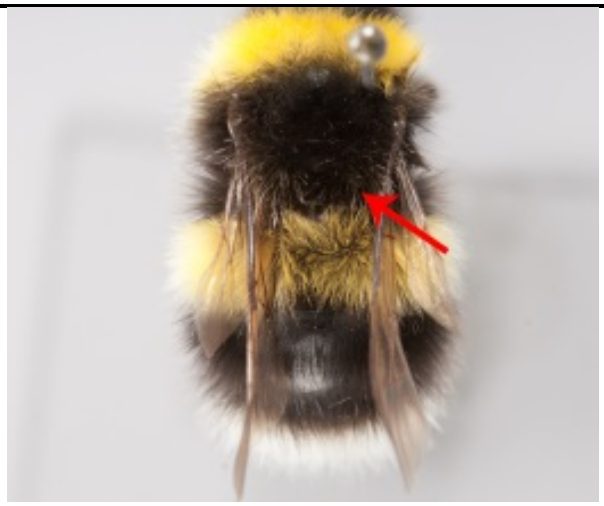
Figure 294b

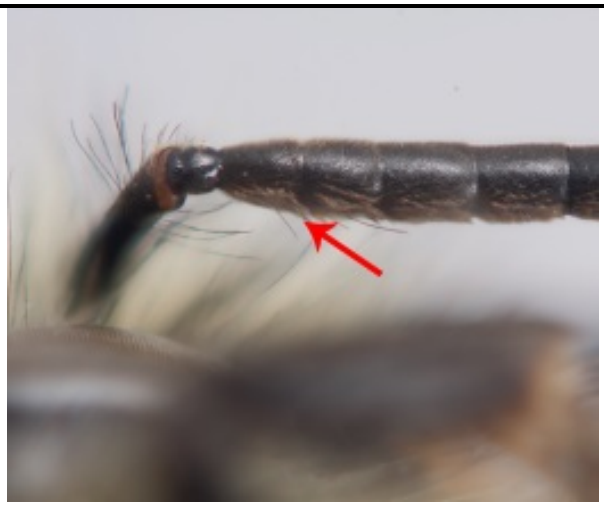
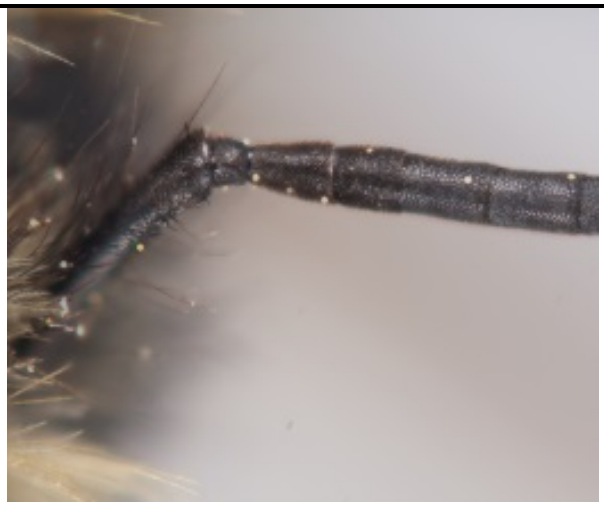
Figure 295b

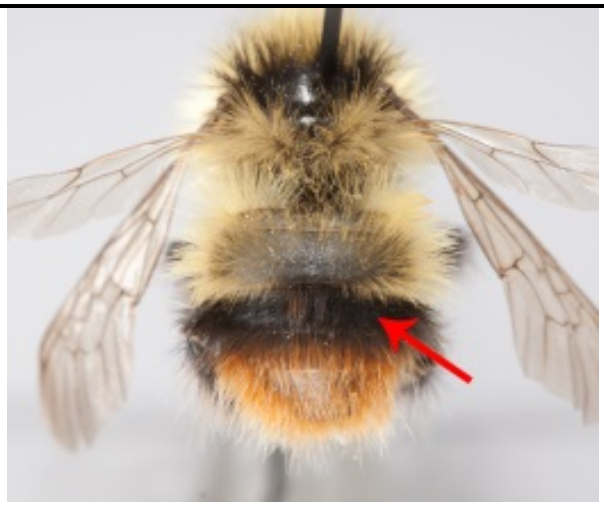
31. Face with black hairs around bases of antenna (fig 296a); tergum 6 strongly recurved, with sternum 6 narrow and projecting as a point [not sting] distally beyond tergum 6 (fig 297a) (female). . . . . . ***Bombus (Psithyrus) fernaldae*** (no map)	 Figure 296a Figure 297a
Face with predominantly yellow hairs around bases of antenna (fig 296b); tergum 6 not recurved, with sternum 6 broad and not projecting distally beyond tergum 6 (fig 297b) (female). . . . . . ***Bombus (Psithyrus) insularis*** (App. C, Map 75)	 Figure 296b

	Figure 297b
32. Outer surface of hind tibia bare and shiny (fig 298a). 33	**Figure 298a**
Outer surface of hind tibia with abundant, short black hairs (fig 298b) (cuckoo bumble bees, subgenus *Psithyrus*). 58	Figure 298b

33. Tergum 7, and usually tergum 6 with hair mostly reddish-orange (fig 299a), yellow, or white (fig 299b), some black hairs may be present.. 34	Figure 299a Figure 299b
Tergum 7 with hair black (fig 299c). 44	Figure 299c

34. Tergum 1 with hair all yellow (fig 300a).. . 35	 Figure 300a
Tergum 1 with hair all black (fig 300b-c). . . 41	 Figure 300b Figure 300c

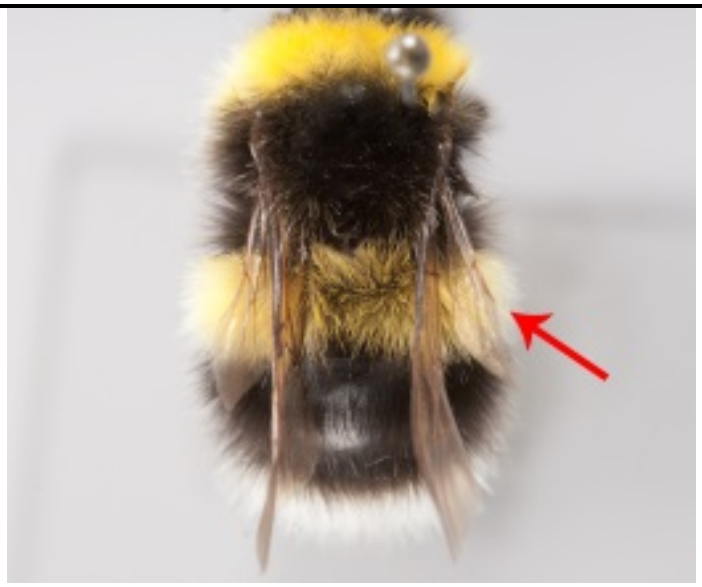
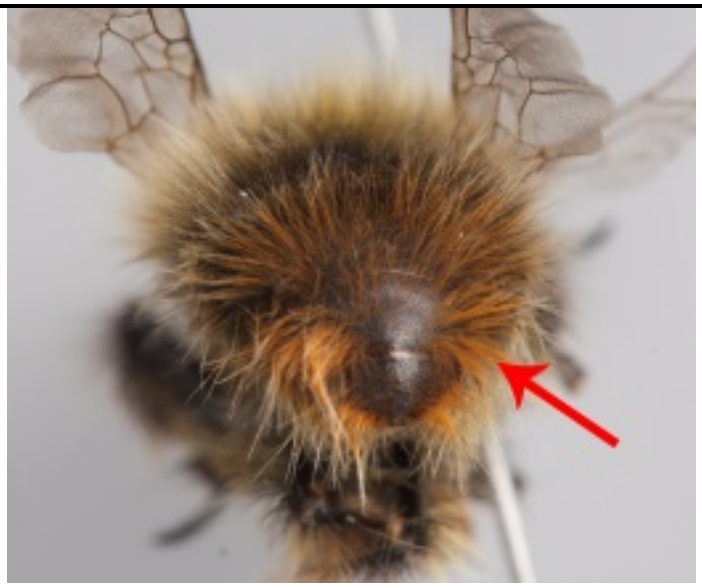
35. First flagellar segment with tuft of hair laterally (fig 301a) (male). . . . . ***Bombus (Pyrobombus) mixtus*** (App. C, Map 78)	 Figure 301a
First flagellar segment with no hair tuft (fig 301b). . 36	 Figure 301b
36. Terga 1-4 with hair entirely yellow, terga 5-7 with hair yellow and/or black (fig 302a) (male). . . . ***Bombus (Subterra-neobombus) borealis*** [in part] (App. C, Map 70)	Figure 302a

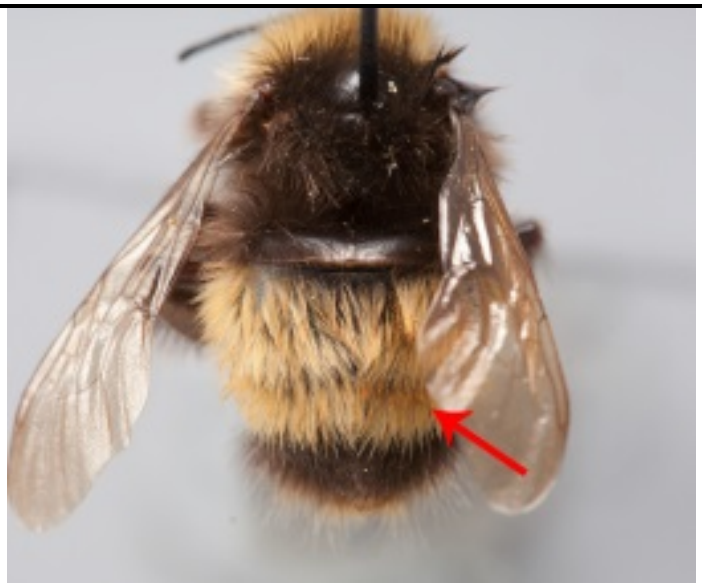
At most, terga 1-3 (usually only 1 and 2) with hair completely yellow, terga 5-7 with mostly with reddish-orange hair (fig 302b), or entirely white (fig 302c).. 37	Figure 302b Figure 302c
37. Tergum 3 completely black, or very few reddish hairs may be present (fig 303a).. . . 38	 Figure 303a

Tergum 3 with at least some yellow or reddish hairs present (fig 303b).. 39	Figure 303b
38. Terga 5-7 with extensive reddish-orange hair (fig 304a) (male). . . . . ***Bombus (Pyrobombus) frigidus*** (App. C, Map 73)	Figure 304a (not available)
Terga 5-7 with white hair (fig 304b) (male). . . ***Bombus (Pyrobombus) jonellus*** (App. C, Map 76)	Figure 304b (not available)

39. Dorsal surface of thorax almost entirely yellow, possibly with a few dark hairs centrally, without a distinct band or spot of dark hair (fig 305a) (male). . . . . ***Bombus (Pyrobombus) perplexus*** [in part] (App. C, Map 81)	Figure 305a
Dorsal surface of thorax with a distinct central spot or stripe of darker hairs intermixed with the yellow hairs (fig 305b). 40	Figure 305b
40. Malar space short, wider than long (fig 306a) (male). . . . . ***Bombus (Bombus) cryptarum*** [in part] (App. C, Map 41)	Figure 306a

Malar space longer than wide (fig 306b) (male). . . ***Bombus (Alpinbombus) balteatus*** (App. C, Map 67) and ***Bombus (Alpinbombus) polaris*** [in part] (App. C, Map 82) At the present, it is difficult to distinguish these species due to overlapping colour variation.	Figure 306b
41. Tergum 2 with black hair (fig 307a). 42	Figure 307a

Tergum 2 with yellow hair (fig 307b).. 43	 Figure 307b
42. Terga 5-7 usually reddish-orange (fig 308a) (male) . . . . . ***Bombus (Alpinbombus) polaris*** [in part] (App. C, Map 82)	 Figure 308a

Terga 5-7 usually pale yellow to white (fig 308b) (male) . . . . . . ***Bombus (Bombus) occidentalis*** (App. C, Map 80)	 Figure 308b
43. Tergum 3 with yellow hair, tergum 4 and 5 with hair black and/or with yellow (fig 309a) (male). . . . . . ***Bombus (Bombus) terricola*** [in part] (App. C, Map 86)	 Figure 309a

Tergum 3 with black hair, tergum 4 and 5 mostly white (fig 309b) (male).. . . . . . ***Bombus (Bombus) cryptarum*** [in part] (App. C, Map 70)	 Figure 309b
44. Tergum 1 with black hair (fig 310a) (male). . . ***Bombus (Bombus) terricola*** [in part] (App. C, Map 86)	 Figure 310a

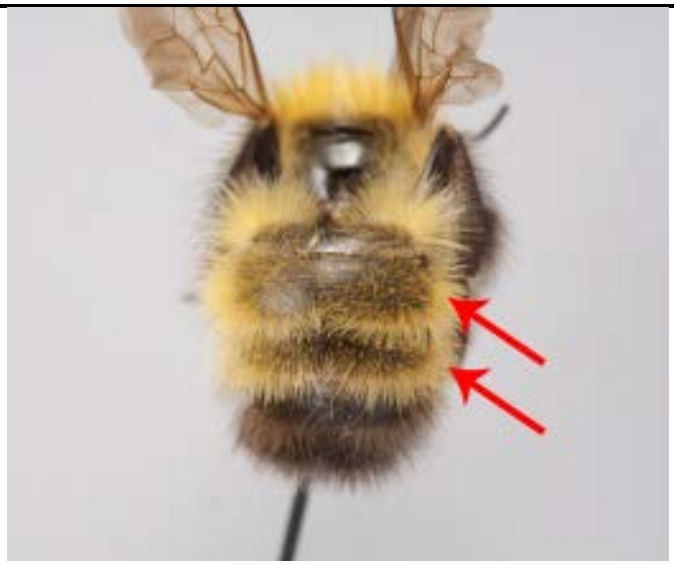
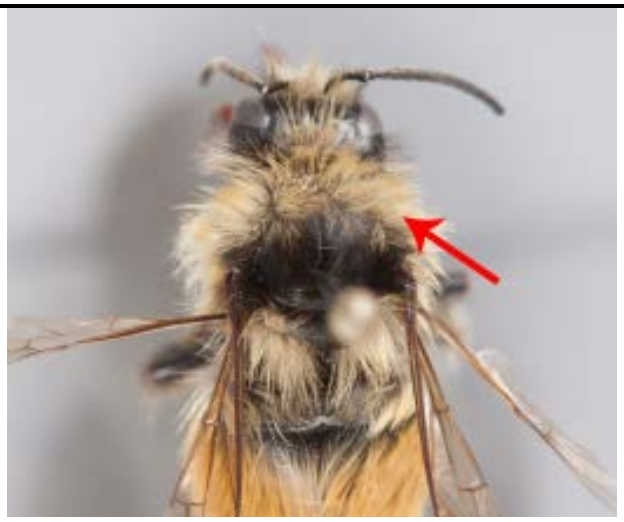
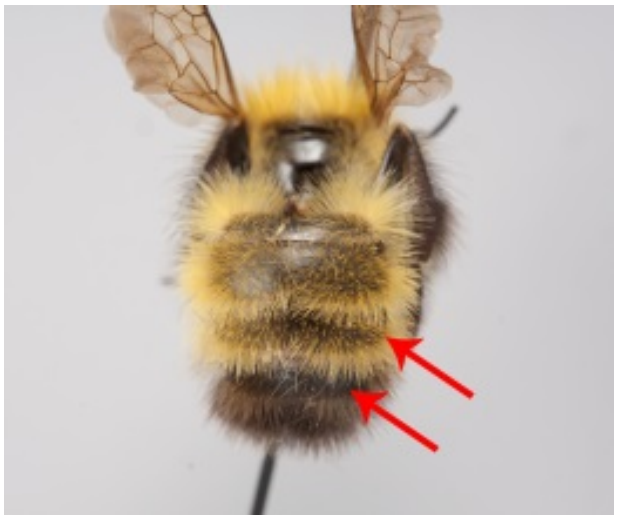
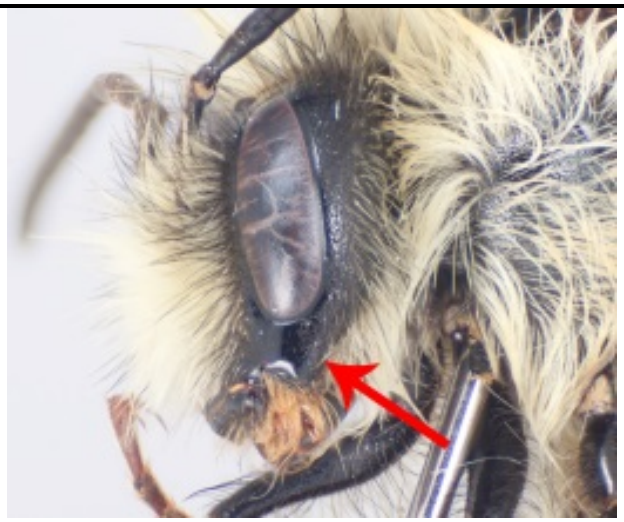
Tergum 1 with yellow hair (fig 310b). 45	Figure 310b
45. Terga 2 and 3 with hair predominantly reddish-orange (fig 311a). 46	Figure 311a
Terga 2 and 3 with hair yellow (fig 311b), black (fig 311c), or only 3 reddish-orange (fig 311d). 49	 Figure 311b

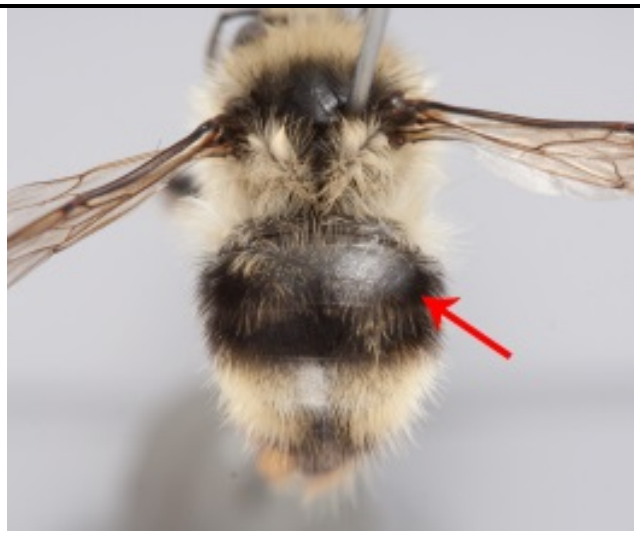
	Figure 311c Figure 311d
46. Dorsal surface of thorax with admixture of yellow and black hair, giving the surface a clouded appearance (fig 312a); tergum 5 with hair mostly black (fig 313a). 47	Figure 312a

	Figure 313a
Dorsal surface of thorax with hair mostly to entirely yellow anterior to tegula (fig 312b); tergum 5 with hair mostly yellow (fig 313b).. 48	 Figure 312b Figure 313b

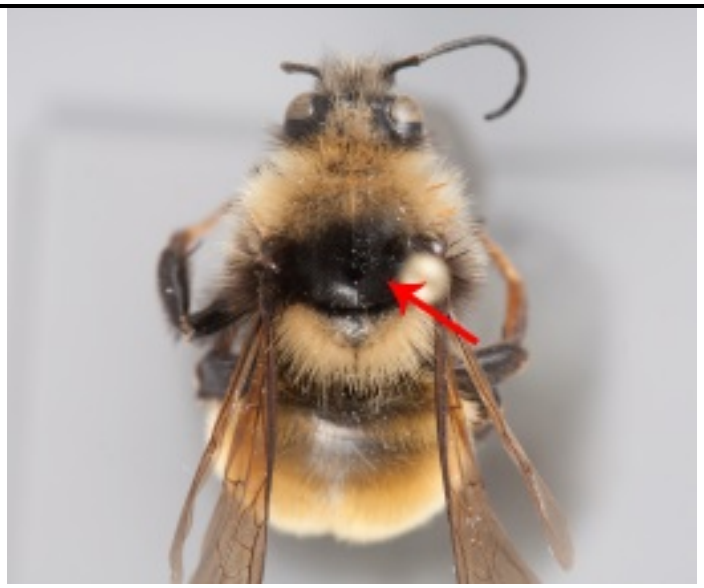
47. Hair on face above antennal bases mostly yellow (fig 314a) (male). ***Bombus (Pyrobombus) melanopygus*** (App. C, Map 77)	 Figure 314a
Hair of face above antennal bases with little or no yellow (fig 314b) (male). . . . . . ***Bombus (Pyrobombus) sylvicola*** [in part] (App. C, Map 85)	 Figure 314b
48. Hair of face above antennal bases with little or no yellow (fig 315a) (male). . . . . . ***Bombus (Pyrobombus) sylvicola*** [in part] (App. C, Map 85)	 Figure 315a

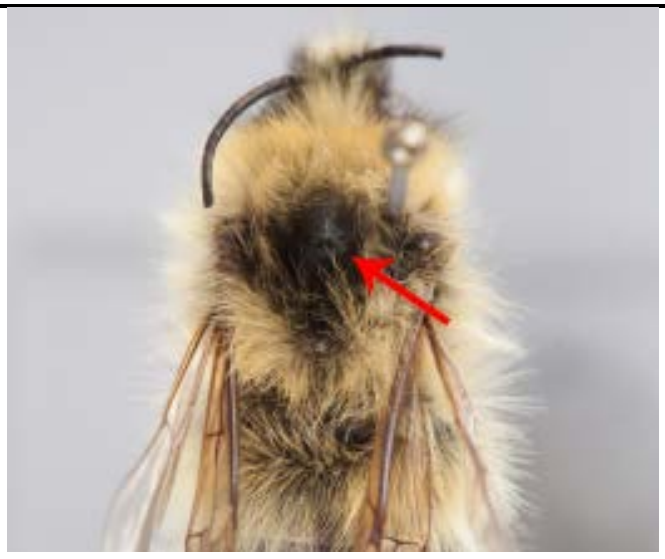
Hair of face above antennal bases yellow (fig 315b) (male) .. . . . . ***Bombus (Pyrobombus) bifarius*** {in part] (App. C, Map 68)	Figure 315b
49. Terga 3 and 4 with reddish-orange hair predominating (fig 316a) (male). . . . . ***Bombus (Pyrobombus) flavifrons*** [in part] (App. C, Map 72)	Figure 316a
Terga 3 and 4 with hair yellow (fig 316b), black (fig 316c), or with combinations of both (fig 316d).. ……. . 50	Figure 316b

	Figure 316c  Figure 316d
50. Malar space shorter, at most as long as broad (fig 317a); tergum 2 with mostly black pile, especially laterally (fig 318a) (male). . . . . ***Bombus (Pyrobombus) bifarius*** [in part] (App. C, Map 68)	 Figure 317a

	 Figure 318a
Malar space longer than broad (fig 317b); tergum 2 with mostly yellow hair (fig 318b).. 51	Figure 317b Figure 318b

51. Terga 1-4 yellow (fig 319a).. 52	Figure 319a
Terga 1-4 not entirely yellow (fig 319b).. . . . 53	Figure 319b
52. Dorsal surface of thorax almost entirely yellow, possibly with a few dark hairs centrally, without a distinct dark hair band (fig 320a) (male).. . . . . ***Bombus (Pyrobombus) perplexus*** [in part] (App. C, Map 81)	Figure 320a

Dorsal surface of thorax with much black hair present, forming a distinct band (fig 320b). . . . ***Bombus (Subterra-neobombus) borealis*** [in part] (App. C, Map 70)	 Figure 320b
53. Face with extensive yellow hairs (fig 321a).. 54	Figure 321a

Face with hairs entirely black, or only traces of yellow (fig 321b).. . . . 55	Figure 321b
54. Dorsal surface of thorax almost entirely yellow, possibly with a few dark hairs centrally, without a distinct dark hair band (fig 322a) (male).. . . . . ***Bombus (Pyrobombus) perplexus*** [in part] (App. C, Map 81)	Figure 322a
Dorsal surface of thorax with much black hair present, forming a distinct hair band (fig 322b) (male). ***Bombus (Pyrobombus) flavifrons*** [in part] (App. C, Map 72)	 Figure 322b

55. Terga 3-7 entirely black (fig 323a).. 56	Figure 323a
Tergum 3 with at least traces of yellow hairs (fig 323b-c). 57	Figure 323b Figure 323c

56. Dorsal surface of thorax almost entirely yellow, possibly with a few dark hairs centrally, without a distinct dark hair band (fig 324a) (male) .. . . ***Bombus (Pyrobombus) perplexus*** [in part] (App. C, Map 81)	 Figure 324a
Dorsal surface of thorax with much black hair present, forming a distinct hair band (fig 324b) (male). ***Bombus (Alpinbombus) hyperboreus*** [in part] (App. C, Map 74)	 Figure 324b
57. Dorsal surface of thorax almost entirely yellow, possibly with a few dark hairs centrally, without a distinct dark hair band (fig 325a) (male). . . . ***Bombus (Pyrobombus) perplexus*** [in part] (App. C, Map 81)	 Figure 325a

Dorsal surface of thorax with much black hair present, forming a distinct hair band (fig 325b) (male). ***Bombus (Alpinbombus) neoboreus*** [in part] (App. C, Map 79)	 Figure 325b
58. Pleuron with black hair on lower half (fig 326a) (male). . . . . . ***Bombus (Psithyrus) ashtoni*** (App. C, Map 69)	 Figure 326a
Pleuron with hair yellow (fig 326b). 59	 Figure 326b

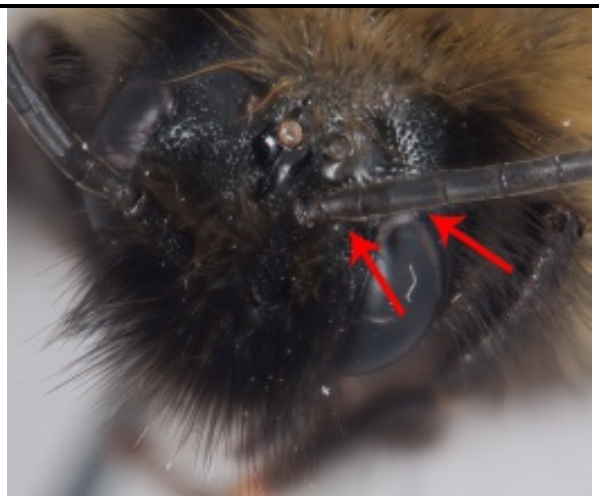
59. Flagellomere 3 longer than 1 (nearly as long as 1 and 2 combined) (fig 327a) (male). . . . . ***Bombus (Psithyrus) insularis*** (App. C, Map 75)	 Figure 327a
Flagellomere 3 about as long as 1 (fig 327b). . 60	Figure 327b
60. Malar space longer than wide (fig 328a); vertex area with abundant yellow hair (fig 329a) (male). . . . . ***Bombus (Psithyrus) fernaldae*** (no map)	Figure 328a

	Figure 328b
Malar space short, wider than long (fig 328b); vertex area with hair mostly black or with traces of yellow (figs 329b-c) (male).. . . . . **_Bombus (Psithyrus) suckleyi_** (App. C, Map 84)	Figure 328b Figure 329b

Figure 329c

Apis

Apis mellifera, commonly known as the honey bee, is an introduced species. It is also the only species that lives in a colony all year long. This species, along with *Bombus* (Bumblebees) could be distinguished by the corbicula (pollen basket) on their hind legs, where they store pollen (females only). Other bee species usually transport pollen on their hind legs or lower abdomen (sterna) where the hairs are dense……

Apis mellifera

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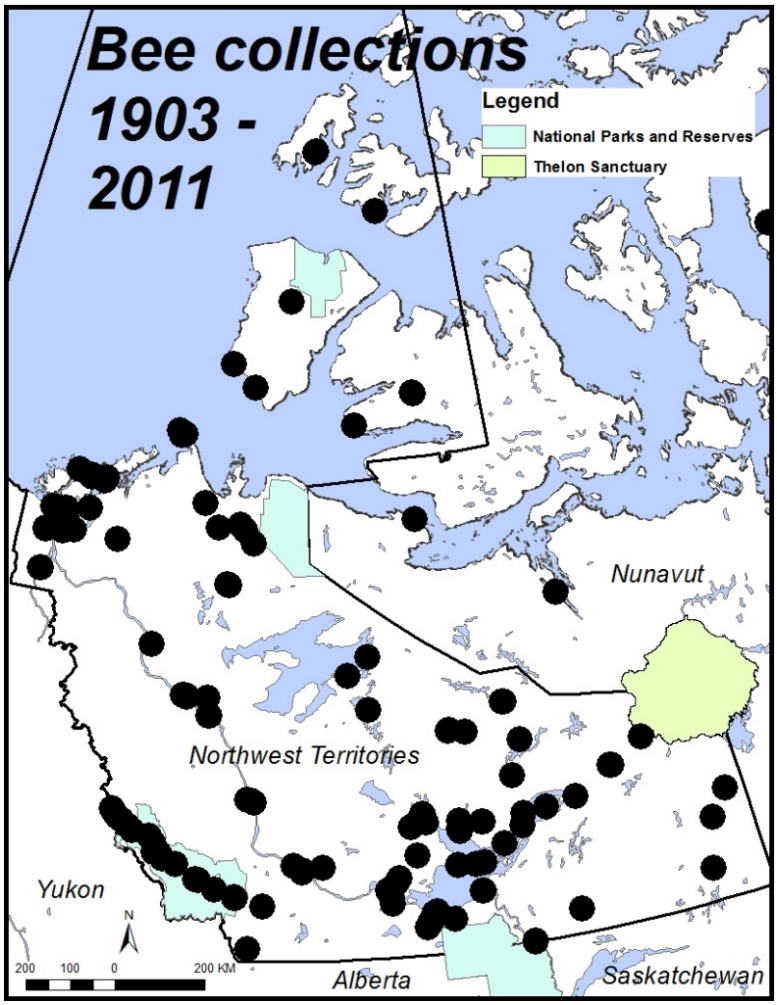
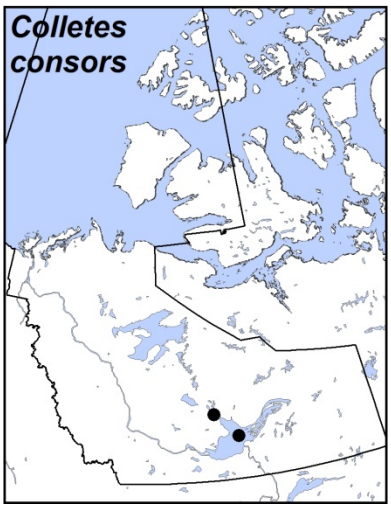
Appendix C: Distribution maps from known locations of bee collections in the NWT.



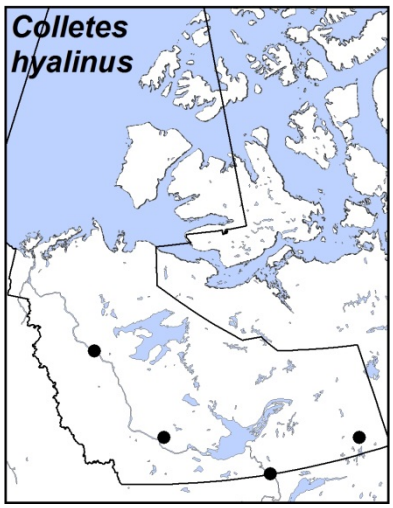
Map 1. All bee specimens with available location data from the NWT (and eastern Nunavut), collected from 1903 to 2011 inclusive. Areas less surveyed include the Mackenzie Mountains north of Nahanni National Park Reserve, Tuktut Nogait National Park on the Beaufort Sea coast, Aulavik National Park on Banks Island, all the Arctic islands, and the Thelon Sanctuary. See Methods for sources.

Maps of Colletidae – Plasterer bees and relatives

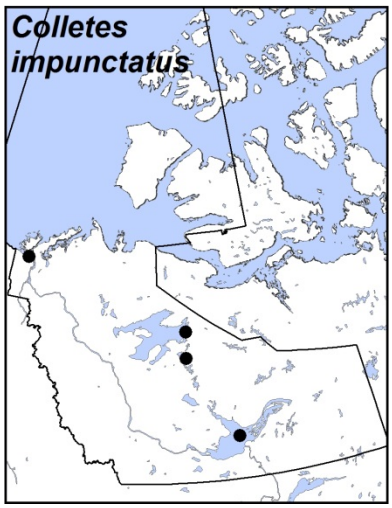
Colletes – Plasterer bees



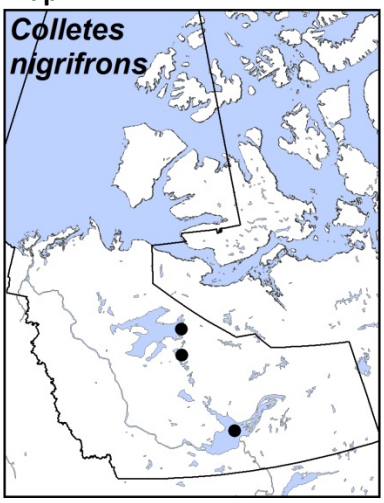
Map 2



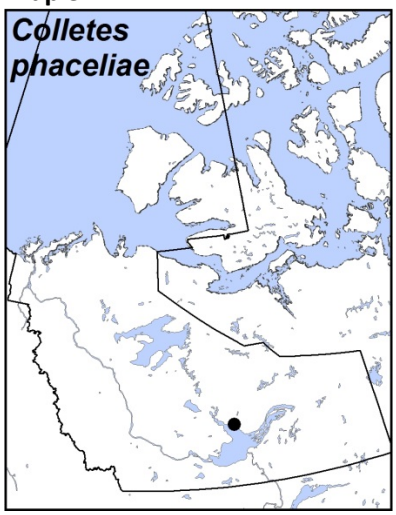
Map 3



Map 4

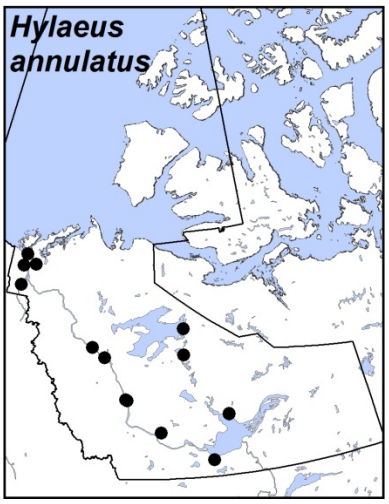


Map 5

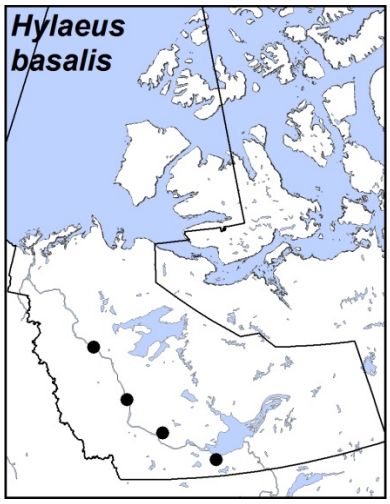


Map 6

Hylaeus – Masked bees



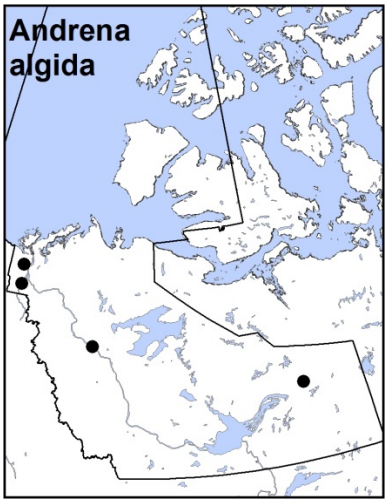
Map 7



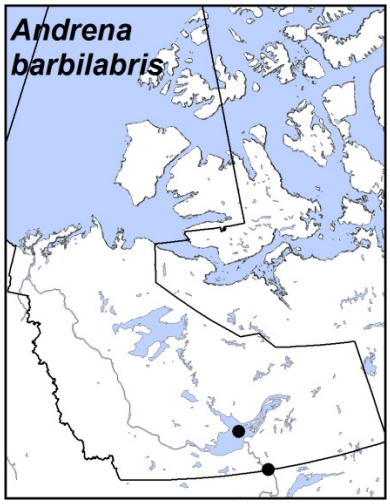
Map 8

Maps of Andrenidae – Andrenid bees

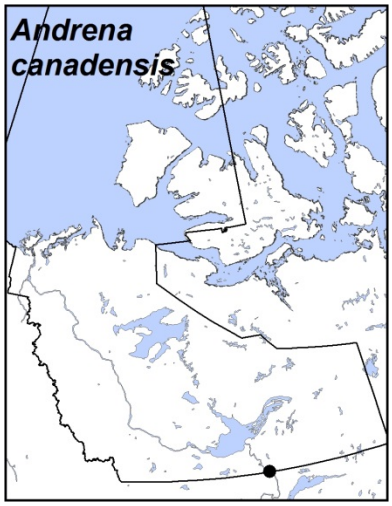
***Andrena* – Miner bees**



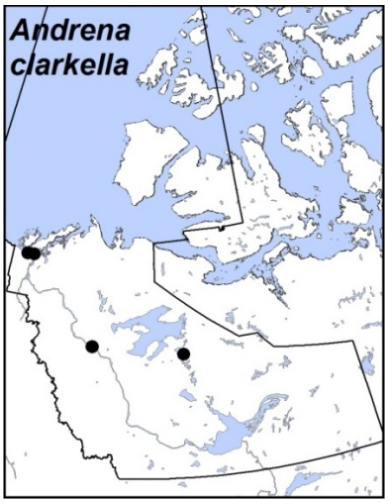
Map 9



Map 10

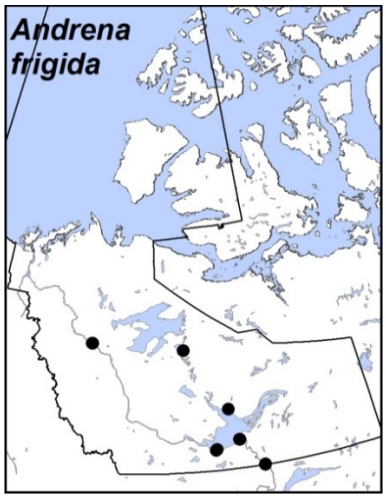


Map 11

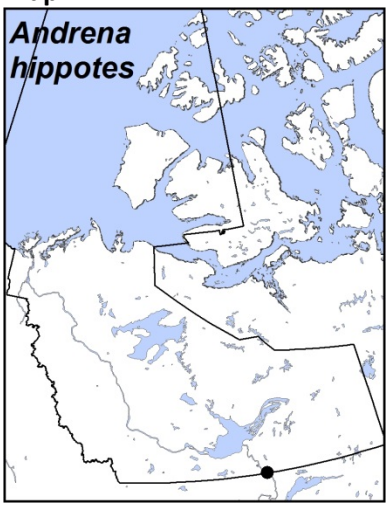


Map 12

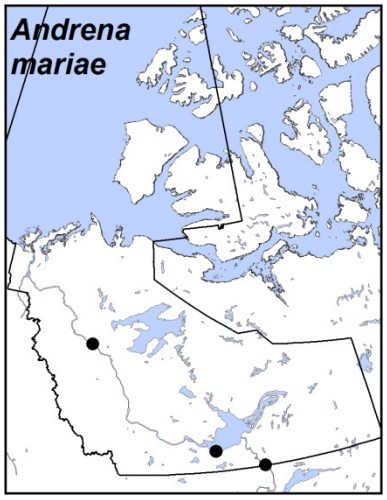
Map 13



Map 14



Map 15



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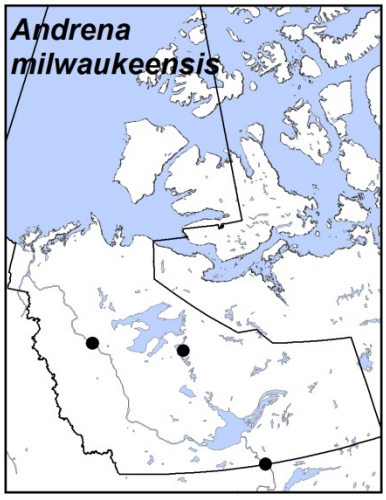
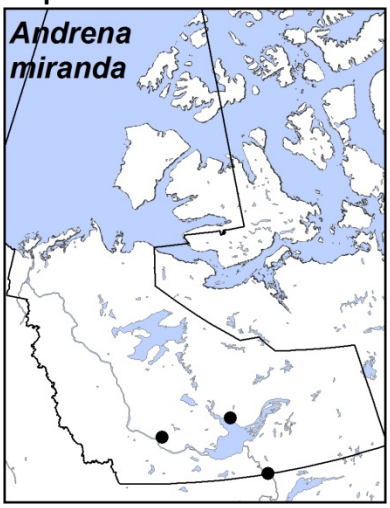
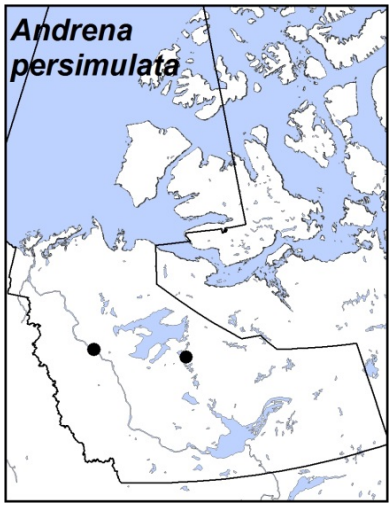


Map 17



Map 18

Map 19



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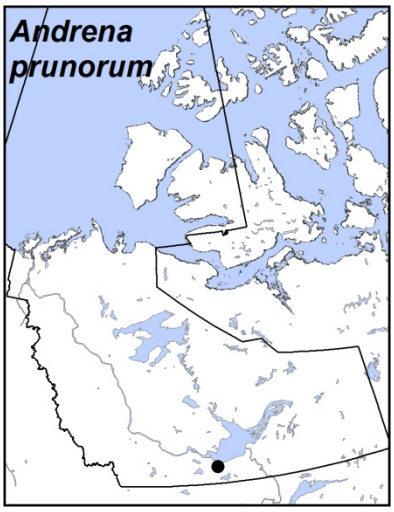

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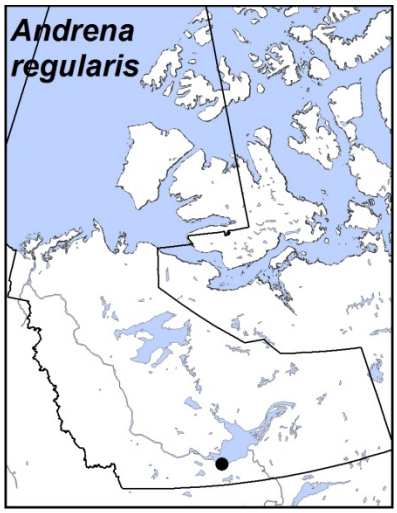

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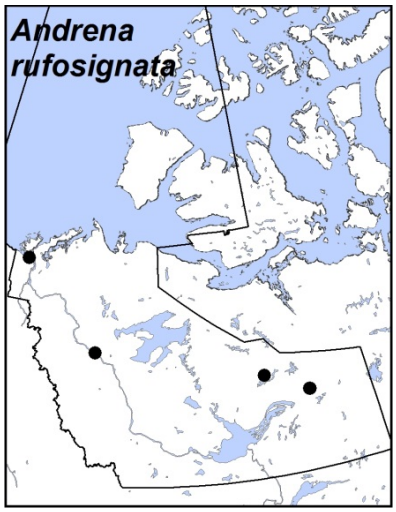
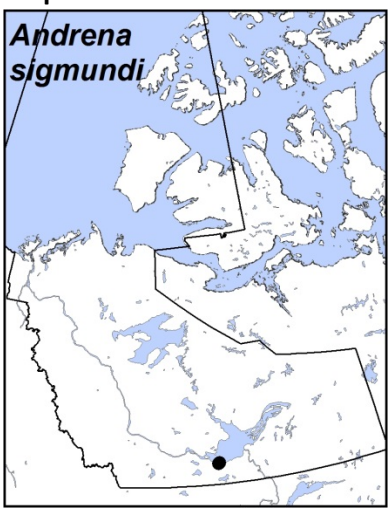


Map 23



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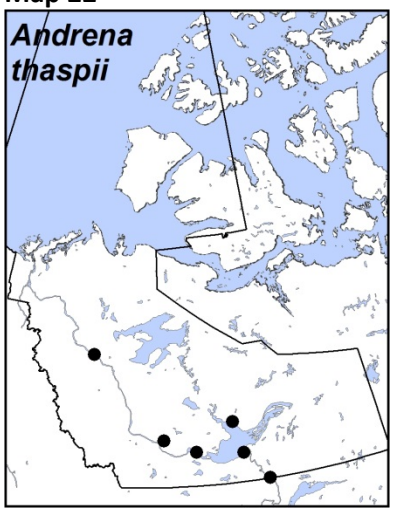

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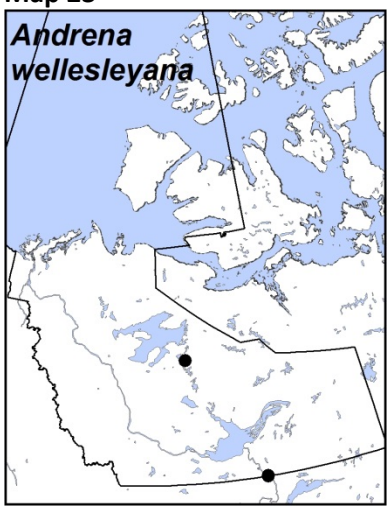
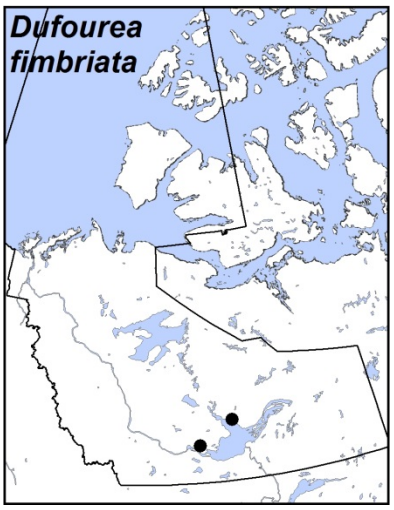


Map 26

Halictidae – Halictic bees

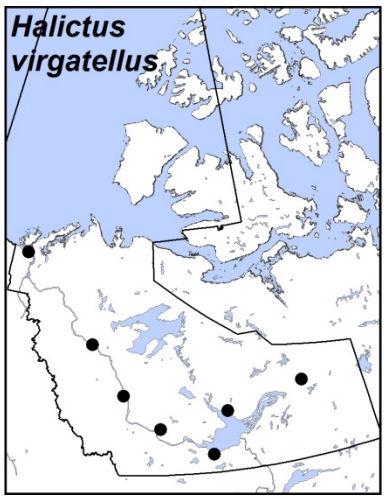
Dufourea **– Dufourea sweat bee**



Map 27

***Halictus* – Sweat bee**

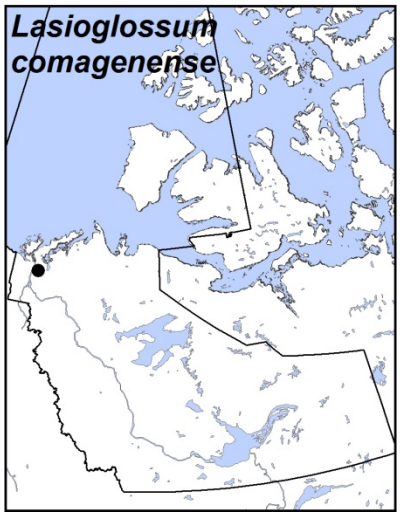
Map 28



Map 29

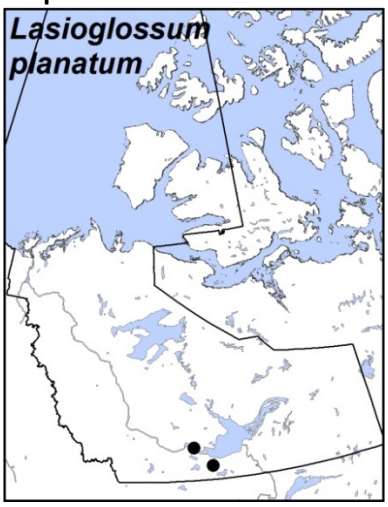
***Lasioglossum* - Veined sweat bees**

Map 30

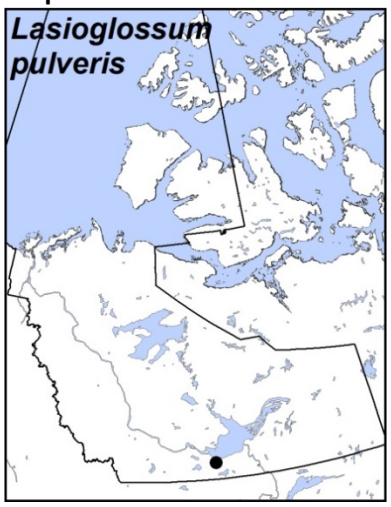


Map 31

Map 32

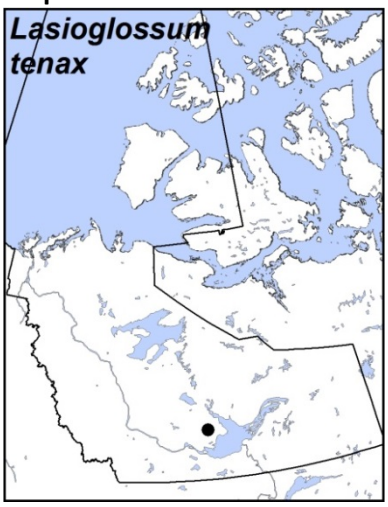


Map 33



Map 34

Map 35



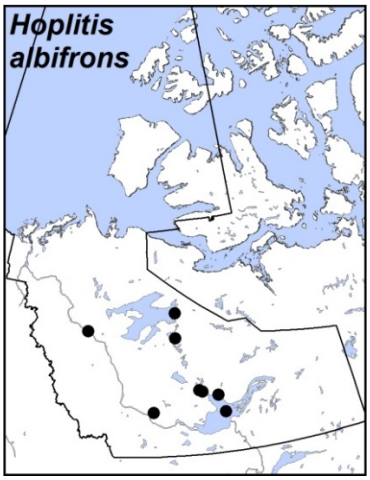
Map 36

***Sphecodes* – Parasitic Halictic bees**

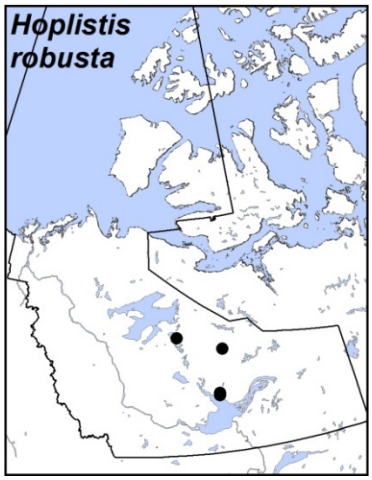
No available location data

Magachilidae – Leafcutter bees and relatives

***Hoplitis* – *Hoplitis* Mason bees**



Map 37

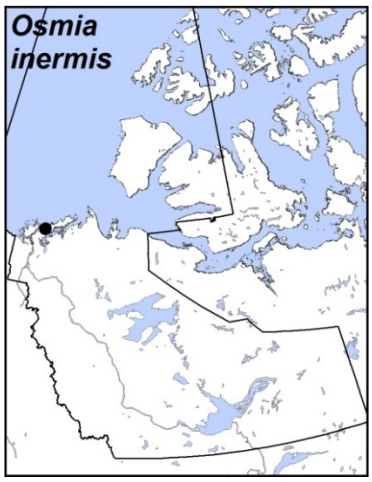


Map 38

Map 39

Osmia – Mason bees

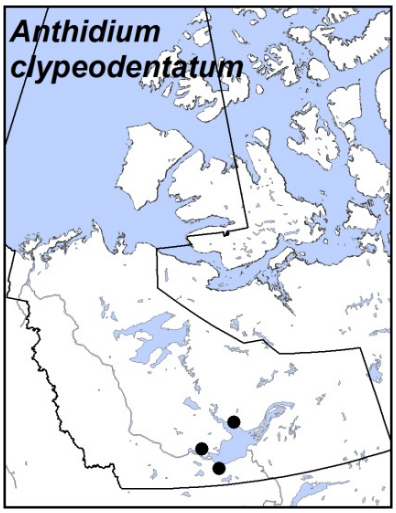
Map 40



Map 41

Ma 42

Anthidium – Potter bees



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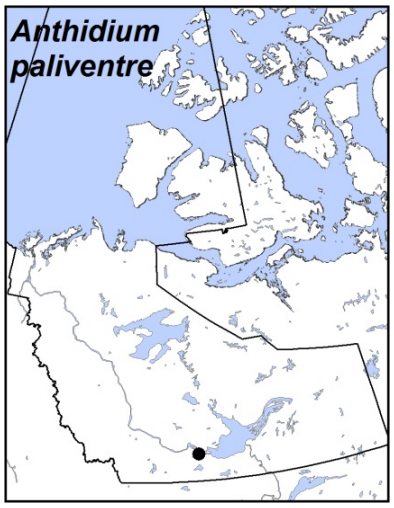
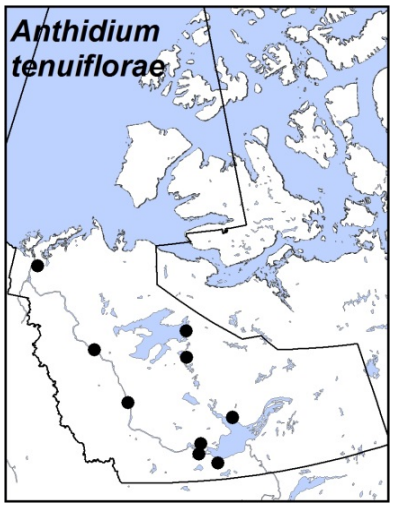
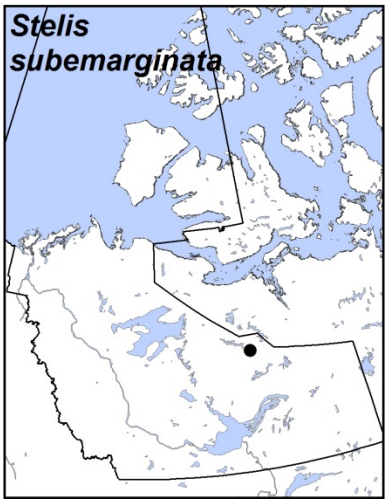


Map 44



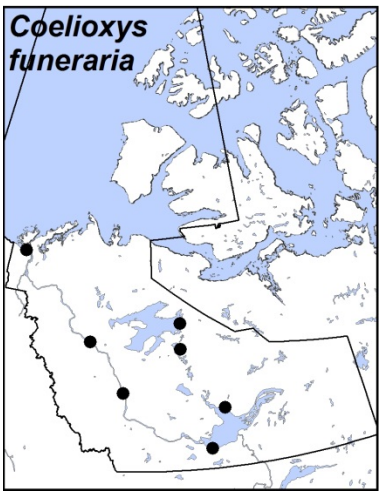
Map 45

Stelis – Parasitic mason bees

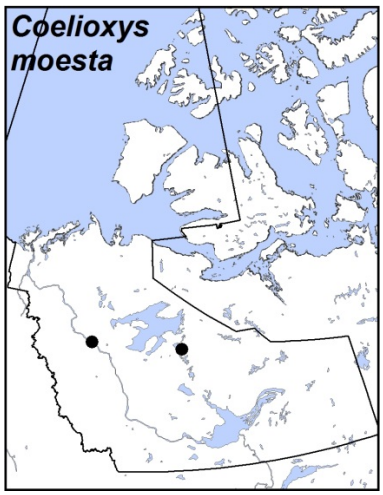


Map 46

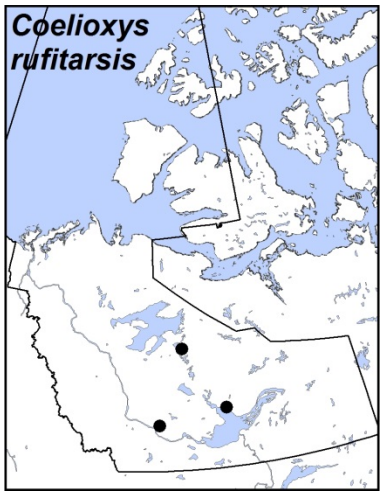
Coelioxys – Cuckoo leafcutter bees



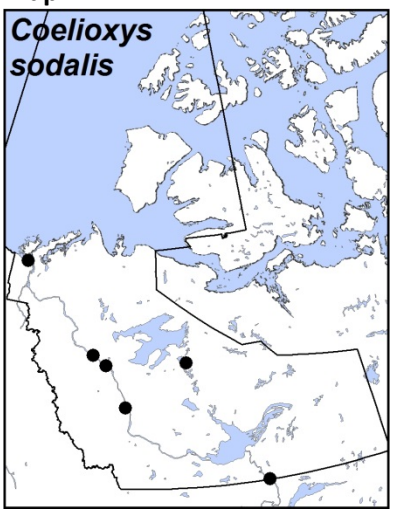
Map 47



Map 48

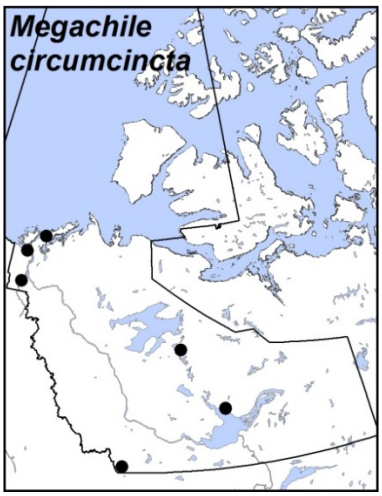


Map 49

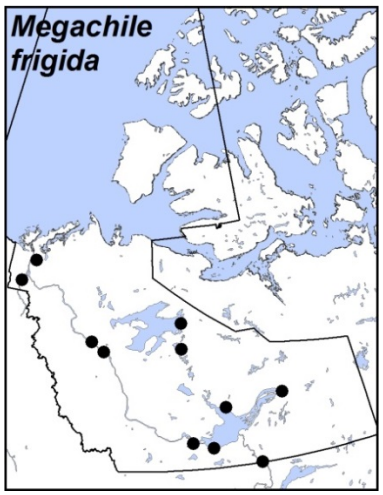


Map 50

***Megachile* – Leafcutter bees**

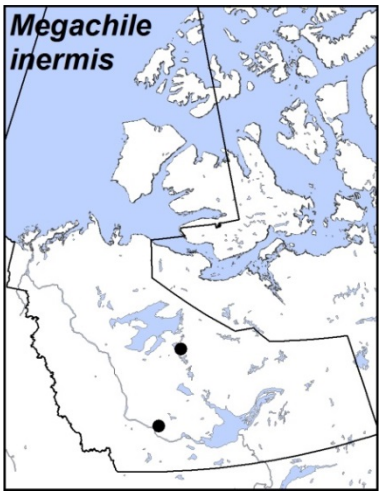


Map 51

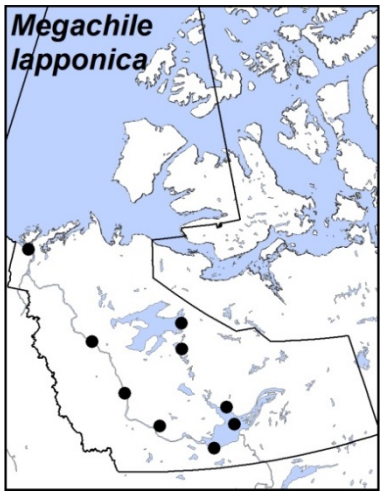


Map 52

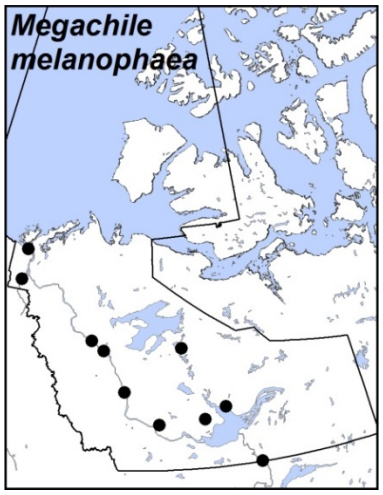
Map 53



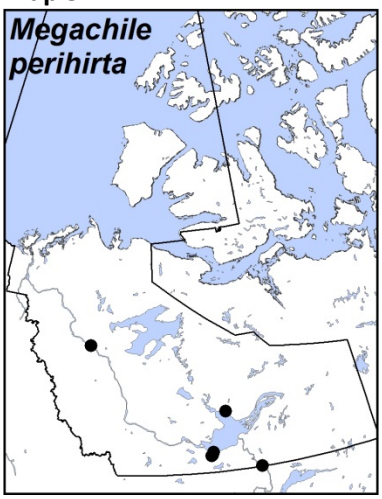
Map 54



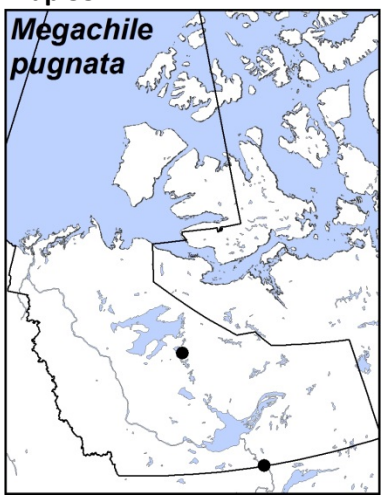
Map 55



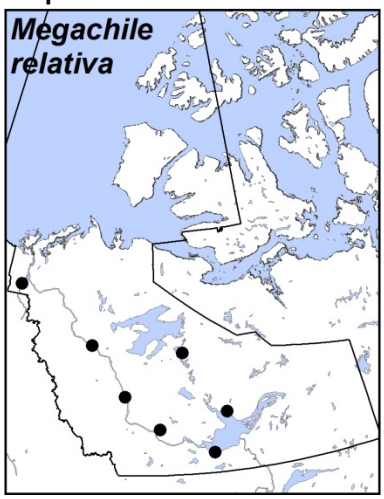
Map 56



Map 57



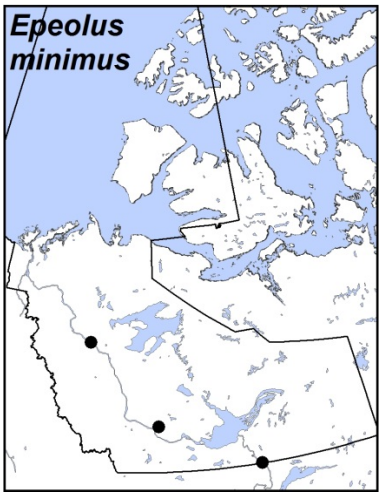
Map 58



Map 59

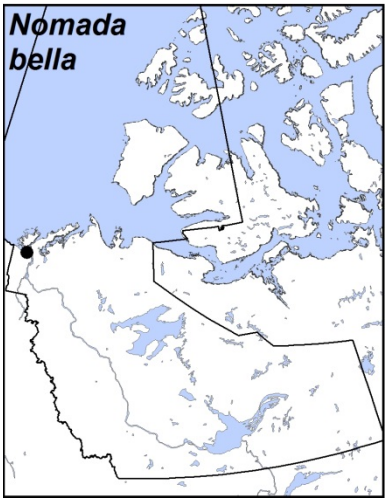
Apidae – Honey bees and relatives

Epeolus **– Epeolus cuckoo bee**

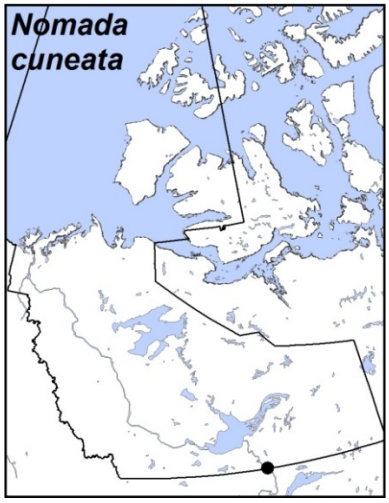


Map 60

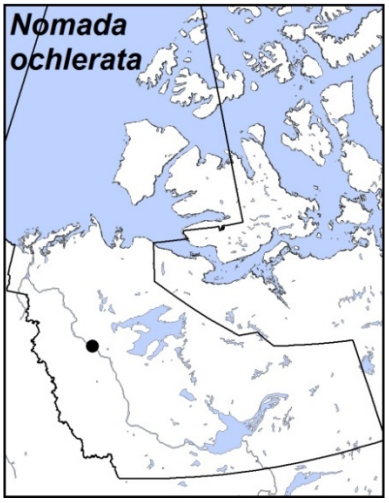
***Nomada* – Nomad bees**



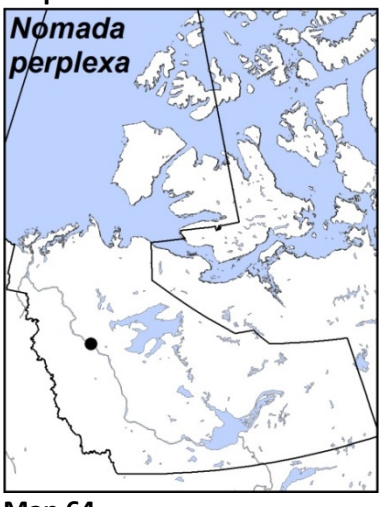
Map 61



Map 62

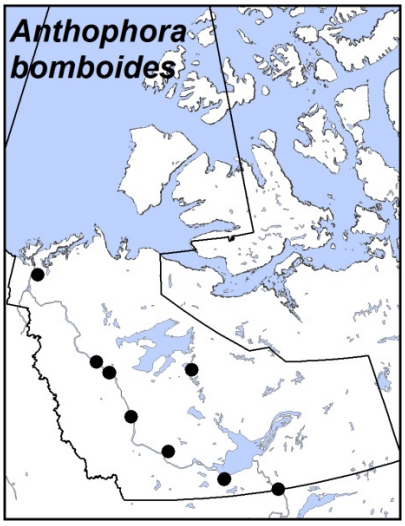


Map 63

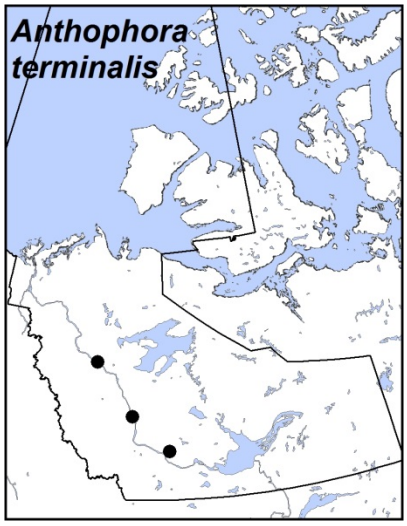


Map 64

***Anthophora* – Flower bees**

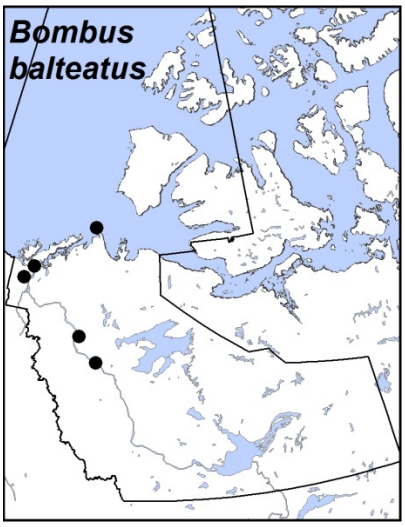


Map 65

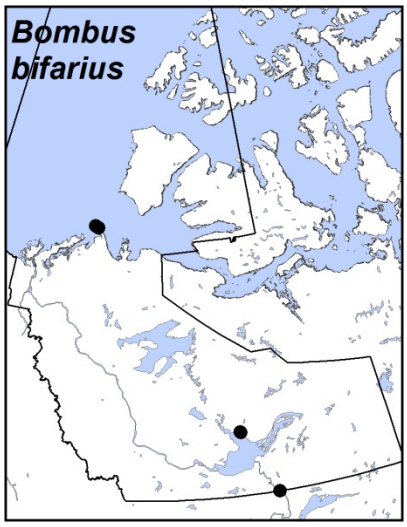


Map 66

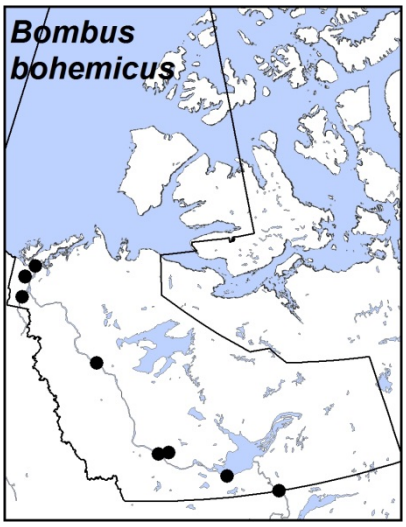
***Bombus* – Bumble bees**



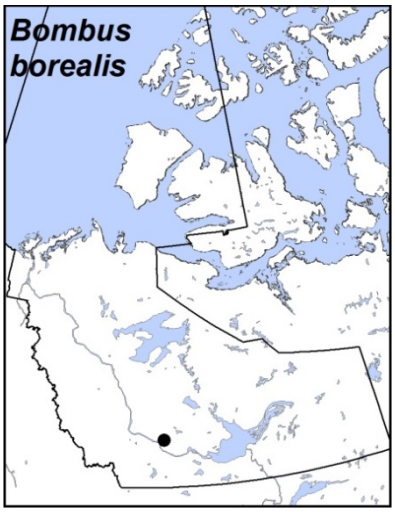
Map 67



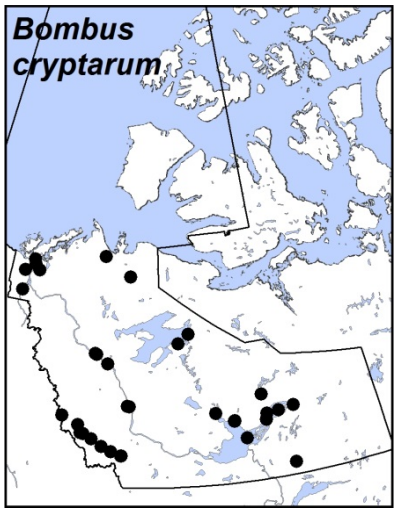
Map 68



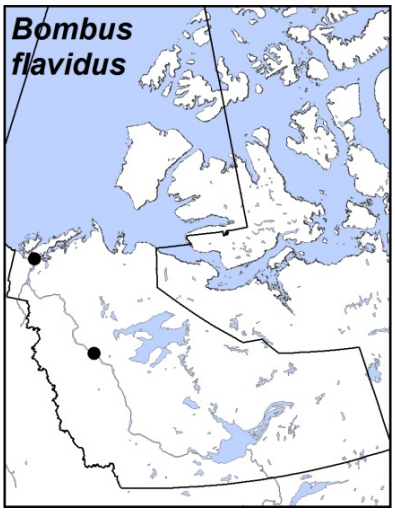
Map 69



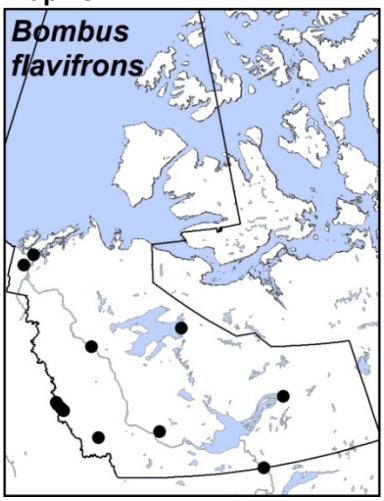
Map 70



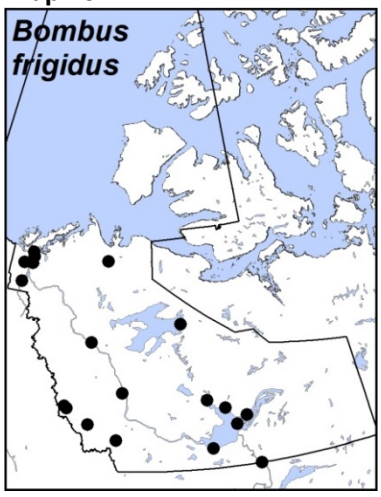
Map 70



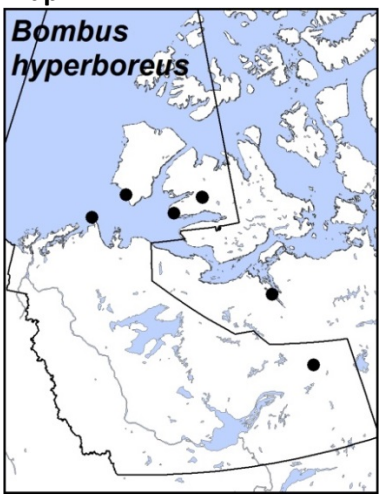
Map 71



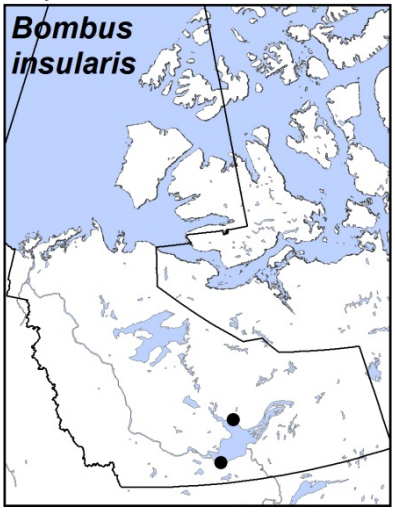
Map 72



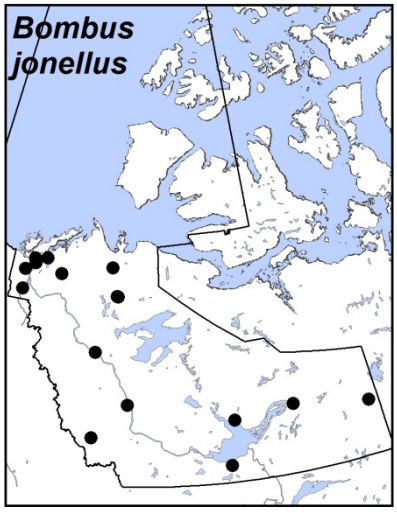
Map 73



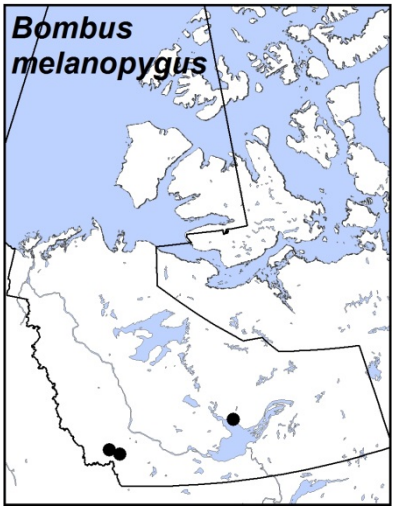
Map 74



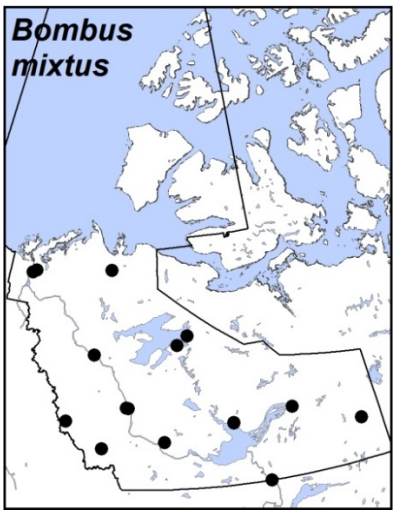
Map 75



Map 76



Map 77



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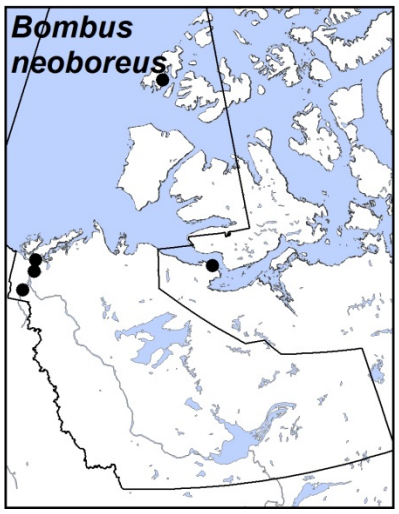

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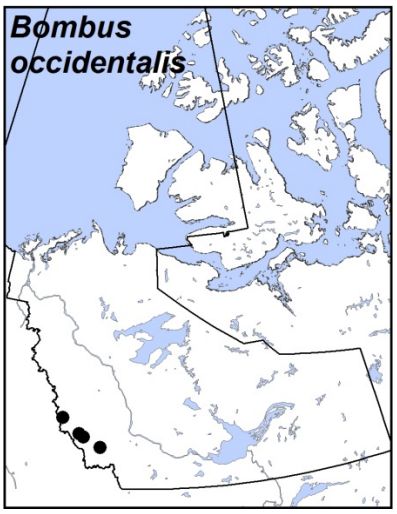
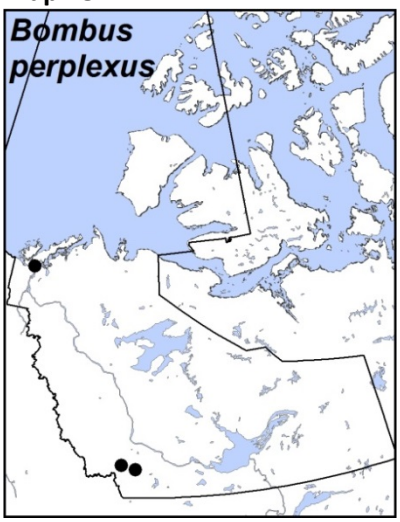
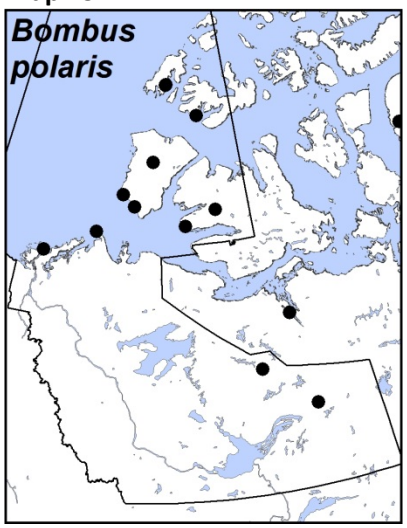


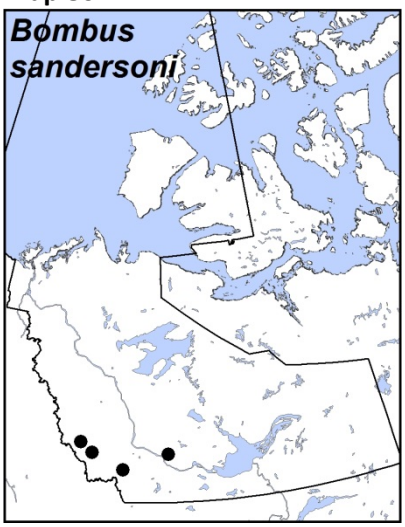
Map 80



Map 81

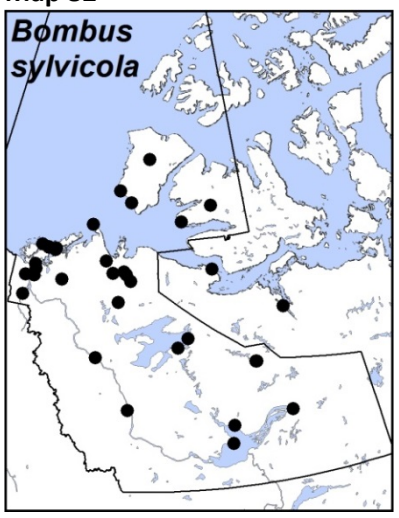


Map 82

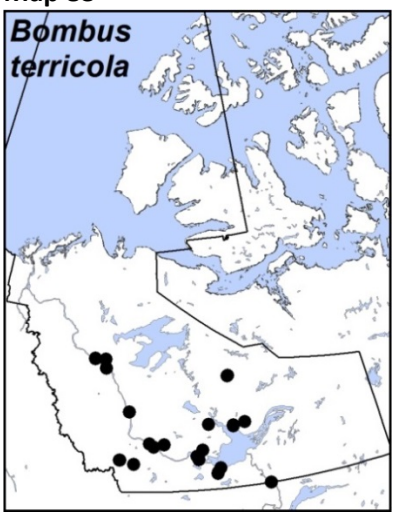


Map 83

Map 84



Map 85



Map 86