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# Bumble Bees of Calgary: A key and illustrated guide for identification of the bumble bee species found in Calgary, Alberta

Neame, Tobyn; Ritchie, Sarah; Summers, Mindi

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# Bumble Bees of Calgary

A key and illustrated guide for identification of the  
bumble bee species found in Calgary, Alberta



Tobyn Neame, Sarah Ritchie, & Mindi Summers

Illustrated by  
Sarah Ritchie and Tobyn Neame

Contributors  
Lincoln Best & Ron Miksha

## **Land Acknowledgement**

We would like to acknowledge the traditional territories of the people of the Treaty 7 region in Southern Alberta, which includes the Blackfoot Confederacy (comprising the Siksika, Piikani, and Kainai First Nations), as well as the Tsuut'ina First Nation, and the Stoney Nakoda (including the Chiniki, Bearspaw, and Wesley First Nations). The City of Calgary is also home to Métis Nation of Alberta, Region 3.

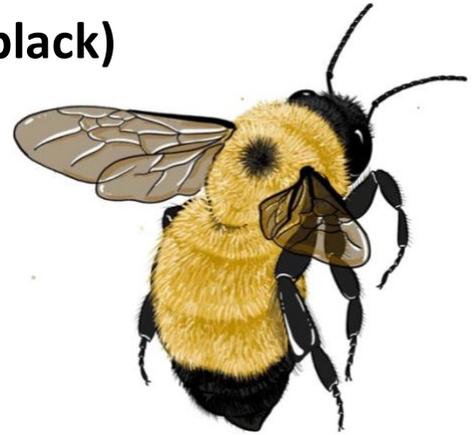
## Bumble bees of Calgary (yellow and black)



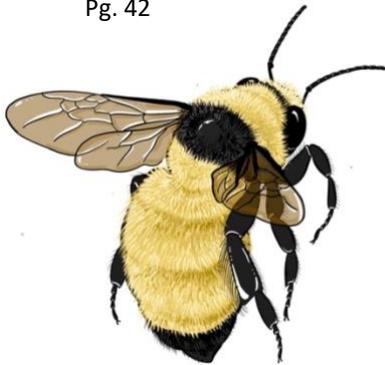
*Bombus vagans*  
Pg. 42



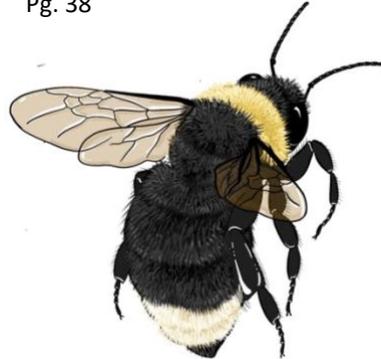
*Bombus perplexus*  
Pg. 38



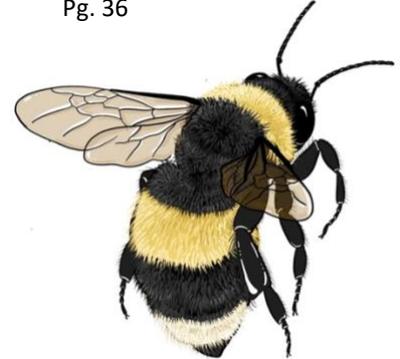
*Bombus nevadensis*  
Pg. 36



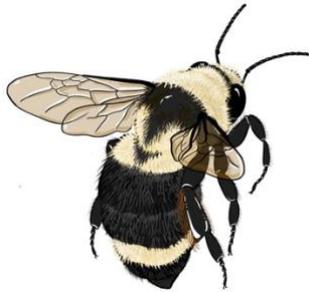
*Bombus borealis*  
Pg. 29



*Bombus occidentalis*  
Pg. 37



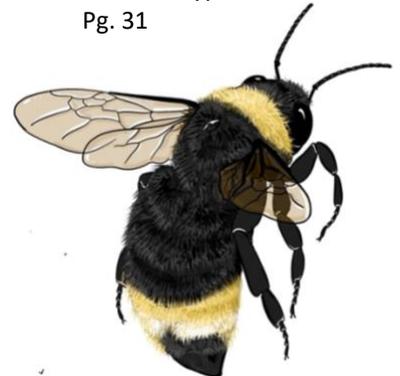
*Bombus cryptarum*  
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*Bombus vancouverensis*  
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*Bombus insularis*  
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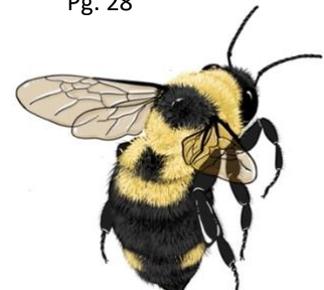
*Bombus bohemicus*  
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*Bombus rufocinctus*  
Pg. 40



*Bombus rufocinctus*  
Pg. 40



*Bombus rufocinctus*  
Pg. 40

## Bumble bees of Calgary (orange)



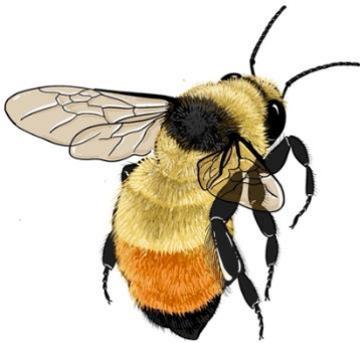
*Bombus ternarius*  
Pg. 41



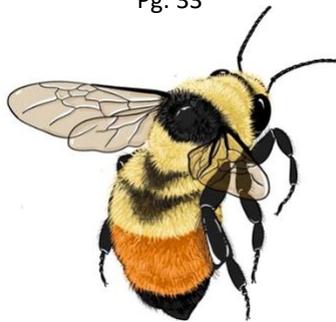
*Bombus huntii*  
Pg. 33



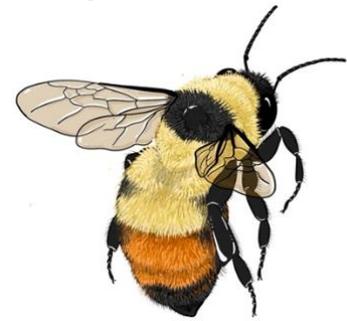
*Bombus rufocinctus*  
Pg. 39



*Bombus flavifrons*  
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*Bombus centralis*  
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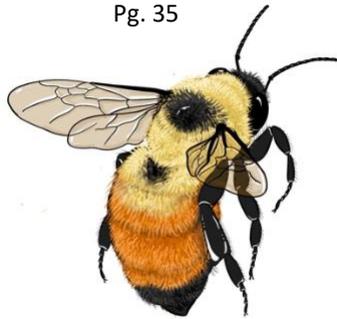
*Bombus rufocinctus*  
Pg. 39



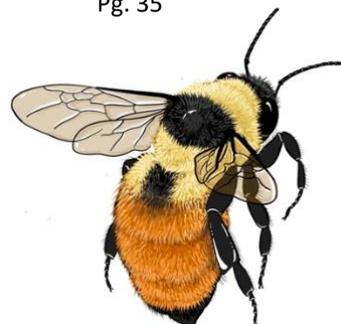
*Bombus mixtus*  
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*Bombus mixtus*  
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*Bombus rufocinctus*  
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*Bombus rufocinctus*  
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## **Introduction**

Bumble bees are important pollinators and essential members of ecosystems, including urban environments. Seventeen species of bumble bees have been definitively recorded in Calgary with the possibility that others are present. According to iNaturalist, Calgary has more species present than any other major North American city. Many of us already know bumble bees as visitors to our gardens, city parks, or brightly coloured picnic blankets, and bumble bees are also important subjects of biological and environmental research. This guide provides a way for people to learn more about and identify the bumble bees in our city, as well as contribute to scientific data by recording and photographing bumble bees.

## **A brief amount of natural history**

Bumble bees all belong to the same genus, *Bombus*, which is in the family Apidae (bees) of the order Hymenoptera (ants, bees, wasps, and sawflies). *Bombus* is a large genus with over 250 species worldwide. Within Calgary there are seven subgenera represented – *Bombias*, *Bombus*, *Cullumanobombus*, *Psithyrus*, *Pyrobombus*, *Subterraneobombus*, and *Thoracobombus*. The most diverse subgenus is *Pyrobombus* with nine of the 17 species.

Bumble bees are among the only native bees in North America that are eusocial, meaning they form colonies that have labour divisions among individuals. A colony will have a single reproductive female (queen), many non-reproductive daughters (workers), and some males (drones). Honey bees (*Apis mellifera*) are also eusocial, but are not native to North America. In Alberta, there are over 400 species of native bees. Non-*Bombus* native bees are also commonly called solitary bees in Alberta because they do not form large eusocial colonies, however solitary bees exhibit varying levels of social organization.

Bumble bees feed on pollen and nectar from plants and use these resources to provide for young. Because of their floral habits, bumble bees are integral pollinators for many native plant species and many biologists are interested in these plant-pollinator relationships. Bumble bees typically build nests in the ground, many times using old rodent burrows, or in tree hollows. As a result, you might find bumble bee nests under your porch, in trees, or in your garden. Unlike European honey bees, bumble bees do not build hives or make honey, but store nectar in pots. Some may also mistake wasp nests made of paper (such as those made by the common aerial yellow jacket, *Dolichovespula arenaria*) for bumble bee nests, but bumble bees do not build nests like this or make paper.

In Calgary and at similar latitudes, the bumble bee lifecycle starts with queens coming out of hibernation and beginning to forage and look for a nest site around late April to May. Workers will emerge four to five weeks later around late June/early July. Male drones appear and mate with new queens in late summer and early fall (August – September). We therefore have the best chance of observing queens, workers, and sometimes drones, between late June and mid-August. The last bumble bee sightings are usually in mid-September to as late as November. In fall, new queens begin hibernation underground.

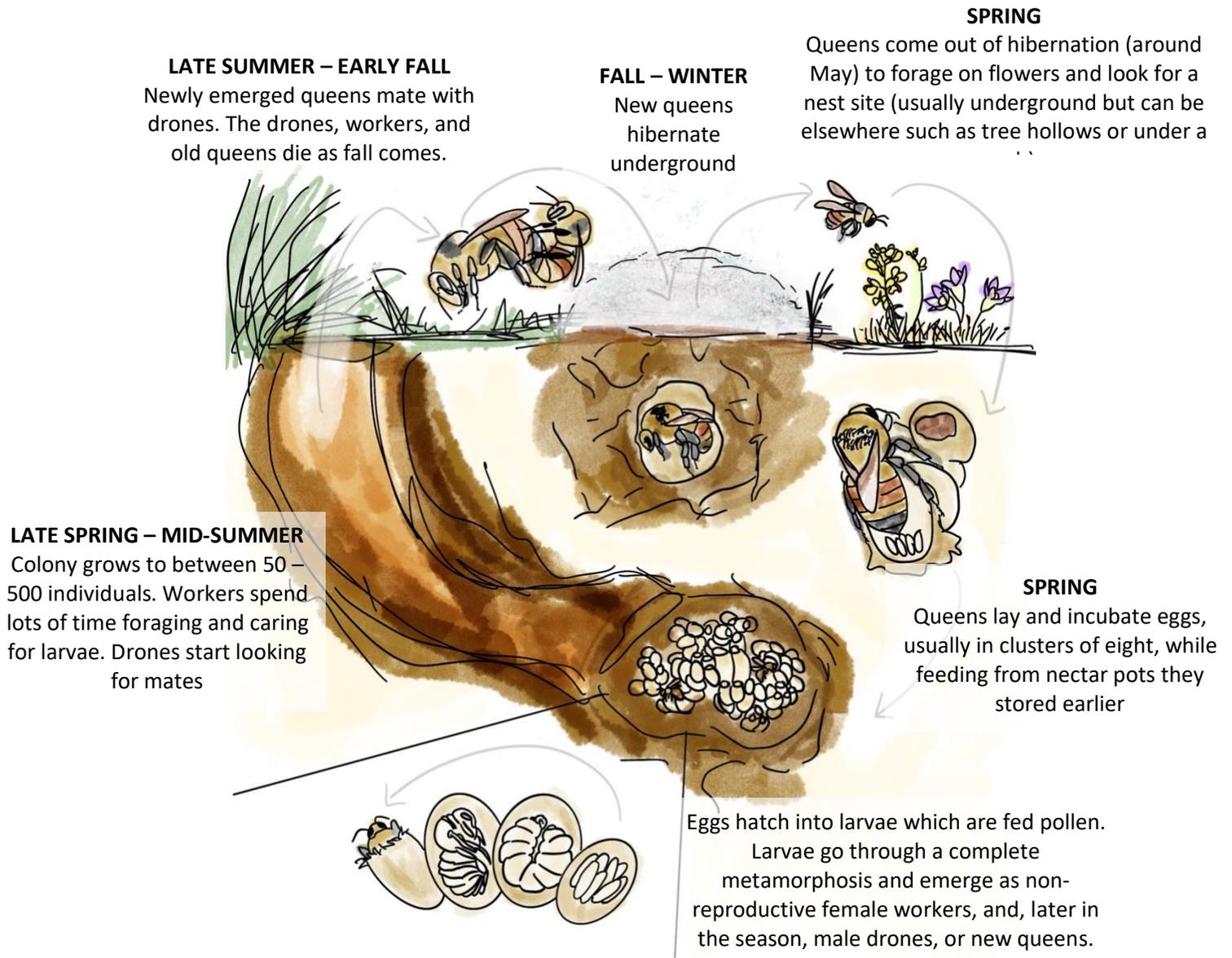


Illustration by Tobyn Neame and Sarah Ritchie

Bumble bee members of the subgenus *Psithyrus* (aka: cuckoo bumble bees) are social parasites and do not follow the above cycle entirely. When the fertilized *Psithyrus* females emerge in the spring, instead of founding their own nest and producing non-reproductive workers, these bees assassinate a queen of a different species (host). These parasite bees then lay their eggs in that queen’s nest which hatch into larvae and are taken care of by the workers of the host species. Eventually these larvae become fertile *Psithyrus* queens and males. Cuckoo bumble bees are therefore dependent on their host species and are at risk if their host species numbers decline.

## Conserving bumble bees

In Calgary, there is one federally listed bumble bee species, which is listed on the Species at Risk Act (SARA) - *Bombus bohemicus*, and one species assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as threatened - *Bombus occidentalis*. *Bombus occidentalis* is a host of the parasitic cuckoo bumble bee *Bombus bohemicus*. Threats to bumble bees in general include habitat loss and fragmentation, pesticide and other chemical use, diseases, loss of native flowers, and invasive species. These threats are further exacerbated by increased human land-use and climate change. Bumble bees of the subgenus *Psithyrus* are also affected by decreasing host populations, making them even more vulnerable.

Bumble bees play an important role in the ecosystem as plant pollinators. Bumble bees are among the few bees capable of buzz pollination (a technique required to pollinate some plants, such as tomatoes, where the bee vibrates the anthers of the plant to release the pollen). Non-parasitic bumble bees have pollen baskets (called corbicula) to carry pollen, and the other body hairs can also become coated in pollen. Bumble bees are also an important part of food webs, with other animals such as birds (e.g., shrikes and flycatchers), crab spiders, wasps, weasels, bats, and bears eating them.

So how do we conserve bumble bees? First and foremost, policy change is important and needed. Becoming politically involved, learning as much as possible, and educating others can be the best course of action – especially if you don't have access to land. Implementing policies that affect large portions of land, such as encouraging native plant use in municipal parks, use of alternatives to pesticides, and incentives for farmers to create habitat for bumble bees can make large-scale impacts.

If you do have access to land (e.g., a community garden plot, managing a golf course) there are things you can do to benefit bumble bees directly. Because habitat loss may be the largest threat to bumble bees, it is good to build suitable bumble bee habitat. Planting native plants, providing nesting and hibernation space, and eliminating pesticides are all important steps to take.

- **Plant native plants:** When choosing native plants, choose plants that will bloom throughout the growing season. It is important that there is food for the bees immediately when the queens come out of hibernation in early spring through to the first frosts in the fall. Also make sure to offer the bees a variety of flower types with different depths of blossoms. Some bumble bee species have shorter mouthparts and can't reach nectar in the deepest flowers. In Calgary, native willows (*Salix* sp.) can provide food to early spring bumble bees. Roses (*Rosa* sp.) and shrubby cinquefoil (*Dasiphora fruticosa*) are good for early summer foraging, and fireweed (*Chamaenerion angustifolium*) and western snowberry (*Symphoricarpos occidentalis*) for mid-summer. Goldenrods (*Solidago* sp.) and asters (*Aster* sp./*Symphyotrichum laeve*) are important for late summer and fall bumble bee feeding.
- **Create habitat:** Nesting and hibernation spots are as important as providing food sources. During the growing season you can leave parts of the land untouched (not

planting, mulching, or tiling the soil) to provide potential open ground nesting spots for native bees. Practicing “No-Till” gardening has benefits for both plants and bumble bees. “No-Till” allows there to be very little chance of disturbing the bumble bees underground when hibernating or nesting. Also, it is recommended to leave leaves on the ground and not dig out dead plants in the fall. Waiting to disturb the soil until the last frost has passed (often this is the May long weekend in Calgary) can help prevent disturbing hibernating bumble bees. If you do unearth a hibernating queen and it’s still lethargic/not moving, you can gently cover the bee back up with the soil you dug it out of. If the bee is actively moving around, you can assist it by putting it in a sheltered place such as under leaf litter.

- **Provide water sources:** Bumble bees require freshwater, so providing water sources, such as a shallow fountain with rocks, can be helpful.
- **Limit or eliminate pesticide use:** Pesticides/insecticides are often non-discriminant when it comes to killing insects. Pesticides applied to weeds (such as dandelions) or crops (such as canola) can be transferred to foraging bees through pollen. The bees bring the pollen back to their nests and eat it, inadvertently being poisoned.

There are many more methods of conserving bumble bees in Calgary. Again, one of the most important things we can do together is create and maintain native habitats throughout the city.

## Observing bumble bees

You can observe bumble bees anywhere – in your backyard, a local natural area, or even walking on the sidewalk! In our city, bumble bees are most abundant and active between June and August on warm (>20°C), sunny days without strong winds. However, you can begin seeing bumble bees in late April and into September.

The best opportunities for observing and photographing bumble bees are when the bees are visiting a flower, and early in the morning before the temperature reaches 15°C so the bees are moving slowly. You can observe and photograph bees in place, or you can use a net to collect the bee. Collected bees can be placed in small vials for further observation or photography.



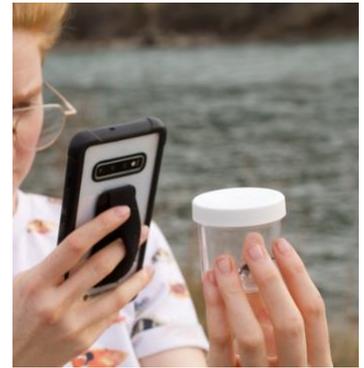
Looking for bumble bees to net on flowering willow - *Salix sp.* (Photographer: Tobyne Neame)



Vialing a bumble bee  
(Photographer: Teegan Neame)



Vialing a bumble bee with no net  
(Photographer: Teegan Neame)



Photographing a bumble bee  
(Photographer: Teegan Neame)

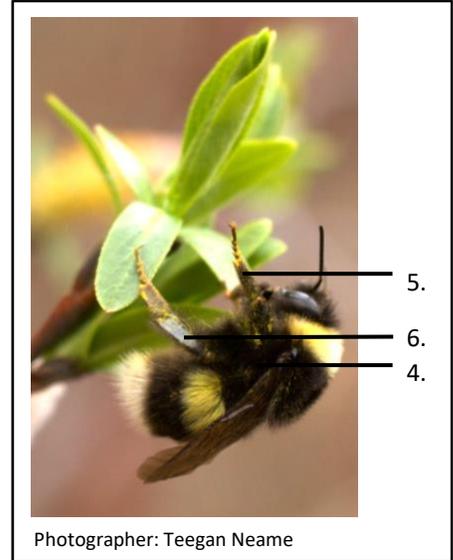
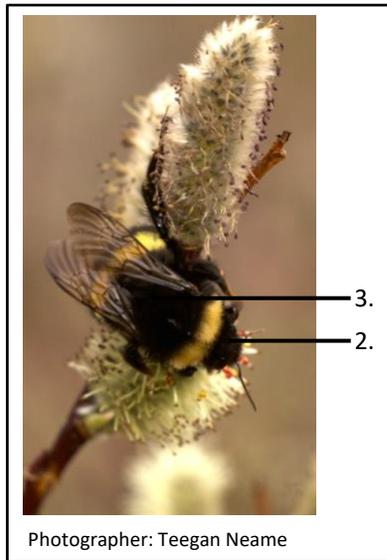
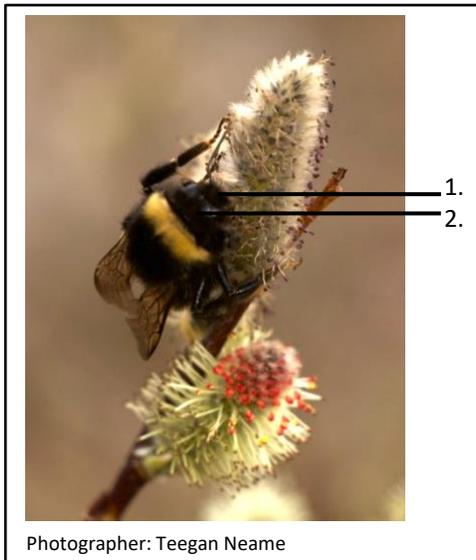
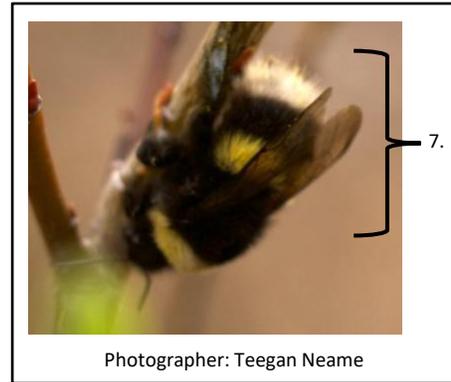
## How to photograph bumble bees

Photographing bumble bees provides a fun and immersive way to observe bumble bee behaviour and the plants that they are interacting with. You can also contribute your photos to scientific research projects through citizen science platforms (see pg. 12).

If you are interested in being able to identify bumble bees from photographs, you will want to ensure that you have captured important identifying features. This will require multiple photographs from different angles – ideally one photo focusing on **lateral** features such as the legs, two from the **top down** to see the colours of the thorax and abdomen, and one at an **angle** to clearly see the head and face. As you improve your identification skills, it will become easier to know when you have captured all the important features!

In your collection of photos, you will want to capture the following important identifying features (also see bumble bee anatomy pg. 17):

1. the face
2. top of the head
3. top of the thorax
4. the side of the thorax
5. the midleg basitarsus
6. the hindleg tibia
7. the full first five segments of the abdomen



## Tips for getting started

- Photograph bees when on a flower and/or early in the morning when the temperature is cooler, so bees are moving more slowly.
- Get as close to the bee as possible.
- Check that your photos are in focus. This may take some practice!
- Consider purchasing a macro-lens adapter for your camera phone. These can be found at various price points.

## Advanced macrophotography

Bumble bees can be very active, which can often result in blurry photographs. One technique for clearer photographs is to slow down a bee's movement – essentially setting up a bee photo shoot! To do this, you will need to be able to collect bumble bees (using a net, vial, and/or small container) and then cool the bee (using ice or icepacks in a cooler). Briefly, you will collect the bee, transfer it to a container, and place the container in the cooler for approximately ten minutes (smaller bees need less time and larger bees need more time to slow down). You will want to be careful not to leave the bees for too long as extended cold can kill them. The lethargic bee can then be placed on the flower it was found on and photographs taken. Be careful to block/monitor wind gusts. Lethargic bees cannot hold onto surfaces as well as fully active bees can and may be blown away if not careful. If the bee starts moving too much, it can be placed back in the cooler for a short time. Once photographs are taken, put the bee in a low traffic, shaded area to warm up (you can give it a few warm breaths to help).



Bumble bee being placed in the cooler  
(Photographer: Teegan Neame)



Bumble bee in the cooler  
(Photographer: Teegan Neame)



Bumble bee photoshoot  
(Photographer: Sarah Ritchie)

## **Citizen science: Sharing your bumble bee observations**

Please consider contributing your bumble bee photographs and observations to science! Citizen science is when any member of the community contributes data to scientific research.

BioBlitz's, organized bird counts, and donations of personal specimen collections to museums are all examples of citizen science. Online platforms and associated smartphone apps like those listed below continue to make citizen science contributions even more accessible. These platforms also make your data available to researchers, either through sharing your data on the Global Biodiversity Information Facility (GBIF) or through allowing other users to directly download your data.

As a citizen scientist, you can also learn a lot by exploring these platforms without immediately contributing or downloading data. For example, you can use the sites to find out when bumble bees are starting to emerge in the spring or to improve your identification skills through meeting others interested in bumble bee identification. We recommend exploring the different platforms and their communities and deciding which one you like working in the most. Remember that the goal is always to have fun, learn, and contribute to science the best you can – in that order!

### **iNaturalist**

#### **inaturalist.org**

*A joint initiative by the California Academy of Sciences and the National Geographic Society.*

For all living organisms found world-wide. Anyone can contribute observations and verifying identifications. Observations with identifications agreed upon by multiple users are considered “research grade” and are contributed to the Global Biodiversity Information Facility (GBIF). We have created a [Calgary Pollinators iNaturalist project](#) for you to contribute your photographs of bumble bees and the flowers they visit.

**The seek app** - [https://www.inaturalist.org/pages/seek\\_app](https://www.inaturalist.org/pages/seek_app)

iNaturalist's second app. The Seek App by iNaturalist is more of an identification tool than a citizen science app. It uses iNaturalist's A.I. to identify observations. It is kid/family/user friendly and gives the option of sharing data with iNaturalist for citizen science or not.

### **Bumble Bee Watch**

#### **bumblebeewatch.org**

*Created through a partnership between Wildlife Preservation Canada, The Xerces Society for Invertebrate Conservation, University of Ottawa, Montreal Insectarium, Natural History Museum in London, BeeSpotter, and the Faculty of Environmental Studies at York University.*

A citizen science platform for observations of North American bumble bees found in Canada and the USA. Identifications are verified by experts, and observations are then made available for users of Bumble Bee Watch. Bumble bee watch datasets are also publicly shared through the Global Biodiversity Information Facility (GBIF).

## NatureLynx

naturelynx.ca

*Created by the Alberta Biodiversity Monitoring Institute.*

For all living organisms found within Alberta. Observer identifications are verified by taxonomic experts and can be viewed by other users of the platform.

## Contributing your bumble bee observations to scientific research

Observations that can be used for scientific research include a **set of clear photographs** and **additional information** on when and where the bumble bee was observed.

Steps:

- Collect clear photographs of your bumble bee (see pg. 9)
- Record the following information in a notebook or directly into the app you are using:
  - Date and time (required)
  - Latitude and longitude (required)
  - Elevation (preferred)
  - Plants that the bumble bee was interacting with; if possible, include photographs of the plant in addition the bumble bee (preferred)
- Upload your photographs and information to one citizen science platform

Please note: It is important to upload each sighting to only one platform. Uploading to more than one can cause duplication of records.

## **How to use this guide to identify bumble bees**

There are two identification tools within this guide: a series of non-dichotomous and dichotomous keys, followed by illustrated pages of each species. Reviewing and using both in combination will yield the best results. Using this guide requires a small amount of anatomy vocabulary and understanding, which is described next.

### **Using keys**

We have created a series of keys to allow you to approach identification as a series of steps, where you increase the resolution of your identification with each step. The keys we have created are based on observations of 765 different specimens collected by University of Calgary researchers and information available in *Bumble Bees of North America* (Williams, Thorp, Richardson, and Colla. 2014). As we observe more bumble bees in Calgary, we will continue to update our keys.

***Why use question series and matrix keys?*** While dichotomous keys are very important for species identification, these keys work best when a physical specimen is available, and all traits can be observed. Since most photographs and observations for live bumble bees will only have some traits visible, we have created keys in the format of question series and matrix keys. A benefit of using matrix keys is that you can use any feature you can observe on a bumble bee as a starting point. Matrix keys then allow you to narrow down which species you may have, by identifying traits and comparing these traits among other species. Every bee on the matrix key can also be easily compared to every other bee on the matrix key.

### **Identification steps**

1. First, you will identify bumble bees from other insects (pg. 20). Honey bees and other insects can often be mistaken for bumble bees and vice versa. This guide is only for bumble bees.
2. Second, you identify whether a bumble bee is male or female (pg. 22). If you have a male bumble bee, this is where you will stop in this guide. Male bumble bees require genital characteristics to identify them, something we cannot look at with living specimens.
3. Lastly, you will identify female bumble bees to species or a set of species. (pg. 24)
4. Once you have your species or set of species, you can cross reference the illustrated pages to confirm and gain more information. The illustrated pages also have hyperlinks embedded in the title names of the species so you can cross reference the University of Calgary digital native bee collection.

## Using illustrated pages

The illustrated pages work more like a birding field guide; they are available for quick and visual reference. We chose to illustrate the pages rather than provide photographs because illustrations can show the clearest example of each trait on one bee (they are representative of a perfect specimen). In the age of the internet, it is easy to access photographs of bumble bees and hyperlinks to available photographs are provided for each species by clicking on the binomial name at the top of the species page (see [biodiversity.ucalgary.ca](http://biodiversity.ucalgary.ca) for identified images of bumble bees).

## Names

The main species names provided are the binomial names (aka: scientific names or Latin names). As is standard practice the genus name comes first (in the case of bumble bees the genus is always *Bombus*) followed by the species name. Common English names have also been provided, but common names for bumble bees are rarely useful and can even be misleading (e.g., the red belted bumble bee – *Bombus rufocinctus* – has many forms that never have any red at all). Sometimes two different species can have the same common name, so it is usually best to use the binomial name when possible.

## How common

Using 2765 bumble bee records collected by University of Calgary researchers between the years 2017 – 2020 we can gain an estimate of the relative abundance of each bumble bee species in Calgary. This scale will be updated as new information is gathered about bumble bees in our city.

Unobserved = These species were not identified within the 2765 records used for this project but may have been identified in Calgary on iNaturalist or Bumble Bee Watch, or in the land closely surrounding Calgary.

Rare = <1% of bumble bees in our records are these species

Uncommon = 1% - 5% of bumble bees in our records are these species

Common = 10% - 20% of bumble bees in our records are these species

Very common = >40% of bumble bees in our records are these species

## Annotated illustrations

Species descriptions from *Bumble Bees of North America* by Williams, Thorp, Richardson, and Colla (2014) served as the starting point for illustrations, along with the matrix keys we created for this guide. Each specimen available (765 specimens total) was put into groupings of the same pattern (morphotype). At least two, but typically four or more, individual bees were used as direct reference for each drawing. The individual reference bees were selected based on how

well they showed the distinguishing characteristics of their species or morphotype. Each drawing may therefore be considered an ideal representative of a species or morphotype.

Each illustration includes notes on the distinguishing characteristics and important features of the species. As such, not all features are mentioned in the notes (e.g., most bumble bees have a corbicula so it is only noted when a bumble bee does not have a corbicula). When using the illustrations, please keep in mind that bees in the wild are varied and won't perfectly look like a drawing (a good example of this is *Bombus rufocinctus*). However, with practice you can use the illustrations to quickly confirm if the bee you have is a certain species or not.

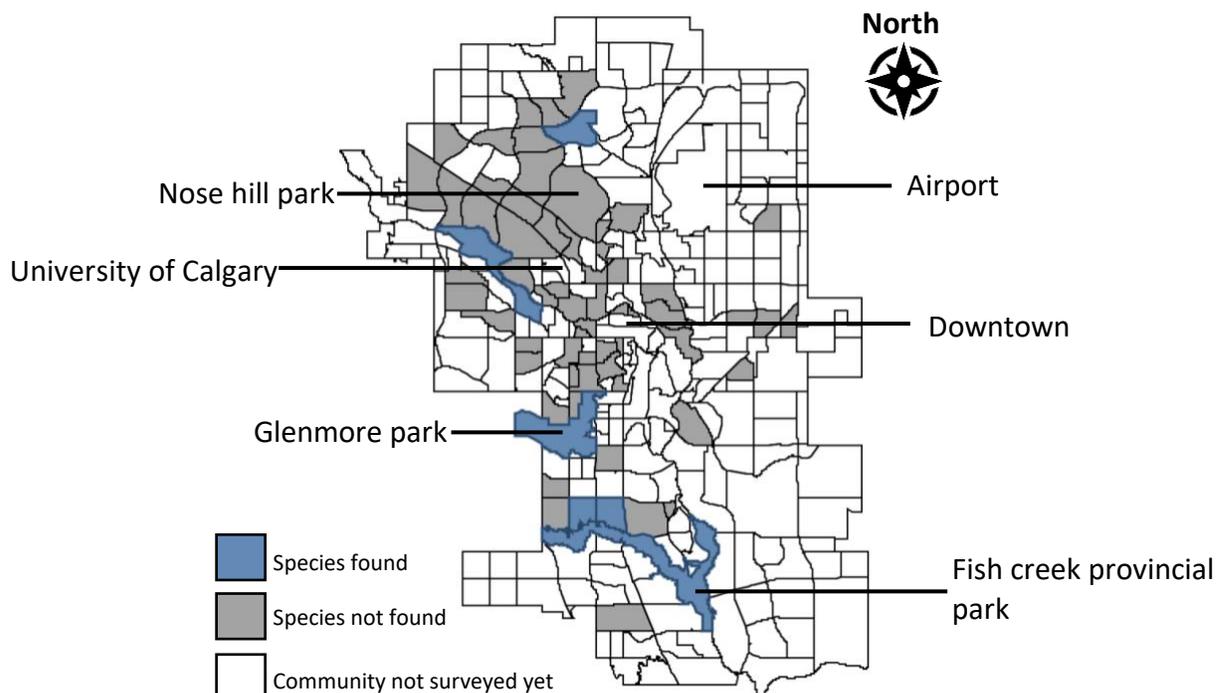
### Known plant interactions

These are native plants that the bumble bee species was observed to be foraging on during the pollinator survey completed in 2020. These lists may assist in deciding bee friendly plants for planting or for general interest. One may also look for these plants in bloom to find bumble bees, but these lists should not be used as a way of identifying bumble bee species. Bumble bees are notoriously generalist foragers and often the plants that bumble bees are found on are just the plants that are in bloom at that time.

### Maps

On each species page there is a map of community boundaries that looks like the one below. Communities are coloured blue if the species has been sampled there; grey if areas have been sampled for bumble bees, but that bumble bee species was not found; and white if communities have not been surveyed for bumble bees yet. These maps were drawn using 2765 records from bumble bee surveys conducted by University of Calgary researchers from 2017-2020. We hope to continue adding to these maps using records from more members of the community.

To orient you to the city maps, a few geographic labels are provided on the map below. These labels are not on the illustrated pages to save space.



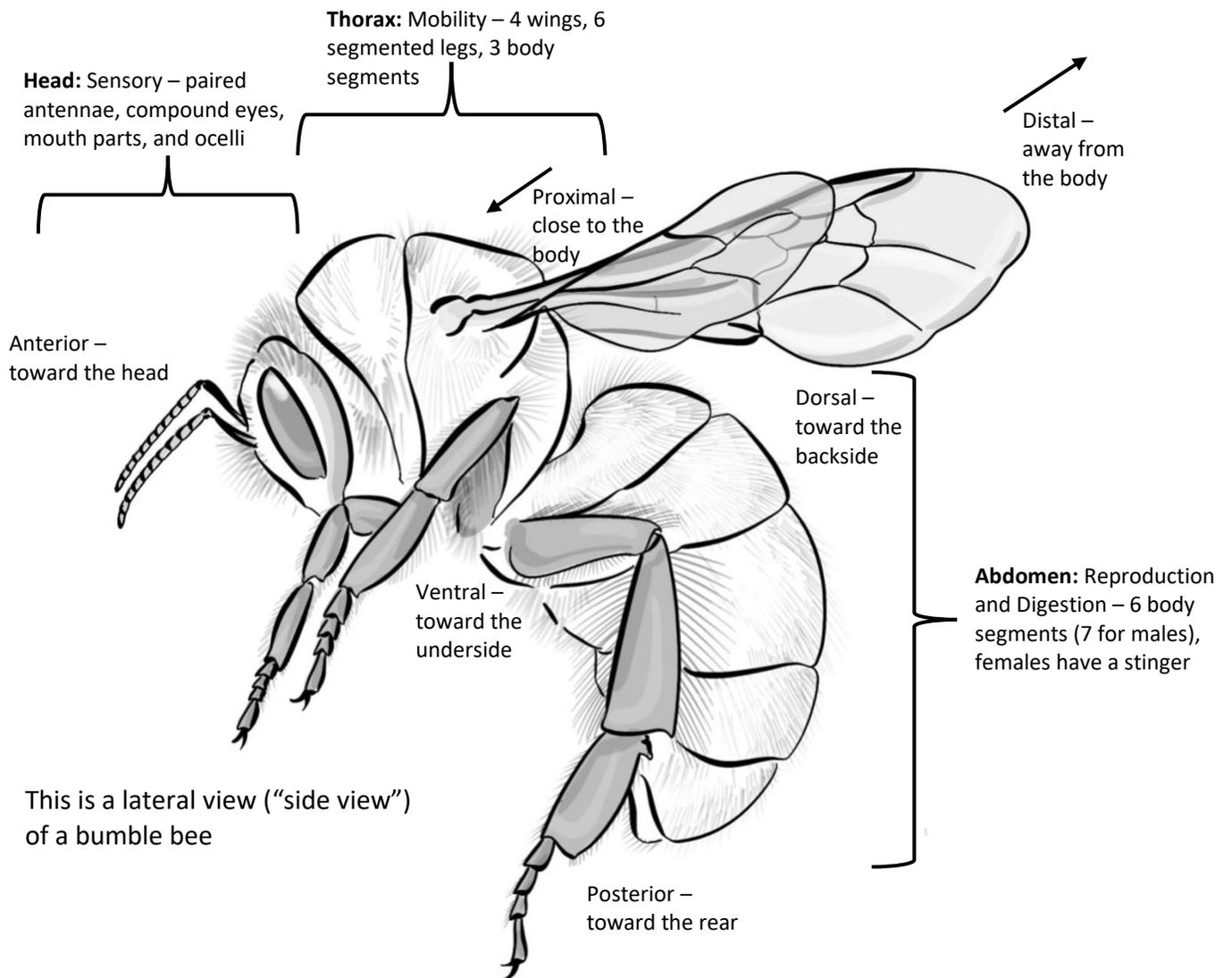
# Bumble bee anatomy

To use our guide to identify bumble bees, you will need to be able to find and communicate about the parts of a bumble bee accurately and clearly. All the terms used are defined in the glossary (pg. 46)

## Terminology

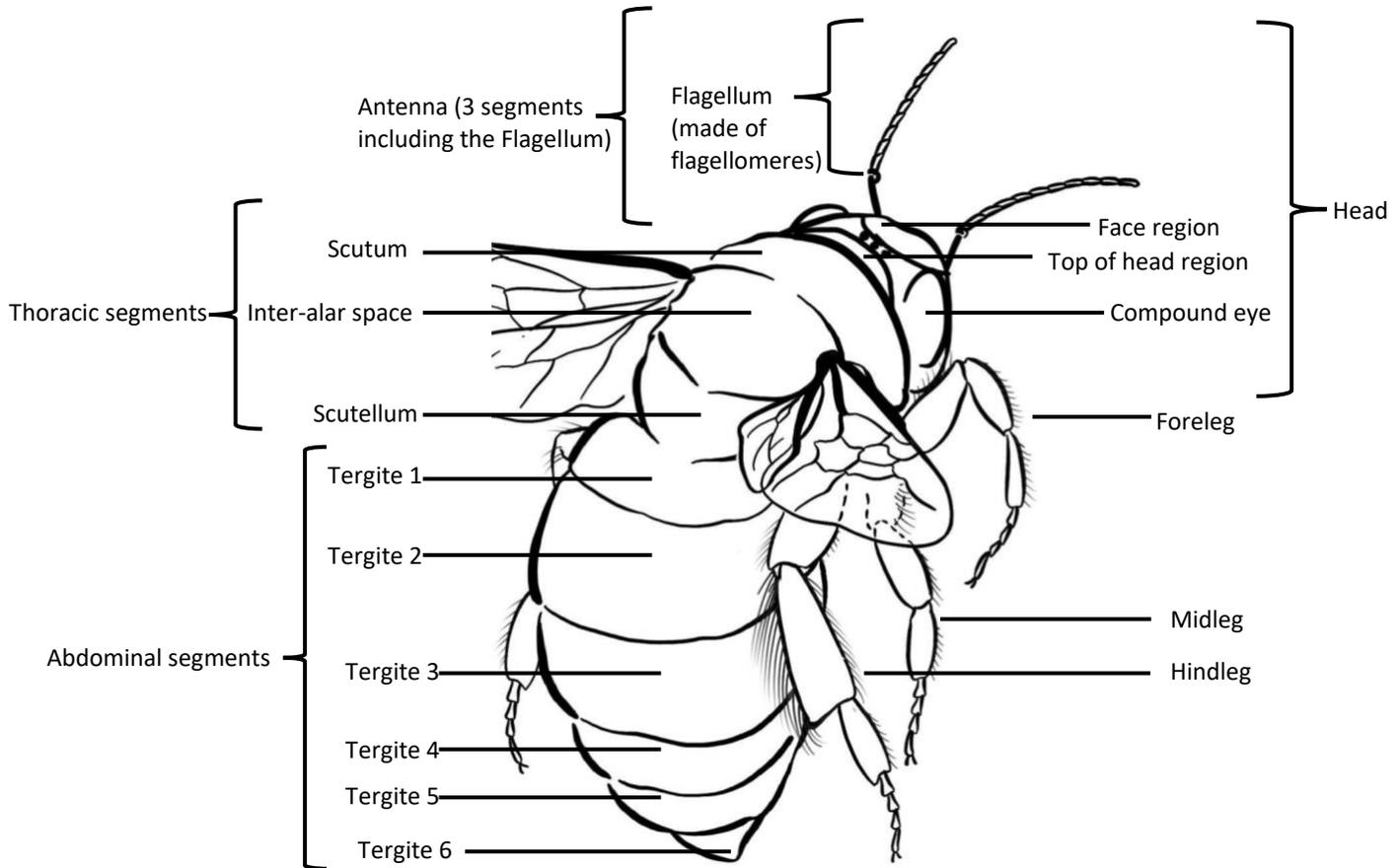
Bumble bee features are typically discussed based on where they are found on a bee. Bumble bee bodies are segmented, and these segments are grouped into three major regions: head, thorax, and abdomen. Additional terms such as anterior/posterior, dorsal/ventral, and proximal/distal will also be used, and these can be considered “directions”.

All illustrations by Sarah Ritchie and Tobyn Neame



## Basic body plan

Segments and body parts that can be observed on all female bumble bees:

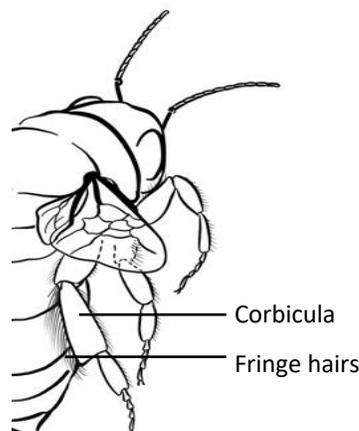


All illustrations by Sarah Ritchie and Tobyn Neame

## Specialized pollen-collecting structures

Female bumble bees that collect pollen will also have a specialized structure called a corbicula. This feature is not seen on parasitic bumble bees or on males. If a large lump of pollen can be seen on the back leg this is evidence of a corbicula.

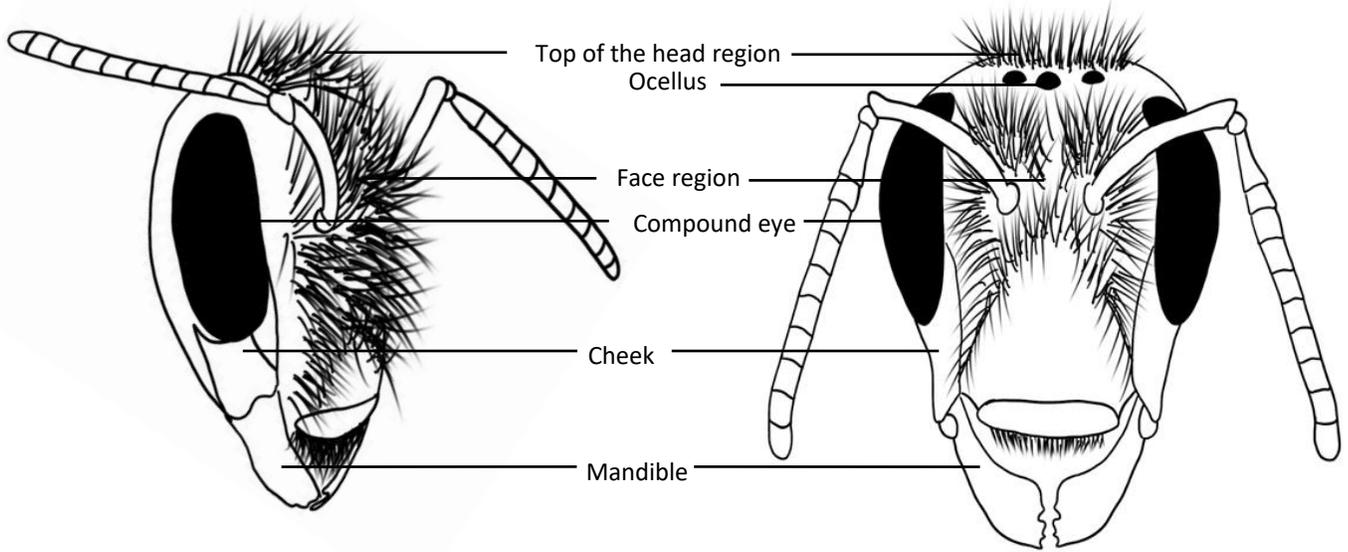
All illustrations by Sarah Ritchie and Tobyn Neame



## Head and face structures

Additional structures of the face and head

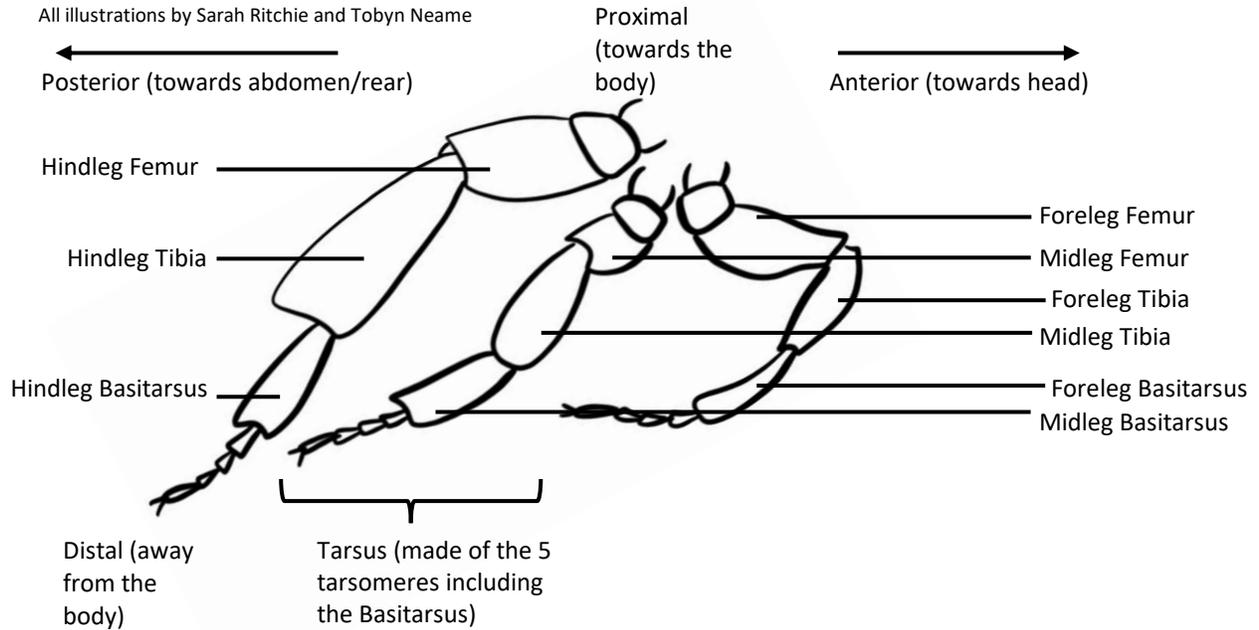
All illustrations by Tobyne Neame and Sarah Ritchie



## Leg structures

Additional structures of the legs

All illustrations by Sarah Ritchie and Tobyne Neame



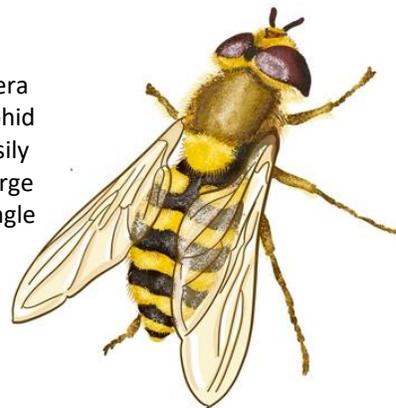
## Is it a bumble bee?

The bright yellow and dark black colouration characteristic of female bumble bees can also be found on non-bumble bees, including other bees and insects. Insects that cannot sting take advantage of predators' avoidance of stinging bumble bees. Here are some tips on identifying these mimics and separating bumble bees from other types of bees.

### Flies, moths, and wasps

Flies and moths do not have their own stinging defenses, and looking like bumble bees is one method of predator deterrence. Some wasps (not all!) do have stinging defenses but looking like a bee still makes predators less likely to attack them - it's also possible the bees look like wasps for this same reason. Once you know what to look for, bumble bees are easy to distinguish from flies, moths, and wasps.

Many flies of the order Diptera mimic bees (such as this syrphid *Syrphus ribesii*). They are easily distinguished by their very large eyes, short antennae, and single pair of wings.



Snowberry clearwings (*Hemaris diffinis*) and other day flying moths may mimic bumble bees by having similar colours and robust bodies. Moths have distinctive non-elbowed feathery antennae and will also have thinner legs than bumble bees.

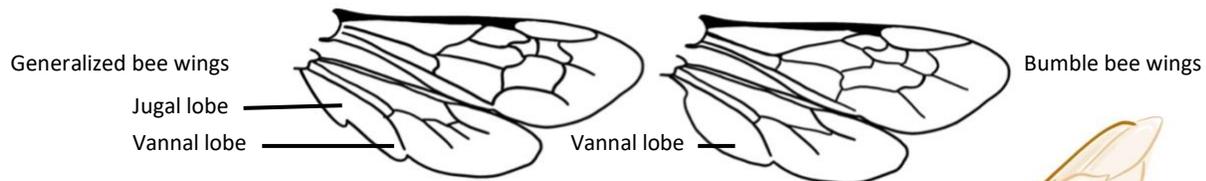
While wasps are very diverse, many (especially in the family Vespidae – such as this aerial yellow jacket, *Dolichovespula arenaria*) have similar colours to bumble bees. Most wasps can be distinguished from bumble bees by having very few/no hairs on their bodies and thinner legs



As a side note: many people claim to tell wasps from bees through the former having more “aggressive” behaviour – this is an unsubstantiated myth.

## Other bees

Non-native, Western Honey Bees (*Apis mellifera*), bees of the family Megachilidae, and other native bees can also be mistaken as bumble bees to the untrained eye. Bumble bees are usually distinguished by their robust bodies and particularly dense hairs giving them a “fluffy” appearance. However, the only physical feature that truly defines bumble bees from all other bees is that all other bees have a jugal lobe on their hindwing while bumble bees do not.



Western honey bees (*Apis mellifera*) can be distinguished from bumble bees by having much fewer hairs on their abdomens than bumble bees and their elongated “wasp-like” body shapes. They are closely related to bumble bees though; female honey bees also have corbiculae.



Megachilid bees (*Megachile frigida*) often look like bumble bees but they never have corbiculae, instead having scopa (modified pollen carrying hairs) only on the ventral part of the abdomen (if at all). The dorsal parts of the abdomen are usually much less hairy than that of a bumble bee as well.

## Identifying the sex of a bumble bee

Identifying male bumble bees to species requires a microscope, which prevents identification of live male bees. For this reason, this guide only focuses on identifying female bumble bees to species. It's therefore important to know if you have a male or a female bumble bee before moving onto the next step of identifying species.

Below are two methods of sexing bumble bees: a **question key** and a **matrix key**. If you are a beginner, it is best to start with the question key. The matrix key offers more information and can be used if there is an anomaly in the bumble bee (e.g., the back legs are missing or not visible).

### Question key for sexing bumble bees

How to use: Start at step 1 and decide which "question" fits your specimen, then follow the instructions of the "answer" until you know the sex of the bumble bee. A question key works like a choose your own adventure novel. Helpful hint: read each question in a set (e.g., 1a AND 1b) before deciding which fits your bumble bee.

Step	Question	Answer
1a	Corbicula present	Female (go to pg. 24)
1b	Corbicula absent	go to step 2
2a	Abdomen rounded	Male (to confirm go to step 4)
2b	Abdomen elongated and pointed	go to step 3 (Subgenus: <i>psithyrus</i> )
3a	18 mm or longer body length	Female (go to pg. 24)
3b	15 mm or shorter body length	Male (to confirm go to step 4)
3c	between 16-17 mm body length	go to step 4
4a	Flagellum with 11 flagellomeres. Abdomen with 7 tergites.	Male
4b	Flagellum with 10 flagellomeres. Abdomen with 6 tergites.	Female (go to pg. 24)

## Matrix key for sexing bumble bees

How to use: Start with any of the traits listed in the first row and identify which row(s) describes the characteristics of your bumble bee. If your specimen has a “yellow characteristic” you can know immediately which sex your bumble bee is. Only one sex will ever have the yellow characteristics and these traits are not very subjective.

Sex	Eyes	Hindleg tibia	Abdomen Length	Abdomen shape	Size	Number of flagellomeres on flagellum
Female	regular	corbicula present	6 tergites	Rounded with a dull point	Any size	10
Female (cuckoo parasite subgenus: <i>psithyrus</i> )	regular	corbicula absent	6 tergites	Elongated and curved into a point	>15mm	10
Male (cuckoo parasite subgenus: <i>psithyrus</i> )	regular	corbicula absent	7 tergites	Elongated and curved into a point	<18mm	11
Male (species: <i>Bombus nevadensis</i> )	*Very large, almost fly-like	corbicula absent	7 tergites	Rounded	16mm-19mm	11
Male	regular	corbicula absent	7 tergites	Rounded	Any size	11

Yellow highlighted characteristics than can be used to identify the sex of a specimen without using any other traits

\*While eye size may seem subjective, if you look at the eyes of a male *Bombus nevadensis* you will see just how large they are in comparison to the eyes of all other bees. It is difficult to mistake once you see it, so we recommend that you first observe the eyes with this characteristic to see this difference before using the trait for identification.

## **Identifying female bumble bee species**

We developed a matrix key that should allow identification of most of the female bumble bees found in the city (see pg. 22 for sexing bumble bees). A matrix key allows you to examine bumble bee traits in any order, and to skip missing traits if necessary (which is particularly useful if one part of the bumble bee is too blurry in a photograph).

The matrix key has two sections, focusing on colours and morphometrics.

The colours section asks you to examine the hair colours on each relevant body region. You will see that tergite 6 is not included. This is because tergite 6 rarely has more than a few hairs and as a result appears black (the colour of the exoskeleton) on almost all female bumble bees. The colour section is organized by major abdominal colours (bumble bees with orange on their abdomen, followed by bumble bees that can have white on their abdomen, followed by bumble bees that are only black and yellow).

The morphometrics section asks you to examine the sizes and shapes of body parts and a few more difficult to observe characteristics that require magnification. Observing these characteristics will likely require a good macro lens, a strong handheld magnifying glass, or a dissecting microscope. While more difficult to observe, these traits are typically more reliable than colour or general size characteristics. The last column provides information on how common or uncommon each species is in Calgary, and what bumble bees are similar in appearance. The morphometrics section cannot be used without also using the colour traits as many of the size traits are similar for different species.

*How to use matrix keys:* Start with any trait (header row) and find the row(s) where the trait is best described. Repeat this process for additional traits until you narrow down to one possible species. You can then check your identification using the illustrated species pages.

### **Other helpful information**

- In multi-morphic species (species with commonly more than one colour pattern), each colour type is listed as a separate row. The most encountered type is listed first (e.g., *Bombus rufocinctus* type 1 is more common than *Bombus rufocinctus* type 5)
- When two colours are listed with a plus sign (Colour + Colour) this indicates hairs of mixed colours. There is usually more or equal amounts of hairs of the first colour listed than the second colour. For example, “Black + Yellow” could appear mostly black with some yellow but only rarely mostly yellow.
- When two colours are listed with a dash (Colour – Colour) this indicates a range of colours between the two listed. For example, “Yellow – White” could appear white, very pale yellow, pale yellow, mostly yellow, or very bright yellow.
- The commonness terms indicate how likely a bumble bee species may be found during the late spring/summer months compared to another species. It does not consider specific ecosystems, times of the day, month, or other aspects.

**Table key for identifying female bumble bees**

Species (Females only)	Face	Head	Scutum	Inter-alar Space	Scutellum	Tergite 1	Tergite 2	Tergite 3	Tergite 4	Tergite 5	Abdomen (can be a difficult trait to use)	Hindleg Tibia	Body Length (typical)	Cheek Length (magnification)	Midleg Basitarsus Angle (magnification)	Head length (magnification)	Corbicular fringe colour (magnification)	Relative commonness of species + Similar species
<i>huntii</i> (pg.33)	Yellow	Yellow	Yellow	Black	Yellow	Yellow	Orange - Red	Orange - Red	Yellow	Black	Rounded with a dull point	Corbicula Present	9-20 mm (medium)	Equally long as broad	posterior distal corner rounded	Medium	Black	Common <i>B. ternarius</i>
<i>ternarius</i> (pg.41)	Yellow + Black	Yellow + Black - Black (Rarely Yellow)	Yellow - Pale Yellow	Black	Yellow - Pale Yellow with Black bisection	Yellow - Pale Yellow with Black bisection	Orange - red	Orange - Red	Yellow - Pale Yellow	Black	Rounded with a dull point	Corbicula Present	9-20 mm (medium)	Equally long as broad	posterior distal corner rounded	Medium	Black	Uncommon <i>B. huntii</i>
<i>rufocinctus</i> (type 1) (pg.39)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Orange - Yellow	Orange	Orange	Orange anterior & Black posterior	Rounded with a dull point	Corbicula Present	9-13 mm (small)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans, B. centralis, B. flavifrons</i>
<i>rufocinctus</i> (type 7) (pg.39)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Yellow - Black middle	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Orange with Yellow bisection	Orange	Orange - Yellow anterior & Black posterior	Black	Rounded with a dull point	Corbicula Present	17-18 mm (large)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans, B. centralis, B. flavifrons</i>
<i>rufocinctus</i> (type 2) (pg.39)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Yellow - Orange	Orange	Yellow - Orange	Yellow with Black bisection	Rounded with a dull point	Corbicula Present	9-13 mm (small)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans, B. centralis, B. flavifrons</i>
<i>rufocinctus</i> (type 5) (pg.39)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow sometimes with Black (hairless) bisection	Yellow with Black anterior lateral	Orange with anterior lateral Black	Orange anterior & Black posterior	Black	Rounded with a dull point	Corbicula Present	9-13 mm (small)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans, B. centralis, B. flavifrons</i>
<i>centralis</i> (pg.30)	Yellow - Pale Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow with Black bisection	Yellow - Pale Yellow with Black bisection	Orange	Orange	Black	Rounded with a dull point	Corbicula Present	8-18mm (small)	Barely longer than broad	posterior distal corner rounded	Medium	Black	Common <i>B. flavifrons, B. rufocinctus</i>

Species (Females only)	Face	Head	Scutum	Inter-alar Space	Scutellum	Tergite 1	Tergite 2	Tergite 3	Tergite 4	Tergite 5	Abdomen (can be a difficult trait to use)	Hindleg Tibia	Body Length (typical)	Cheek Length (magnification)	Midleg Basitarsus Angle (magnification)	Head length (magnification)	Scopa colour (magnification)	Relative commonness of species + Similar species
<i>flavifrons</i> (pg.32)	Yellow + Black	Yellow + Black	Yellow + Black	Black (Some Yellow hairs laterally)	Yellow + Black	Yellow (hairs sparse)	Yellow (hairs sparse)	Orange	Orange	Black	Rounded with a dull point	Corbicula Present	10-18 mm (small)	Distinctly longer than broad (very long)	posterior distal corner rounded	Very Long	Black	Rare <i>B. centralis</i> , <i>B. rufocinctus</i>
<i>mixtus</i> (type 1) (pg.35)	Yellow + Black	Yellow + Black	Yellow + Black	Black	Yellow	Yellow	Yellow	Black	Pale Orange	Pale Orange	Rounded with a dull point	Corbicula Present	10-17 mm (small)	Equally long as broad	posterior distal corner rounded	Medium	Black - Orange	Uncommon
<i>mixtus</i> (type 2) (pg.35)	Yellow + Black	Yellow + Black	Yellow + Black	Black with a few Yellow hairs and Black middle	Yellow + Black	Yellow + Black	Black with anterior Yellow + Black bisection	Black	Pale Orange	Pale Orange	Rounded with a dull point	Corbicula Present	10-17 mm (small)	Equally long as broad	posterior distal corner rounded	Medium	Black - Orange	Uncommon
<i>occidentalis</i> (pg.37)	Black	Black	Yellow	Black	Black	Black	Black	Black	White	White	Rounded with a dull point	Corbicula Present	9-21 mm (medium)	Barely shorter than broad	posterior distal corner rounded	Short	Black	Rare <i>B. cryptarum</i>
<i>cryptarum</i> (pg.31)	Black	Black	Yellow - Pale Yellow	Black	Black sometimes with pale hairs intermixed	Black	Yellow - Pale Yellow	Black	Black anterior & White posterior	White	Rounded with a dull point	Corbicula Present	13-21 mm (medium)	Barely shorter than broad	posterior distal corner rounded	Short	Black	Uncommon <i>B. occidentalis</i>
<i>vancouverensis</i> (pg.43)	Pale Yellow - White	Pale Yellow - White	Pale Yellow - White	Black	Pale Yellow - White with Black (hairless) bisection	Pale Yellow - White with Black (hairless) bisection	Black	Black	Pale Yellow - White	Black	Rounded with a dull point	Corbicula Present	8-19 mm (small)	Barely shorter than broad	posterior distal corner rounded	Medium	Orange - Black	Uncommon
<i>borealis</i> (pg.29)	Pale Yellow	Yellow	Yellow	Black	Yellow	Yellow	Yellow	Yellow	Yellow	Black	Rounded with a dull point	Corbicula Present	13-22 mm (medium)	Distinctly longer than broad	posterior distal corner pointed	Long	Black	Uncommon <i>B. nevadensis</i>
<i>nevadensis</i> (pg.36)	Black	Black (rarely with a few Yellow hairs)	Yellow	Yellow with distinct Black middle	Yellow	Yellow	Yellow	Yellow	Black	Black	Rounded with a dull point	Corbicula Present	15-25 mm (large)	Longer than broad	posterior distal corner pointed	Long	Black	Uncommon <i>B. borealis</i>

Species (Females only)	Face	Head	Scutum	Inter-alar Space	Scutellum	Tergite 1	Tergite 2	Tergite 3	Tergite 4	Tergite 5	Abdomen (can be a difficult trait to use)	Hindleg Tibia	Body Length (typical)	Cheek Length (magnification)	Midleg Basitarsus Angle (magnification)	Head length (magnification)	Scopa colour (magnification)	Relative commonness of species + Similar species
<i>perplexus</i> (pg.38)	Black	Yellow + Black - Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow (rarely with black middle)	Yellow - Pale Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Black	Black	Rounded with a dull point	Corbicula Present	8-20 mm (medium)	Barely longer than broad	posterior distal corner rounded	Medium	Black	Common <i>B. vagans</i> , <i>B. rufocinctus</i>
<i>vagans</i> (pg.42)	Yellow + Black	Yellow + Black - Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow with Black middle	Yellow - Pale Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Black	Black	Rounded with a dull point	Corbicula Present	11-21 mm (medium)	Barely longer than broad	posterior distal corner rounded	Medium	Black	Uncommon <i>B. perplexus</i> , <i>B. rufocinctus</i>
<i>rufocinctus</i> (type 3) (pg.40)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Yellow + Black	Black	Black	Black	Rounded with a dull point	Corbicula Present	9-13 mm (small)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans</i> , <i>B. centralis</i> , <i>B. flavifrons</i>
<i>rufocinctus</i> (type 4) (pg.40)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Black	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Black with Yellow bisection	Black	Yellow	Black	Rounded with a dull point	Corbicula Present	9-13 mm (small)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans</i> , <i>B. centralis</i> , <i>B. flavifrons</i>
<i>rufocinctus</i> (type 6) (pg.40)	Black	Yellow - Pale Yellow	Yellow - Pale Yellow	Yellow - Pale Yellow with Black middle	Yellow - Pale Yellow	Yellow - Pale Yellow often with Black (hairless) bisection	Black with Yellow bisection	Black	Black	Black	Rounded with a dull point	Corbicula Present	17-18 mm (large)	Distinctly shorter than broad	posterior distal corner rounded	Very short	Black	Very common <i>B. vagans</i> , <i>B. centralis</i> , <i>B. flavifrons</i>
<i>bohemicus</i> (pg.28)	Black	Black	Yellow	Black	Black sometimes with yellow hairs intermixed	Black	Black	Black with posterior lateral Yellow - White	Yellow with White bisection	Yellow + Black with Black bisection	Elongated and curved into a point and ventral shiny	Corbicula Absent	17-19 mm (medium)	NA - use abdomen shape	posterior distal corner pointed	NA - use abdomen shape	NA	Rare <i>B. insularis</i>
<i>insularis</i> (pg.34)	Yellow with some black hairs	Yellow	Yellow	Black + Yellow with Black middle	Yellow	Black	Black	Black with posterior lateral Yellow	Yellow with Black bisection	Yellow with Black bisection	Elongated and curved into a point and ventral shiny	Corbicula Absent	16-20 mm (medium)	NA - use abdomen shape	posterior distal corner pointed	NA - use abdomen shape	NA	Uncommon <i>B. bohemicus</i>

# **Bombus bohemicus**

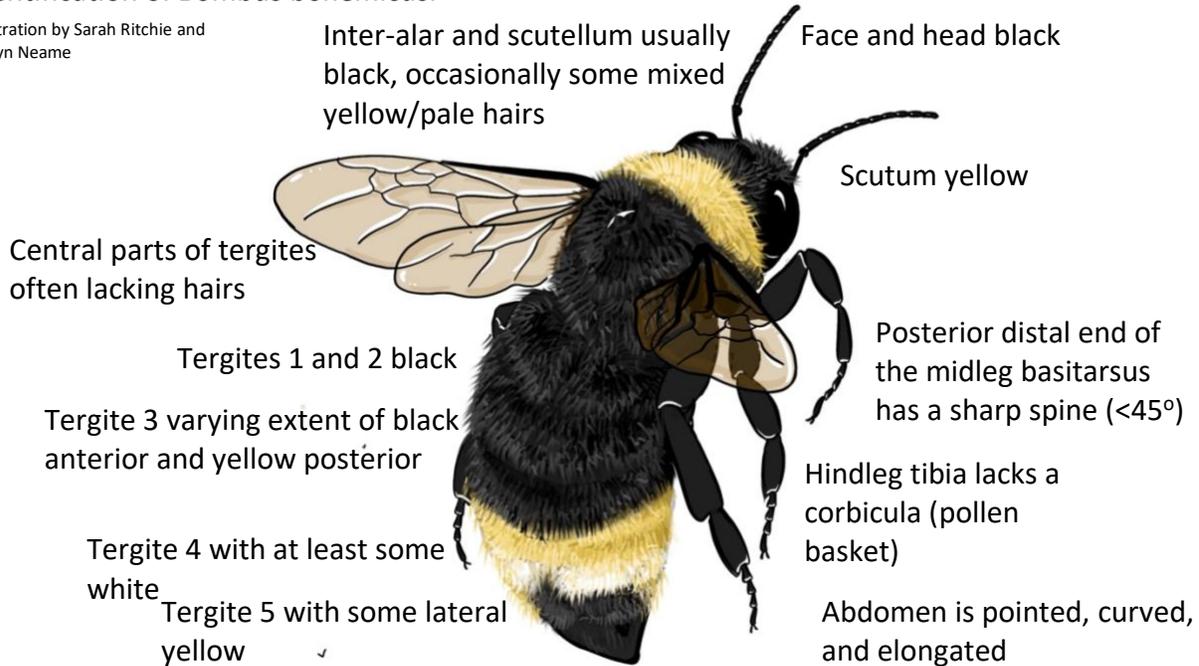
Common Name: Ashton cuckoo bumble bee

Rare in Calgary – COSEWIC: Endangered (Protected under the Species at Risk Act)<sup>1</sup>

Compare *Bombus bohemicus* to *Bombus insularis*. *Bombus insularis* never has any white hairs on the abdominal tergites while *Bombus bohemicus* females always have at least some white. *Bombus insularis* also has very few black hairs on the face while *Bombus bohemicus* has an entirely black face. Note that it is also possible for *Bombus flavidus* and *Bombus suckleyi* to be found in Calgary. *Bombus bohemicus* has more white hairs on its abdomen than *Bombus suckleyi* and a more extensively black top of the head than *Bombus flavidus*. *Bombus bohemicus* is a member of the subgenus *Psithyrus* which means this bee is a nest parasite of other bumble bees in Calgary.

## Identification of *Bombus bohemicus*:

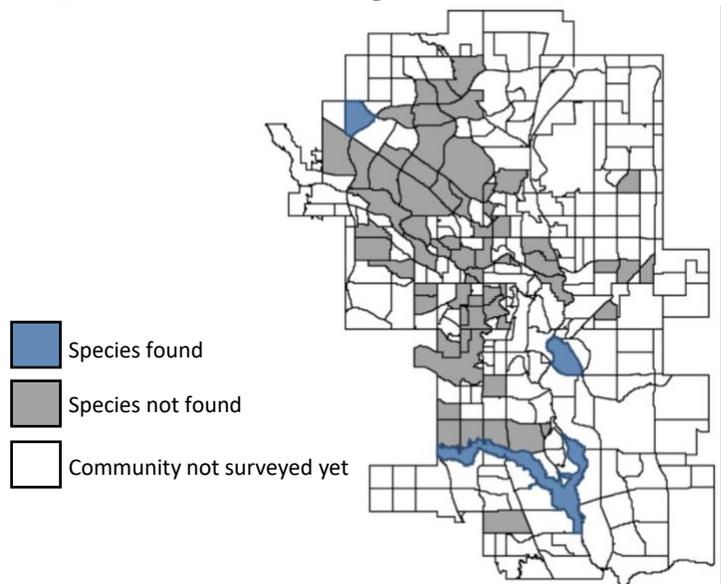
Illustration by Sarah Ritchie and  
Tobyn Neame



Size: Female 17-19 mm (no workers)

**Known Plant Interactions**  
*Solidago* sp. – Goldenrods

**Known Hosts** (also found in Calgary)  
*Bombus occidentalis*  
 Possible hosts also include *Bombus cryptarum*



1. COSEWIC 2014. COSEWIC assessment and status report on the gypsy cuckoo bumble bee *Bombus bohemicus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa

## **Bombus borealis**

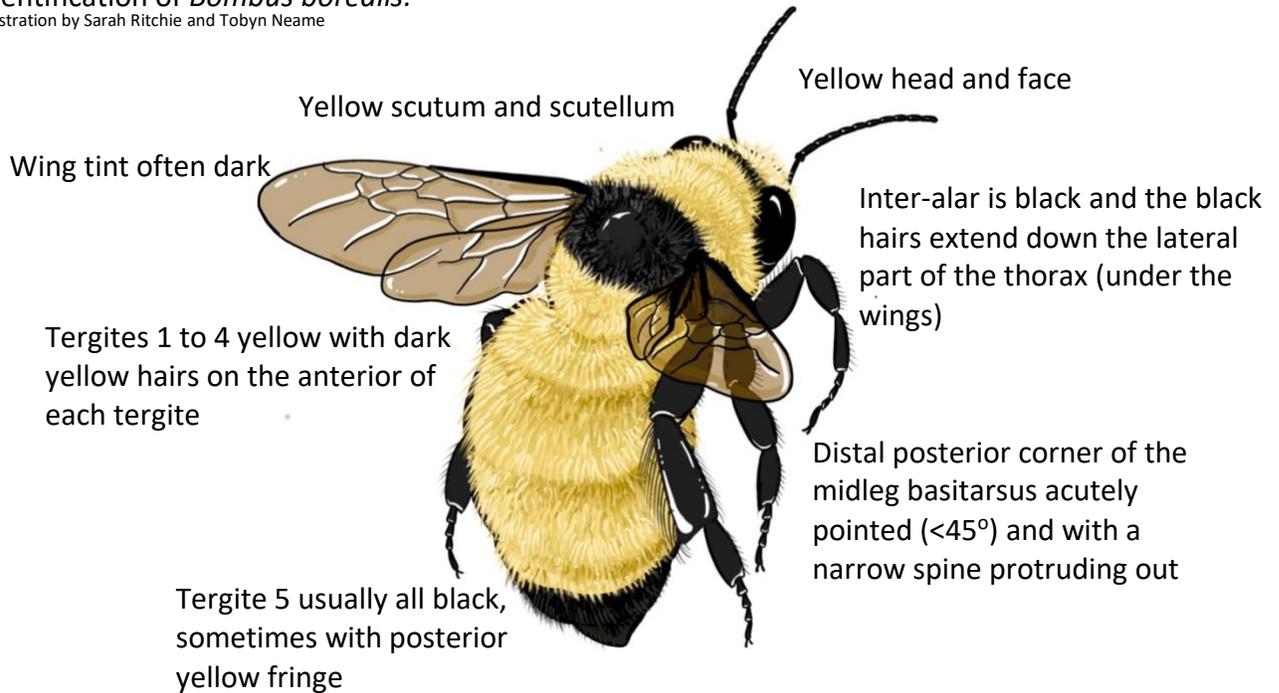
Common Name: Northern amber bumble bee

**Uncommon** in Calgary

Distinct from most other bees in Calgary. Similar to the very rare *Bombus fervidus* but *Bombus borealis* has yellow hairs on the face and head while *Bombus fervidus* has extensive black hairs on the face and head.

### Identification of *Bombus borealis*:

Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 13-15 mm Queen 18-22 mm

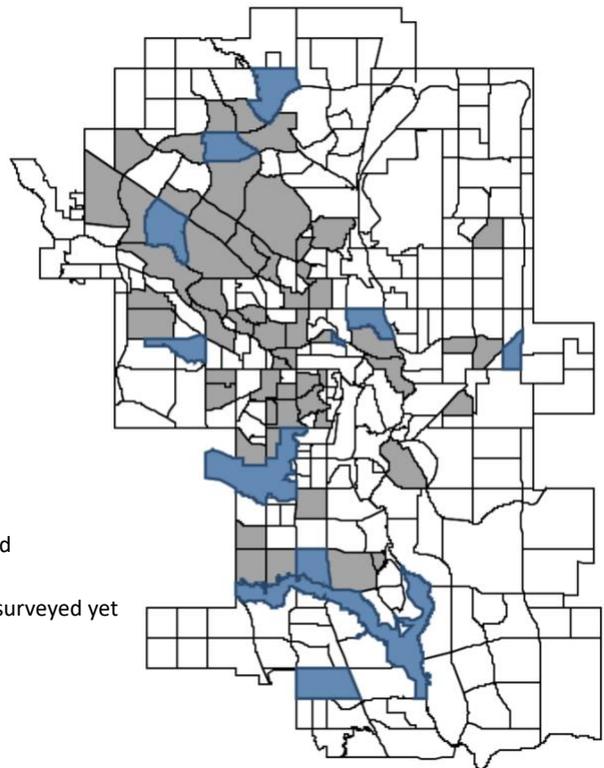
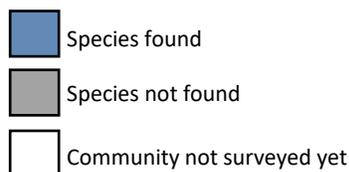
#### Known plant interactions:

*Astragalus canadensis* – Canadian milkvetch

*Chamaenerion angustifolium* – Fireweed

*Monarda fistulosa* – Wild bergamot

*Solidago lepida* – Western goldenrod



## **Bombus centralis**

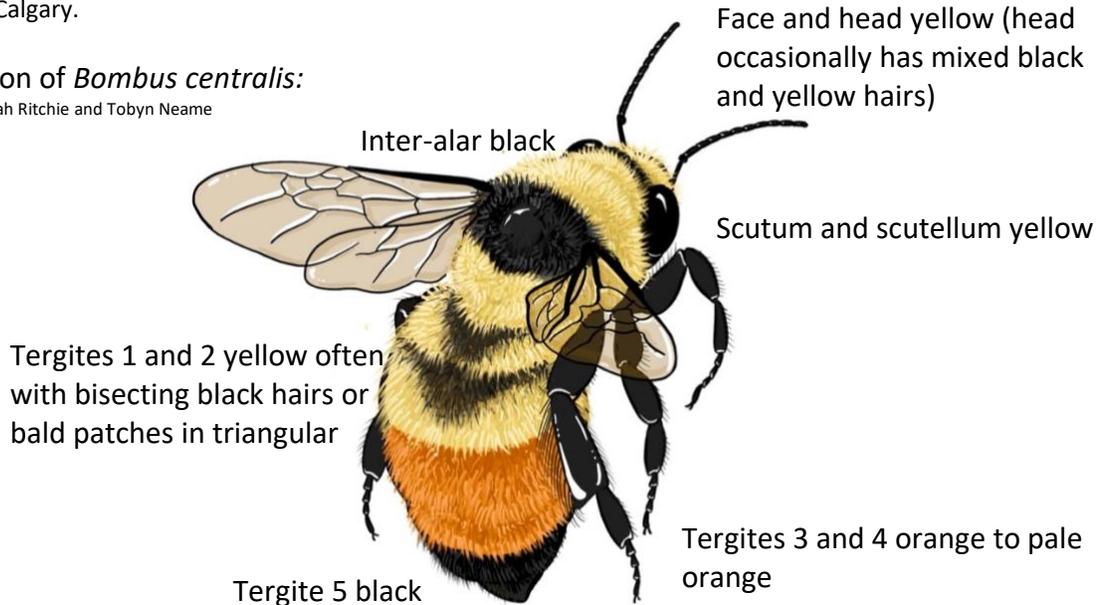
Common Name: Central bumble bee

**Common** in Calgary

Compare this bee to *Bombus flavifrons*. *Bombus centralis* has much more consistent yellow colouring on the thorax with few and usually no black hairs mixed in. *Bombus centralis* is also much more commonly found than *Bombus flavifrons* in Calgary.

### Identification of *Bombus centralis*:

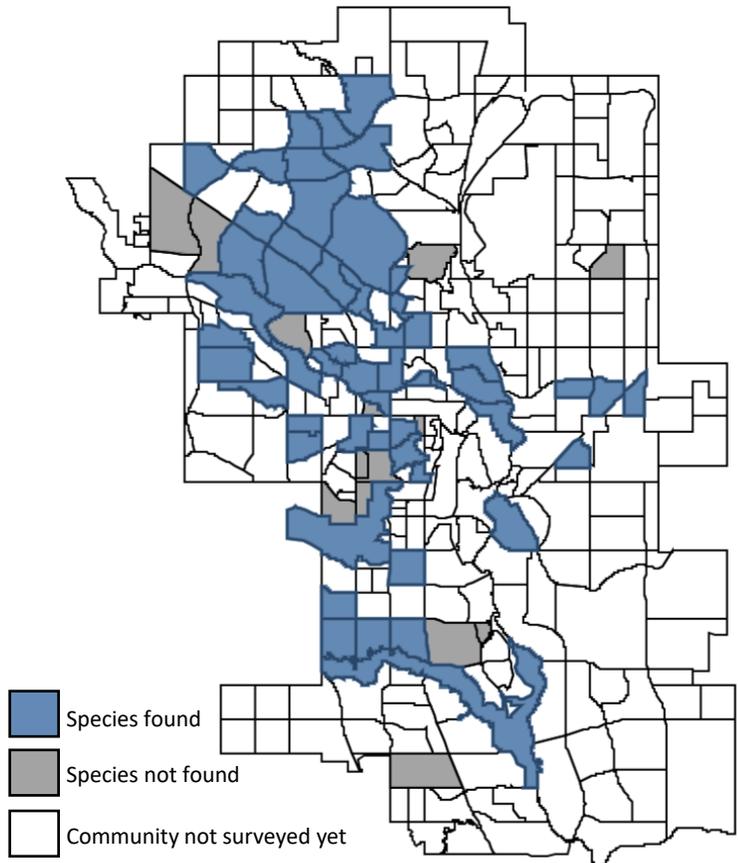
Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 8-13 mm Queen 16-18 mm

#### Known plant interactions:

- Aster* sp. – Asters
- Astragalus canadensis* – Canadian Milkvetch
- Chamaenerion angustifolium* - Fireweed
- Dalea purpurea* – Purple prairie clover
- Dasiphora fruticosa* – Shrubby cinquefoil
- Geranium viscosissimum* – Sticky geranium
- Glycyrrhiza lepidota* – American licorice
- Hedysarum alpinum* – Alpine sweetvetch
- Hedysarum boreale* – Boreal sweetvetch
- Hieracium umbellatum* – Narrowleaf hawkweed
- Lactuca tatarica* – Wild blue lettuce
- Linum lewisii* – Lewis flax
- Lupinus sericeus* – Silky lupine
- Monarda fistulosa* – Wild bergamot
- Rosa acicularis* – Prickly wild rose
- Rosa arkansana* – Prairie rose
- Rosa woodsii* – Interior rose
- Solidago lepida* – Western goldenrod
- Solidago* sp. – Goldenrods
- Symphoricarpos occidentalis* – Western snowberry
- Symphyotrichum laeve* – Smooth aster
- Vicia cracca* – Bird vetch



# **Bombus cryptarum**

Common Name: Cryptic bumble bee

Uncommon in Calgary

*Bombus cryptarum* is fairly distinct from other bees in Calgary on the basis of its black scutellum shared only with the four cuckoo bumble bees (Subgenus: *Psithyrus*) in Calgary, *Bombus occidentalis*, and *Bombus terricola* (possibly in Calgary). *Bombus occidentalis* has at least a mostly black tergite 2 while *Bombus cryptarum* has at least mostly yellow on tergite 2. *Bombus cryptarum* is more commonly found in Calgary than *Bombus occidentalis*.

### Identification of *Bombus cryptarum*:

Illustration by Sarah Ritchie and  
Tobyn Neame

Inter-alar band, the scutellum,  
and tergite 1 all black.

Face and head black

Scutum is yellow or  
occasionally very pale yellow  
such that it appears almost  
white

Scutellum of workers  
occasionally (rarely) has a few  
pale hairs intermixed

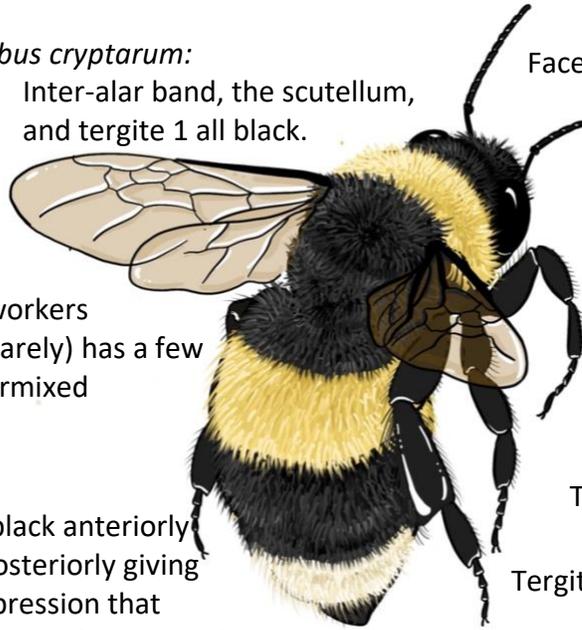
Tergite 2 yellow, sometimes  
with a posterior black fringe

Tergite 4 is black anteriorly  
and white posteriorly giving  
the false impression that  
tergite 5 is larger than normal

Tergite 3 is black

Tergite 5 is white

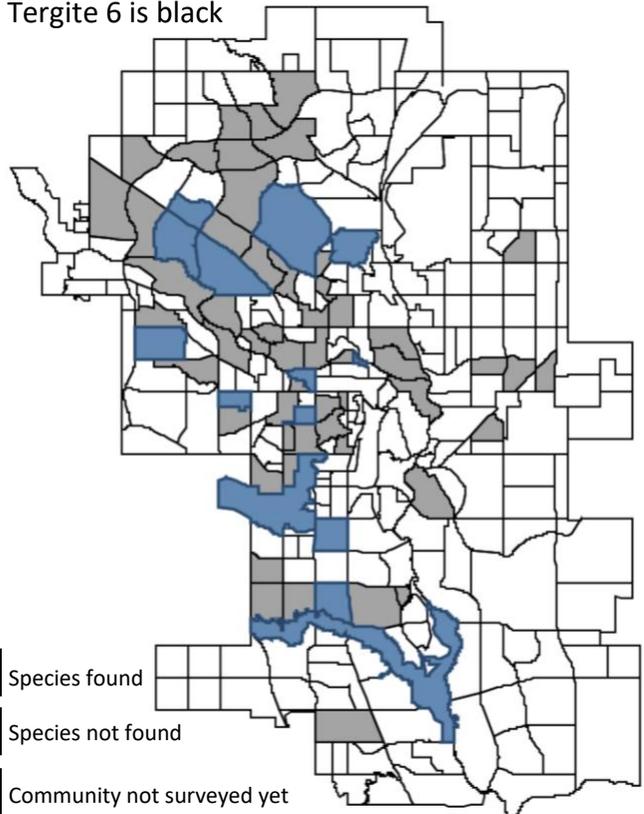
Tergite 6 is black



Size: Worker 13-17 mm Queen 19-21 mm

#### Known plant interactions:

- Aster* sp. – Asters
- Chamaenerion angustifolium* – Fireweed
- Dasiphora fruticosa* – Shrubby cinquefoil
- Lactuca tatarica* – Blue lettuce
- Monarda fistulosa* – Wild bergamot
- Rosa acicularis* – Prickly wild rose
- Rosa arkansana* – Prairie rose
- Rosa woodsii* – Interior rose
- Solidago altissima* – Late goldenrod
- Solidago gigantea* – Giant goldenrod
- Solidago lepida* – Western goldenrod
- Solidago* sp. – Goldenrods
- Symphoricarpos occidentalis* – Western snowberry



## **Bombus flavifrons**

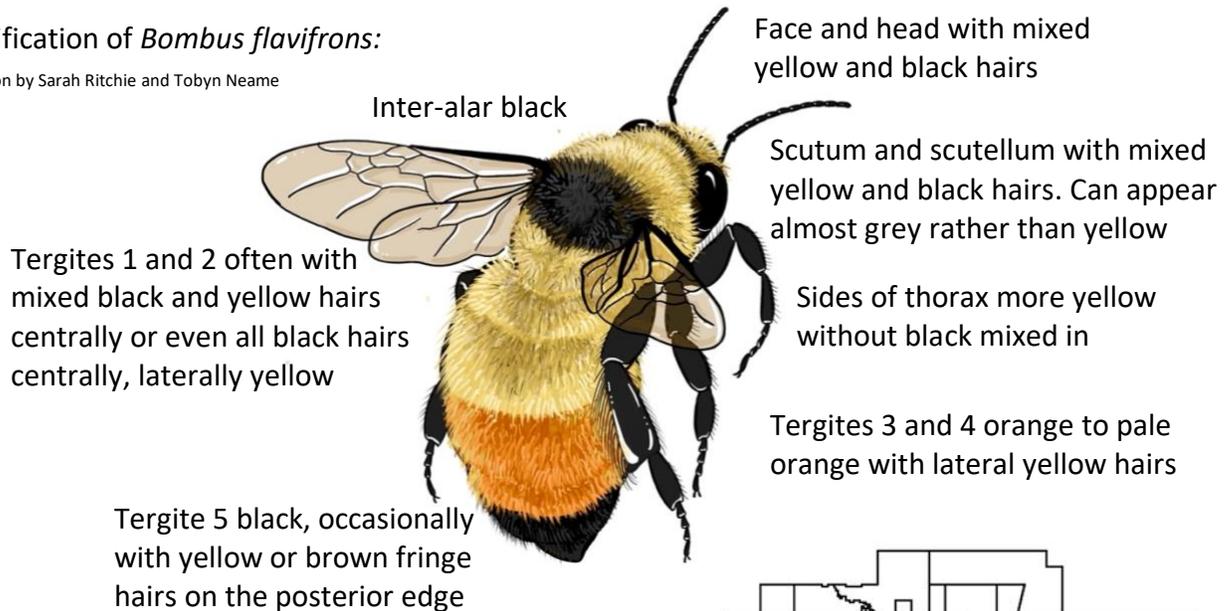
Common Name: Yellowhead bumble bee

Rare in Calgary

Compare this bee to *Bombus centralis*. *Bombus flavifrons* has much more mixing of black hairs into the yellow colouring on the thorax. *Bombus centralis* is also much more commonly found than *Bombus flavifrons* in Calgary. The subspecies of *Bombus flavifrons* found in Calgary is *Bombus flavifrons flavifrons*. Some evidence<sup>1,2</sup> suggests that *Bombus flavifrons* may be found more at higher elevation and therefore may be found more often closer to the mountains or in montane ecosystem patches within the city.

### Identification of *Bombus flavifrons*:

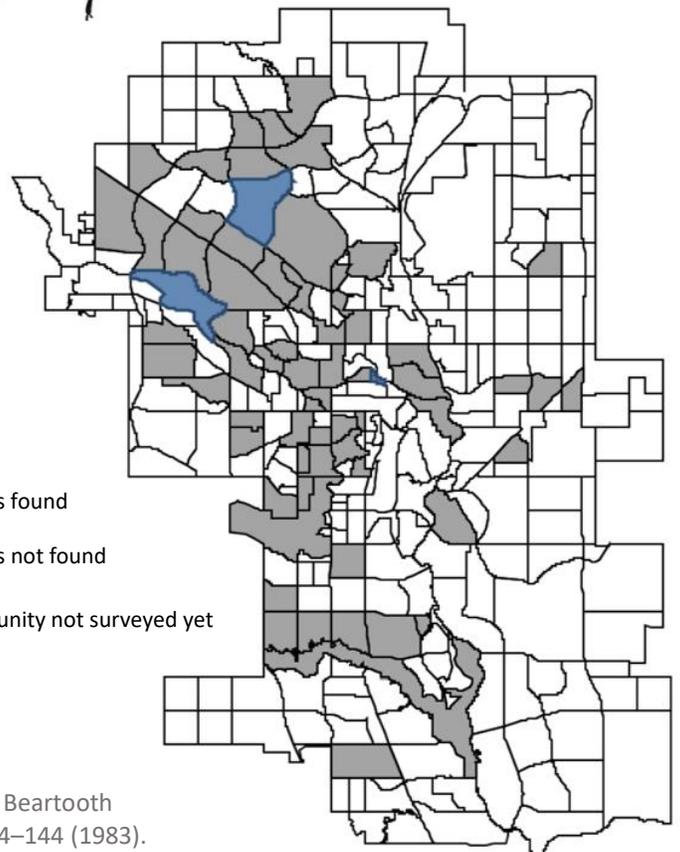
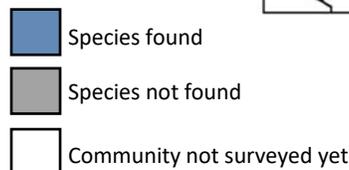
Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 10-13 mm Queen 16-18 mm

#### Known plant interactions:

*Solidago lepida* – Western goldenrod



1. Bauer, P. J. Bumble bee pollination relationships on the Beartooth Plateau tundra of southern Montana. *Am. J. Bot.* **70**, 134–144 (1983).
2. Bowers, M. A. Bumble bee colonization, extinction, and reproduction in subalpine meadows in northeastern Utah. *Ecology* **66**, 914–927 (1985).

# **Bombus huntii**

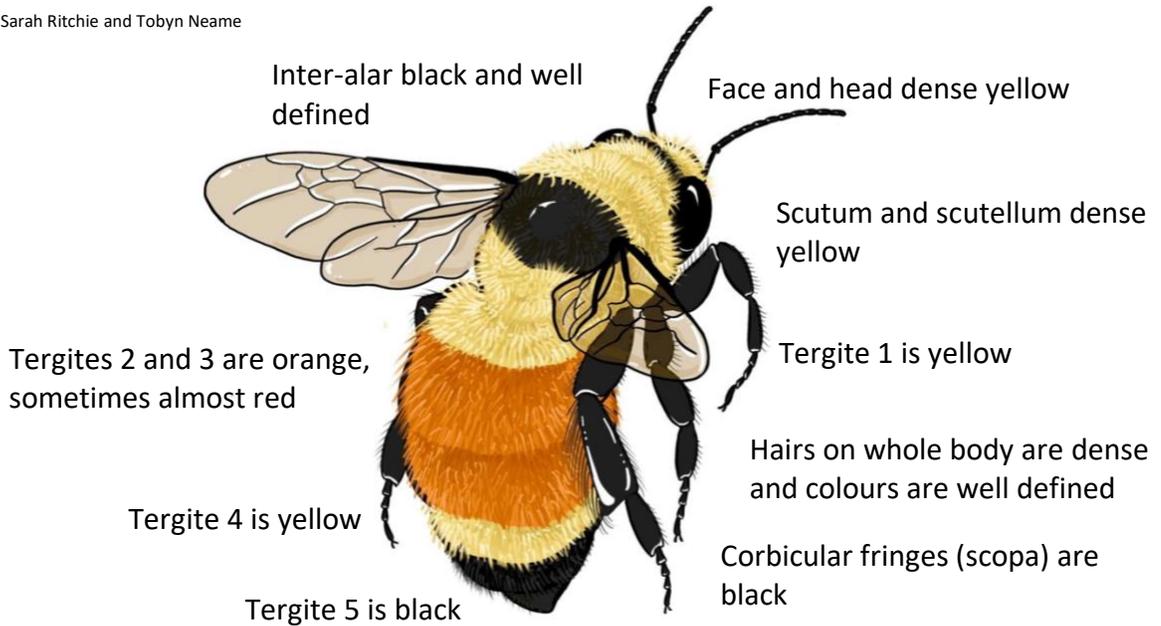
Common Name: Hunt’s bumble bee

**Common** in Calgary

Compare this bee to *Bombus ternarius*. You will find that *Bombus huntii* has a completely yellow scutellum and more yellow on the face and head and is found slightly more often than *Bombus ternarius*.

## Identification of *Bombus huntii*:

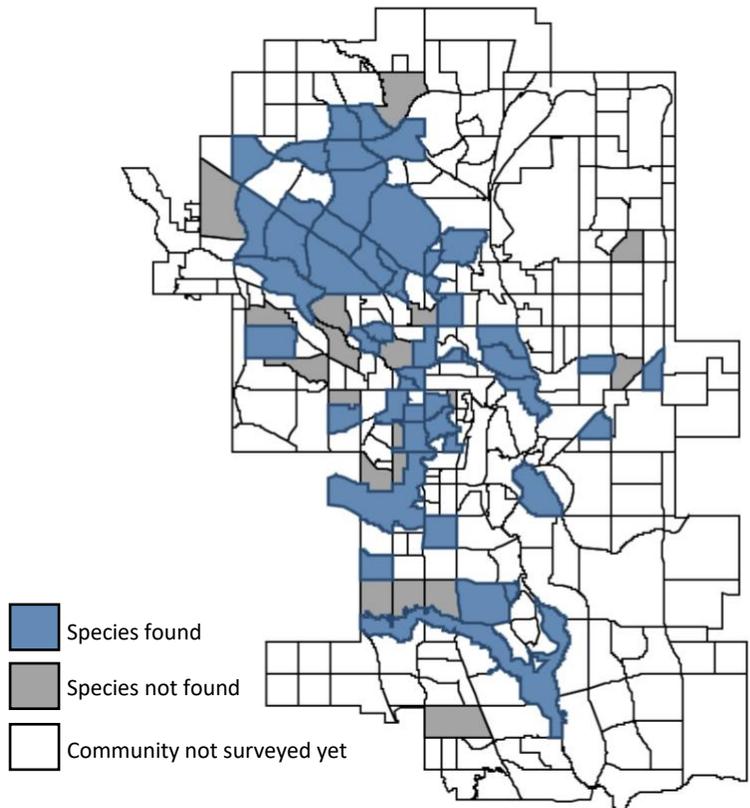
Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 11-14 mm Queen 19-20 mm

### Known plant interactions:

- Achillea millefolium* – Yarrow
- Astragalus canadensis* – Canadian milkvetch
- Chamaenerion angustifolium* – Fireweed
- Dalea purpurea* – Purple prairie clover
- Dasiphora fruticosa* – Shrubby cinquefoil
- Glycyrrhiza lepidota* – American licorice
- Helianthus petiolaris* – Prairie sunflower
- Heterotheca villosa* – Hairy goldenaster
- Lupinus sericeus* – Silky lupine
- Monarda fistulosa* – Wild bergamot
- Solidago altissima* – Late goldenrod
- Solidago gigantea* – Giant goldenrod
- Solidago lepida* – Western goldenrod
- Solidago* sp. – Goldenrods
- Symphoricarpos occidentalis* – Western snowberry
- Symphotrichum laeve* – Smooth aster



## **Bombus insularis**

Common Name: Indiscriminate cuckoo bumble bee

Uncommon in Calgary

Compare *Bombus insularis* to *Bombus bohemicus*. *Bombus insularis* never has any white hairs on the abdominal tergites while *Bombus bohemicus* females always have at least some. *Bombus insularis* also has very few black hairs on the face while *Bombus bohemicus* has an entirely black face. Note that it is also possible for *Bombus flavidus* and *Bombus suckleyi* to be found in Calgary, both of which have more extensive black hair on their face than *Bombus insularis*. *Bombus insularis* is a member of the subgenus *Psithyrus* which means this bee is a nest parasite of other bumble bees in Calgary.

### Identification of *Bombus insularis*:

Inter-alar is black and extends convexly into the scutellum

Central parts of tergites often lacking hairs

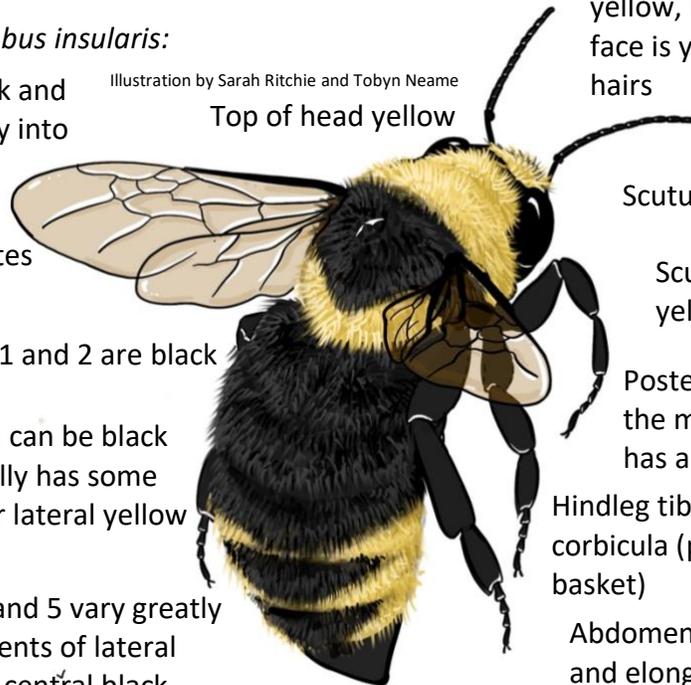
Tergites 1 and 2 are black

Tergite 3 can be black but usually has some posterior lateral yellow

Tergites 4 and 5 vary greatly in their extents of lateral yellow and central black

Illustration by Sarah Ritchie and Tobyn Neame

Top of head yellow



Face above the antennae is yellow, below the antennae the face is yellow with some black hairs

Scutum is yellow

Scutellum is usually yellow but can be black

Posterior distal end of the midleg basitarsus has a sharp spine (<45°)

Hindleg tibia lacks a corbicula (pollen basket)

Abdomen is pointed, curved, and elongated

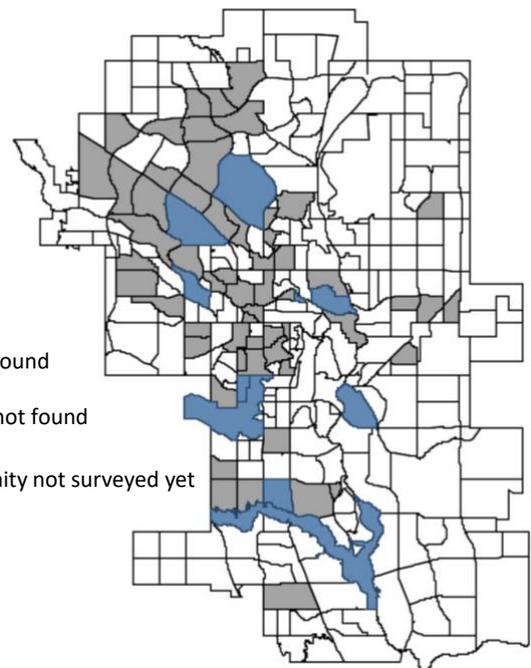
Size: Female 16-20 mm (no workers)

#### Known Plant Interactions

*Chamaenerion angustifolium* – Fireweed  
*Gaillardia aristata* – Common blanket flower  
*Heterotheca villosa* – Hairy goldenaster  
*Hieracium umbellatum* – Narrow leaf hawkweed  
*Solidago altissima* – Late goldenrod  
*Solidago gigantea* – Giant goldenrod  
*Solidago lepida* – Western goldenrod  
*Solidago* sp. - Goldenrods  
*Symphotrichum laeve* – Smooth aster

#### Known Hosts (also found in Calgary)

*Bombus flavifrons*, *Bombus nevadensis*, *Bombus ternarius*, *Bombus fervidus*  
 Possible hosts also include *Bombus rufocinctus* and *Bombus occidentalis*



# ***Bombus mixtus***

Common Name: Fuzzy-horned bumble bee

Uncommon in Calgary

Distinct from most other bees in Calgary. Superficially similar to *Bombus flavifrons* or *Bombus centralis* but *Bombus mixtus* has orange hairs on tergite 5 instead of black. Also similar to *Bombus rufocinctus* because of the yellow crescent on tergite 2 but *Bombus mixtus* has more intermixed hairs in the yellow and a pattern of yellow, black, orange on the abdomen that *B. rufocinctus* never has.

### Identification of *Bombus mixtus*:

Illustrations by Sarah Ritchie and Tobyn Neame

Inter-alar not sharply defined but mostly black

Face and head mixed yellow and black hairs

Scutum and scutellum mixed yellow and black hairs

Sides of thorax yellow

Tergite 1 usually mixed hairs but can be all yellow

Tergite 3 black

Corbicular fringe hairs black with orange tips

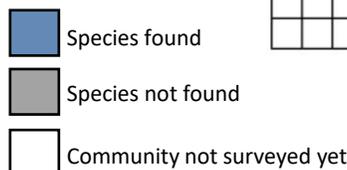
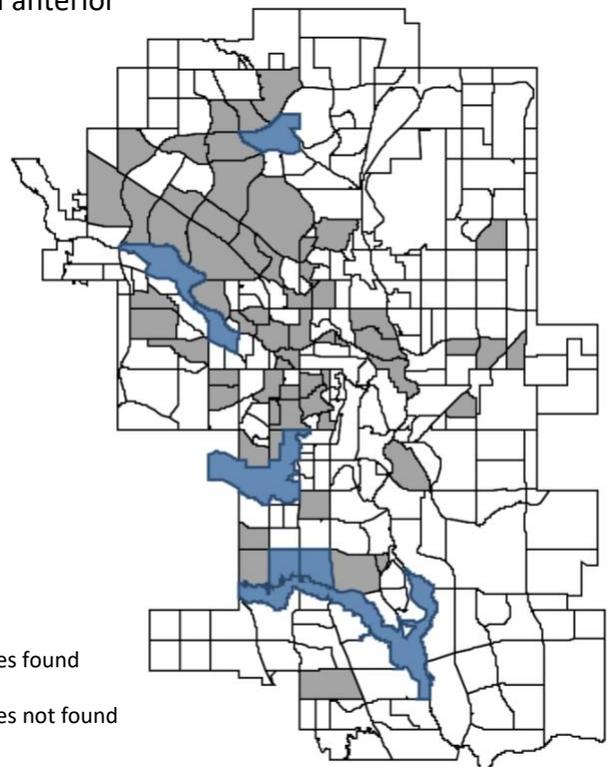
Tergites 4 and 5 pale orange. Tergite 4 with some black hairs anteriorly

Tergite 2 yellow and black mixed or black with yellow and black only on the central anterior

Size: Worker 10-14 mm Queen 15-17 mm

#### Known plant interactions:

- Chamaenerion angustifolium* – Fireweed
- Dasiphora fruticosa* – Shrubby cinquefoil
- Hedysarum alpinum* – Alpine sweetvetch
- Hieracium umbellatum* – Narrowleaf hawkweed
- Lactuca tatarica* – Blue lettuce



## **Bombus nevadensis**

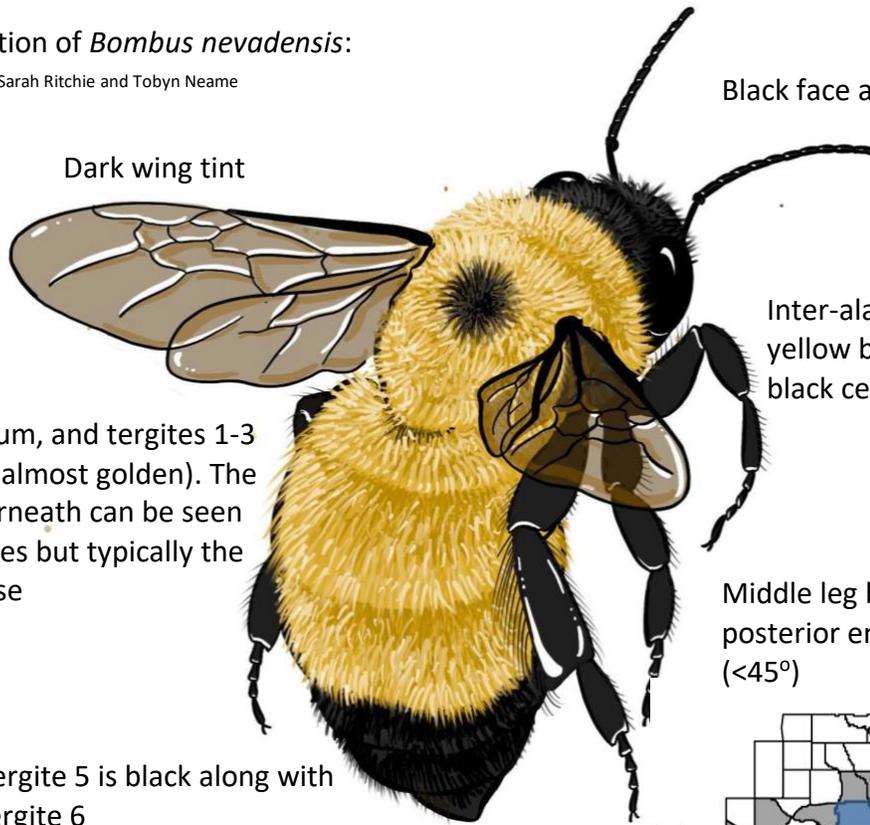
Common Name: Nevada bumble bee

**Uncommon in Calgary**

Compare this bee to *Bombus perplexus* and *Bombus vagans*. You will find that *Bombus nevadensis* has more yellow on the abdominal tergites than either of those two and is one of the largest, if not the largest bumble bees, we see in Calgary. Unlike other bees in Calgary, *Bombus nevadensis* belongs to the subgenus *Bombias*. This means that, unlike other bees in Calgary, it is actually fairly easy to determine the males of this species by their huge, almost fly-like, eyes. The females of *Bombus nevadensis* unfortunately do not have the huge eye trait, so must be distinguished by more traditional means.

### Identification of *Bombus nevadensis*:

Illustration by Sarah Ritchie and Tobyn Neame



Scutum, scutellum, and tergites 1-3 all dark yellow (almost golden). The black skin underneath can be seen from some angles but typically the hair is very dense

Black face and head

Inter-alar space mostly dark yellow but with distinguishing black central circle

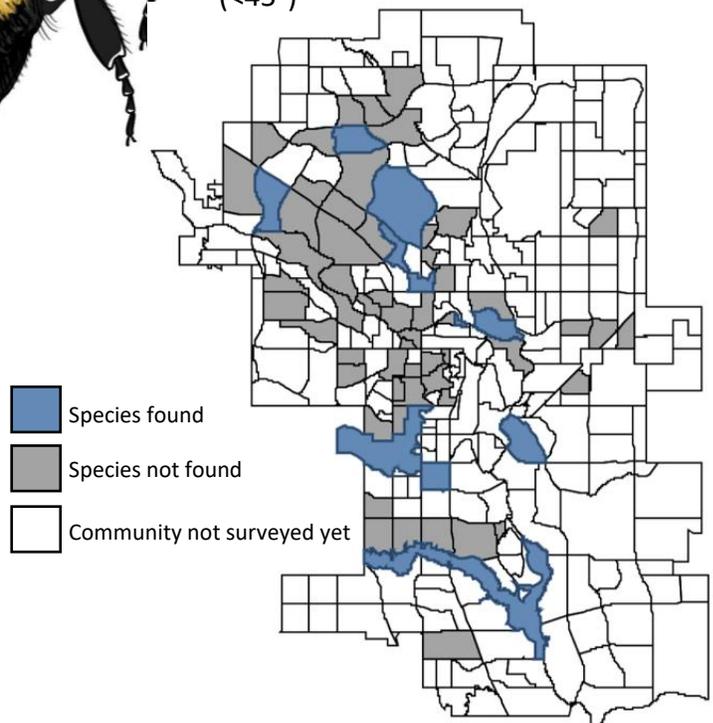
Middle leg basitarsus distal posterior end an acute angle (<45°)

Tergite 5 is black along with tergite 6

Size: Worker 15-21 mm Queen 24-25 mm

#### **Known plant interactions:**

- Astragalus canadensis* – Canadian milkvetch
- Gaillardia aristata* – Common blanket flower
- Glycyrrhiza lepidota* – American licorice
- Lupinus sericeus* – Silky lupine
- Monarda fistulosa* – Wild bergamot
- Solidago* sp. – Goldenrods
- Vicia cracca* – Bird vetch



## **Bombus occidentalis**

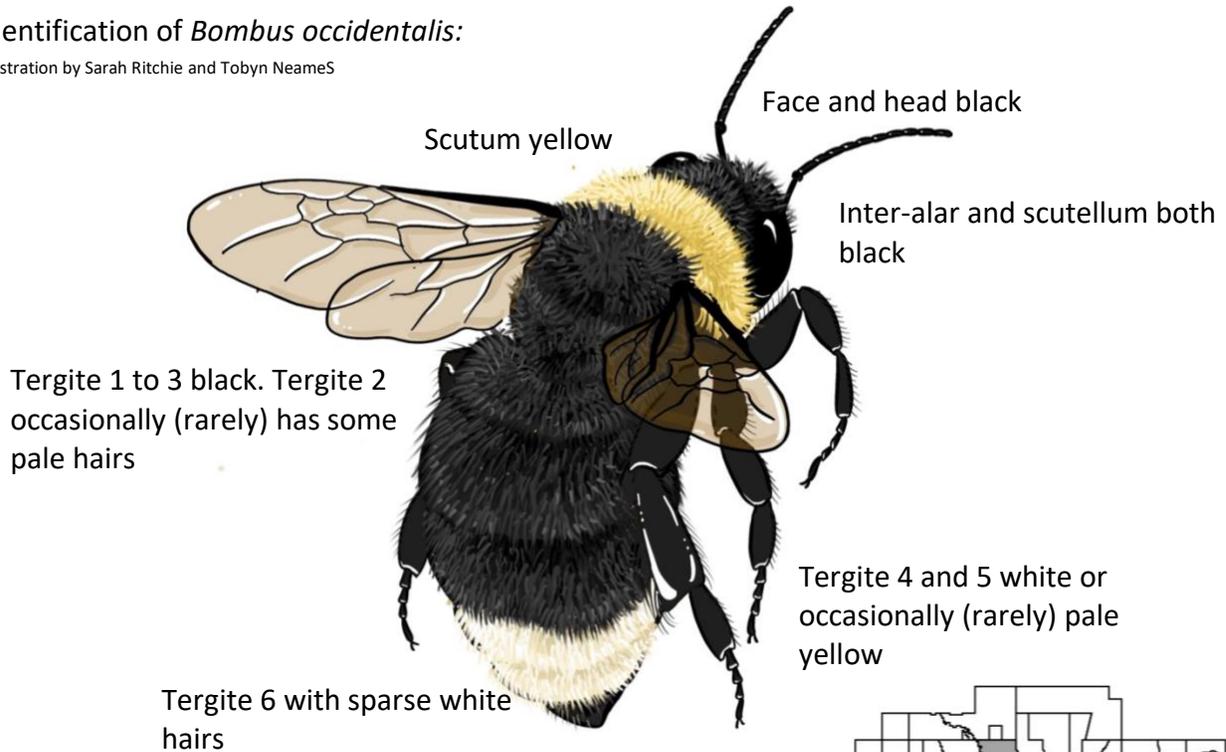
Common Name: Western bumble bee

Rare in Calgary – COSEWIC: Threatened<sup>1</sup>

Compare this bee to *Bombus cryptarum*. You will find that *Bombus occidentalis* has less yellow on the abdomen (tergite 2) and usually more white hairs anteriorly on tergite 4 than *Bombus cryptarum*. *Bombus occidentalis* is found much less often in Calgary than *Bombus cryptarum*. *Bombus occidentalis* is listed as threatened throughout much of its range due to habitat loss/fragmentation, pesticide use, and pathogens from commercial bee colonies<sup>1</sup>

### Identification of *Bombus occidentalis*:

Illustration by Sarah Ritchie and Tobyn Neames

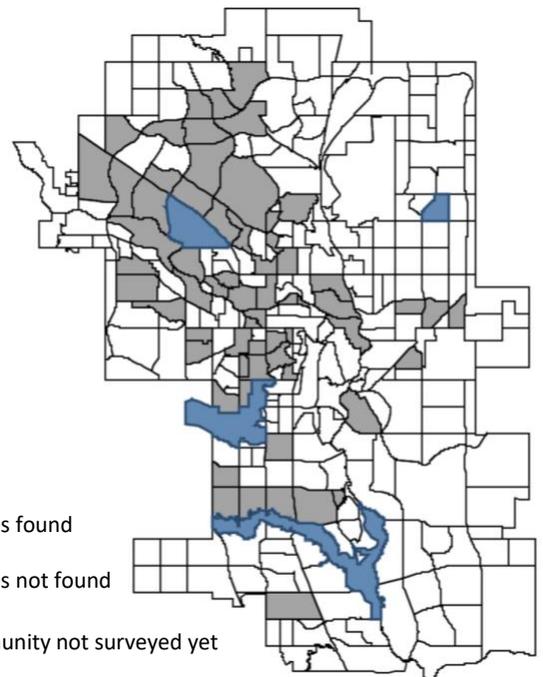


Size: Worker 9-15 mm Queen 20-21 mm

#### Known plant interactions:

*Aster* sp. – Asters

*Monarda fistulosa* – Wild bergamot



1. COSEWIC 2014. COSEWIC assessment and status report on the western bumble bee *Bombus occidentalis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa

## **Bombus perplexus**

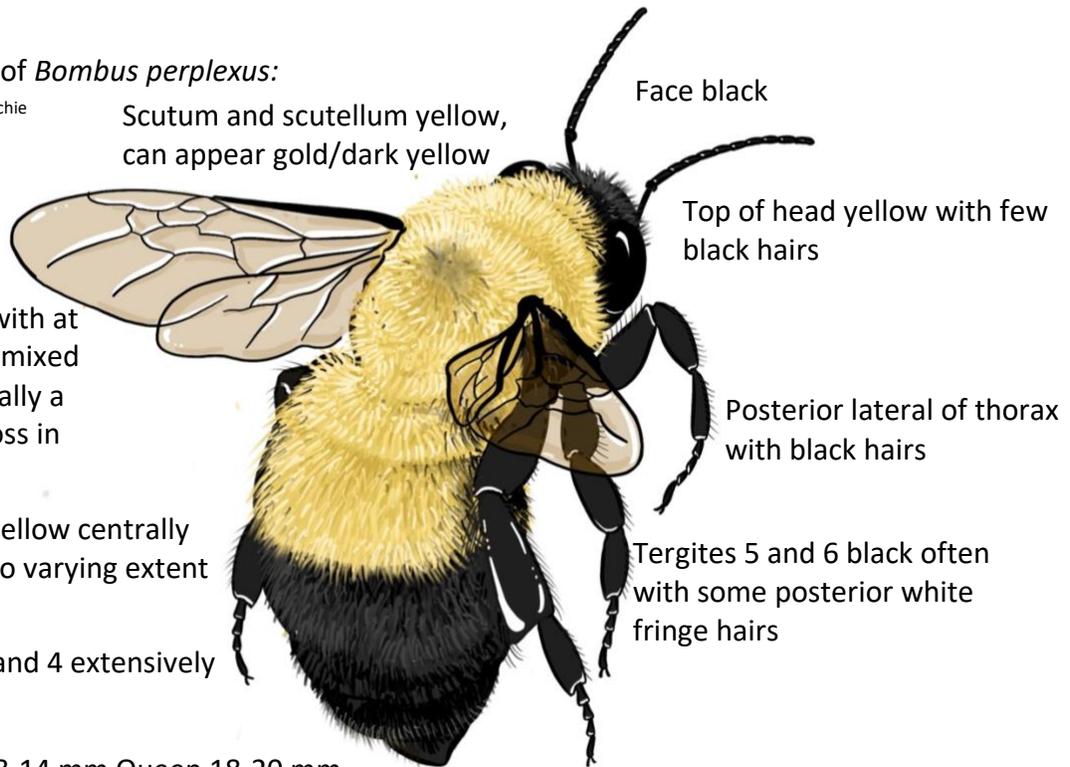
Common Name: Perplexing bumble bee/confusing bumble bee

**Common** in Calgary

Compare *Bombus perplexus* to *Bombus vagans*. *Bombus vagans* has extensively more yellow hairs on the lateral (sides) and ventral (underside) portions of the thorax while *Bombus perplexus* has dense black hairs covering the ventral and lateral portions of the thorax.

### Identification of *Bombus perplexus*:

Illustration by Sarah Ritchie and Tobyn Neame



Inter-alar fully yellow with at most a few black hairs mixed in the centre, occasionally a small amount of hair loss in the centre

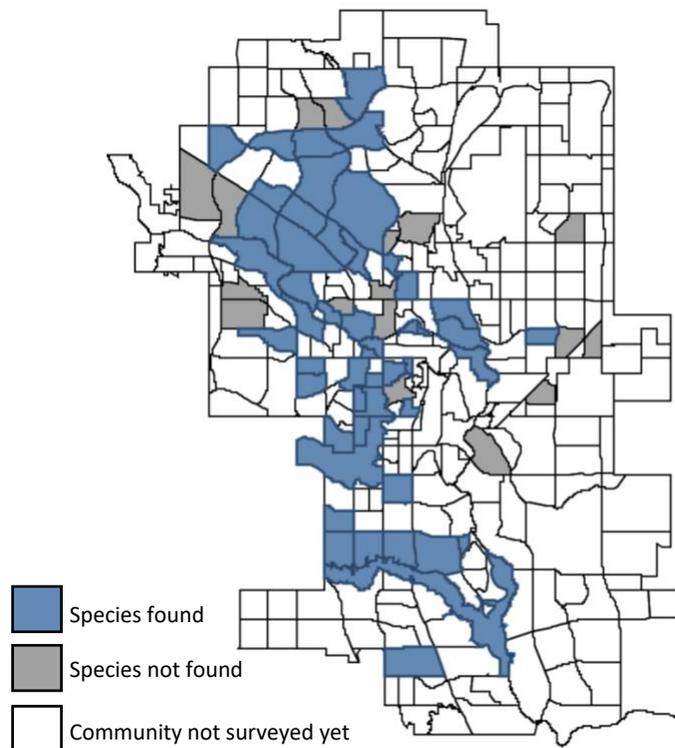
Tergites 1 and 2 yellow centrally with some black to varying extent laterally

Tergites 3 and 4 extensively black

Size: Worker 8-14 mm Queen 18-20 mm

#### **Known Plant Interactions:**

- Chamaenerion angustifolium* – Fireweed
- Dasiphora fruticosa* – Shrubby cinquefoil
- Gaillardia aristata* – Common blanketflower
- Hedysarum alpinum* – Alpine sweetvetch
- Hedysarum boreale* – Boreal sweetvetch
- Hieracium umbellatum* – Narrowleaf hawkweed
- Lactuca tatarica* – Blue lettuce
- Lupinus sericeus* – Silky lupine
- Monarda fistulosa* – Wild bergamot
- Rosa acicularis* – Prickly wild rose
- Rosa woodsii* – Interior rose
- Rosa* sp. – Roses
- Salix* sp. – Willows
- Solidago gigantea* – Giant goldenrod
- Solidago* sp. – Goldenrods
- Symphoricarpos* sp. – Snowberries
- Symphyotrichum laeve* – Smooth aster



## **Bombus rufocinctus**

Common Name: Red-belted bumble bee

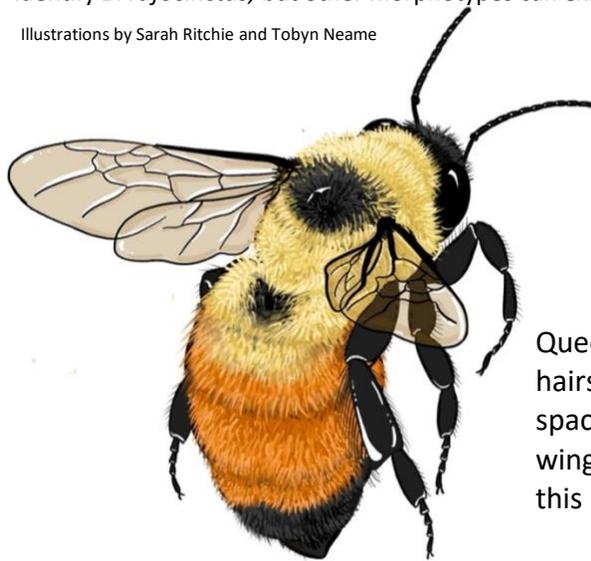
**Very Common** in Calgary

*Bombus rufocinctus* is a Müllerian mimic of almost every other bumble bee (basically it can have similar colour patterns to many other bees). The colour morphs of this bee do not seem to belong to particular geographic locations. Interestingly, even within colonies (of which all bees are genetically related) *Bombus rufocinctus* can have different colour morphs. *Bombus rufocinctus* is also by far the most common bumble bee that can be found in Calgary. That being said, there are a few key traits that make this bee stand out and with practice identifying *Bombus rufocinctus* can be done. Being the only member of the subgenus *Cullumanobombus* in this area means that *Bombus rufocinctus* has some traits not found in other bumble bees in Calgary, such as a shortened head length and a rounder abdomen. Males also have enlarged eyes, but not as large as the males of *Bombus nevadensis*.

### Identification of *Bombus rufocinctus*:

(the morphotypes shown here are the 7 most common within the bees collected and can be used directly to identify *B. rufocinctus*, but other morphotypes can exist and gradients between the morphotypes are common)

Illustrations by Sarah Ritchie and Tobyn Neame



Queens often have yellow hairs in their inter-alar space (between their wings), workers rarely have this



Face is black (sometimes some yellow hairs) while the top of the head is usually yellow

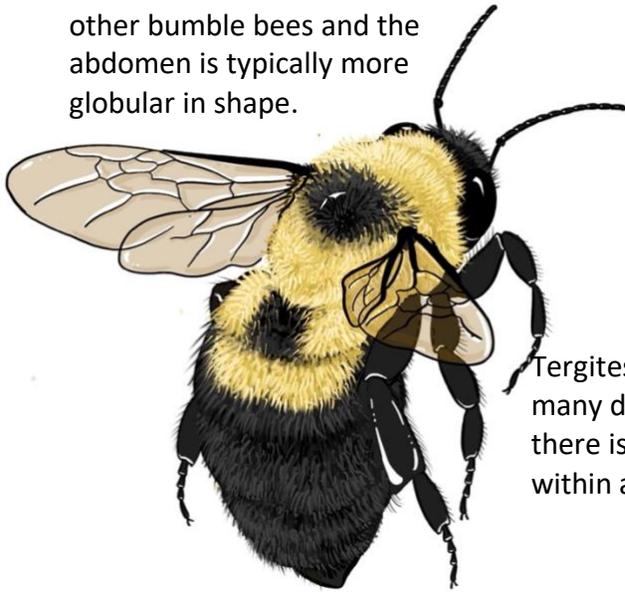


Tergite 1 is yellow and often (not always) has a bald patch in the centre of it

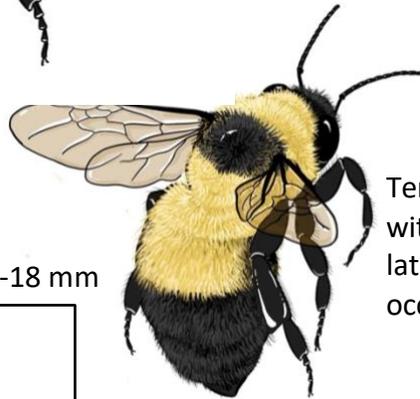


Illustrations by Sarah Ritchie and Tobyn Neame

The head is shorter than all other bumble bees and the abdomen is typically more globular in shape.



Tergites 2 through 5 can be many different colours and there is often colour mixing within a tergite

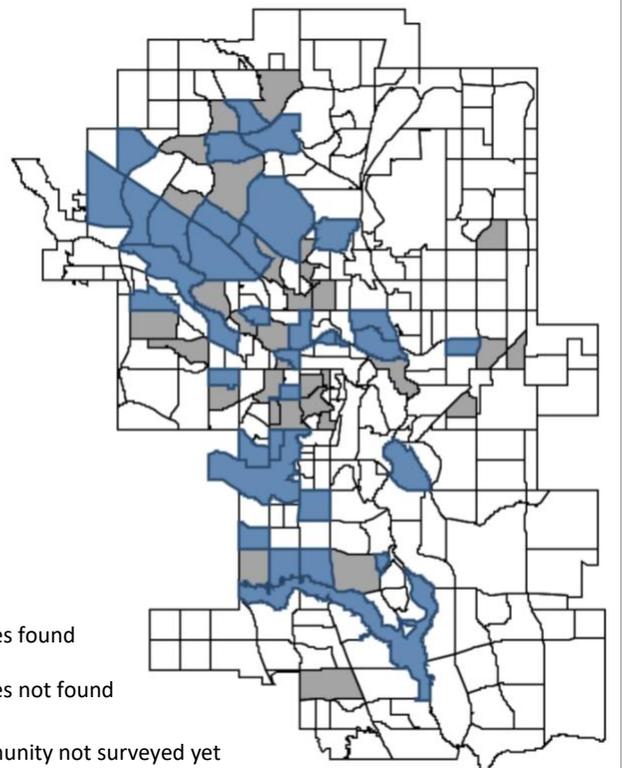


Tergite 2 often has a yellow crescent with black or orange posteriorly and laterally to varying extent (on rare occasions the crescent is orange)

Size: Worker 9-13 mm Queen 17-18 mm

**Known plant interactions:**

- Achillea millefolium* - Yarrow
- Aster* sp. - Asters
- Astragalus canadensis* - Canadian milkvetch
- Dalea purpurea* - Purple prairie clover
- Dasiphora fruticosa* - Shrubby cinquefoil
- Erigeron caespitosus* - Tufted fleabane
- Gaillardia aristata* - Common blanketflower
- Glycyrrhiza lepidota* - American licorice
- Hedysarum alpinum* - Alpine sweetvetch
- Helianthus petiolaris* - Prairie sunflower
- Heterotheca villosa* - Hairy goldenaster
- Hieracium umbellatum* - Narrow leaf hawkweed
- Lactuca tatarica* - Blue lettuce
- Linum lewisii* - Lewis flax
- Lupinus sericeus* - Silky lupine
- Melilotus albus* - White sweetclover
- Monarda fistulosa* - Wild bergamot
- Ratibida columnifera* - Upright prairie coneflower
- Rosa arkansana* - Prairie rose
- Rosa woodsii* - Interior rose
- Solidago altissima* - Late goldenrod
- Solidago gigantea* - Giant goldenrod
- Solidago lepida* - Western goldenrod
- Symphoricarpos* sp. - Snowberries
- Symphotrichum leave* - Smooth aster
- Vicia cracca* - Bird vetch



# **Bombus ternarius**

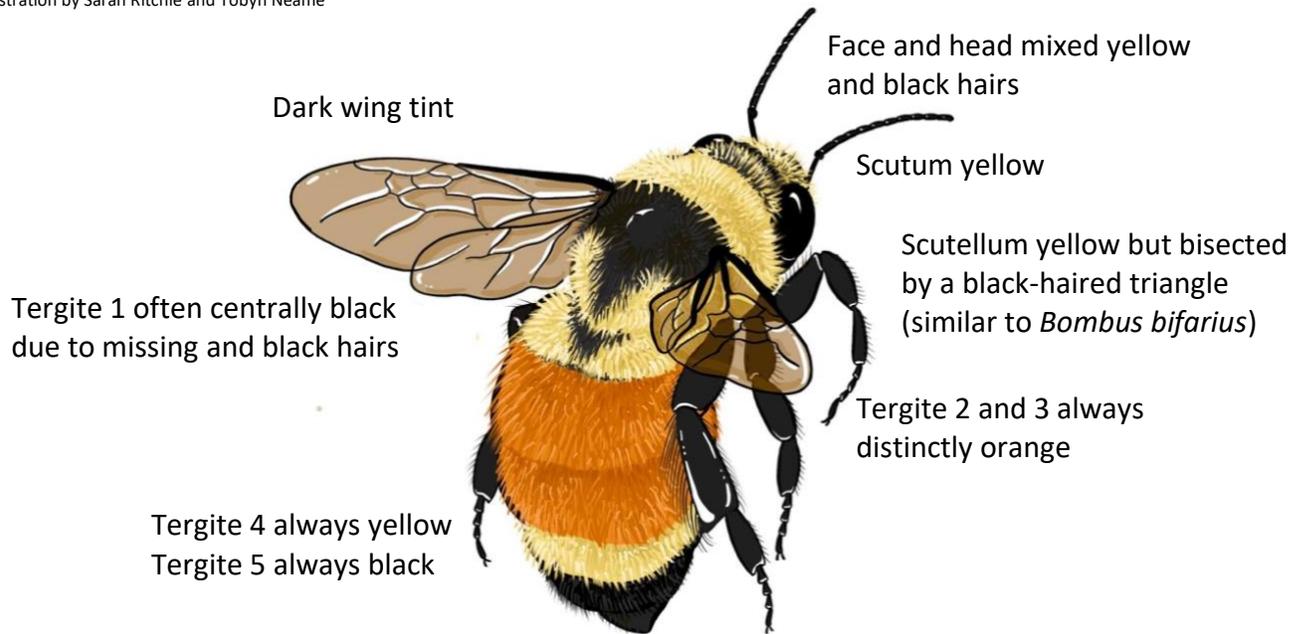
Common Name: Tri-Coloured bumble bee

Uncommon in Calgary

Compare this bee to *Bombus huntii*. You will find that *Bombus ternarius* has a complete black bisection across the scutellum that *Bombus huntii* never has. *Bombus ternarius* also has less yellow on the face and head and is typically found a little less than *Bombus huntii* in Calgary.

### Identification of *Bombus ternarius*:

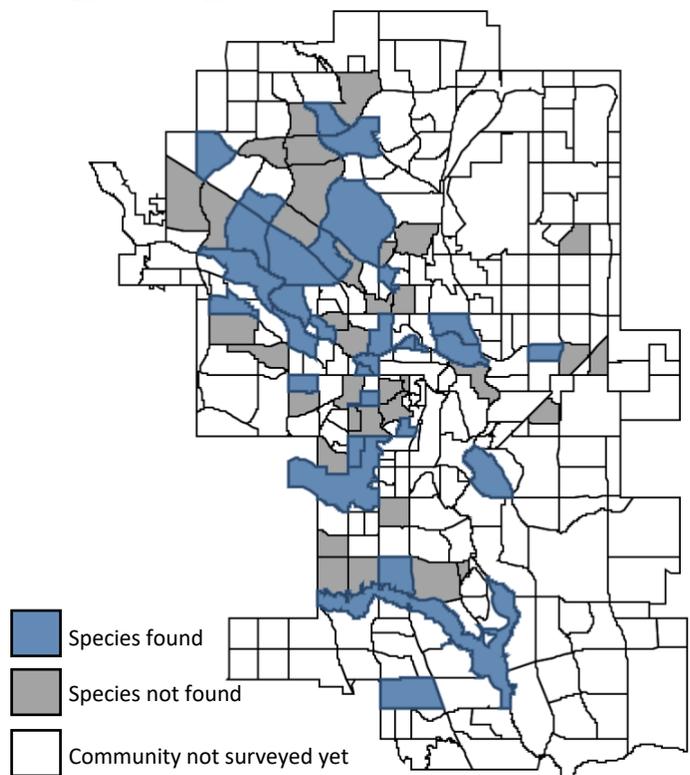
Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 9-13 mm Queen 17-20 mm

#### Known plant interactions:

- Solidago altissima* – Late goldenrod
- Solidago gigantea* – Giant goldenrod
- Solidago lepida* – Western goldenrod
- Solidago* sp. – Goldenrods
- Chamaenerion angustifolium* - Fireweed
- Hedysarum alpinum* – Alpine sweetvetch
- Dasiphora fruticosa* – Shrubby cinquefoil
- Symphotrichum leave* – Smooth aster
- Achillea millefolium* – Yarrow
- Dalea purpurea* – Purple prairie clover
- Salix* sp. – Willows
- Rosa acicularis.* – Prickly wild rose
- Rosa woodsii* – Interior rose
- Symphoricarpos occidentalis* – Western snowberry



## **Bombus vagans**

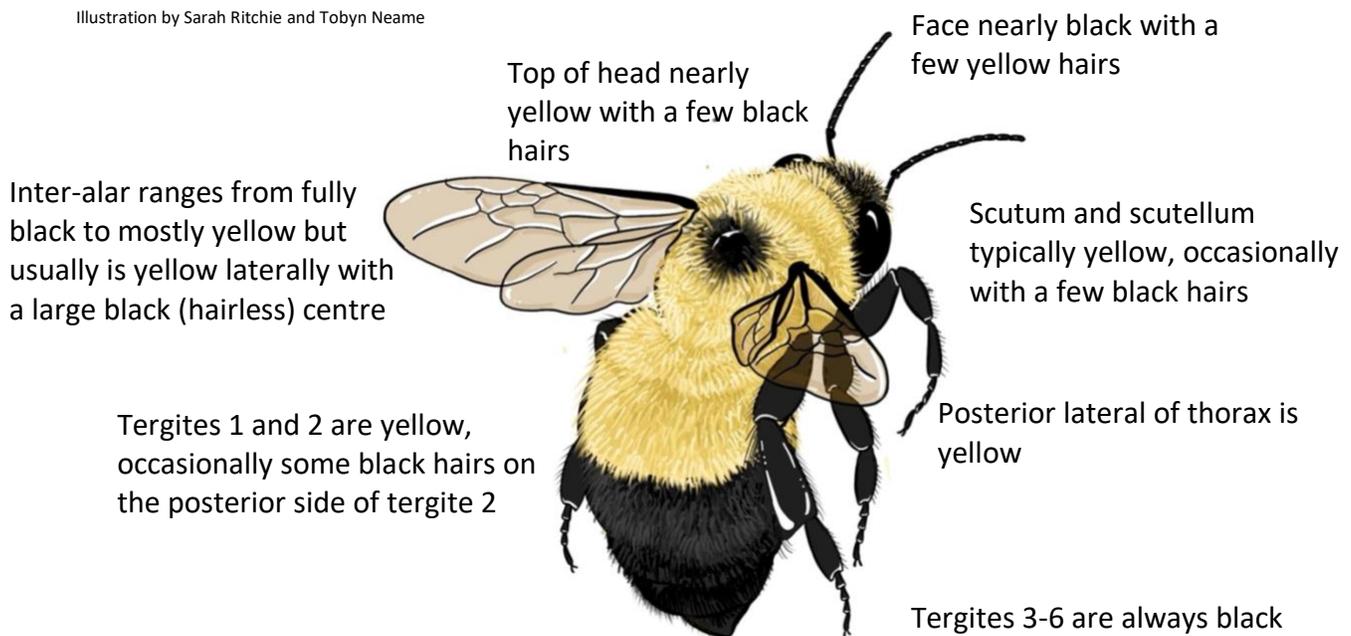
Common Name: Half-black bumble bee

**Uncommon** in Calgary

Compare *Bombus vagans* to *Bombus perplexus*. *Bombus vagans* has extensively more yellow hairs on the lateral (sides) and ventral (underside) portions of the thorax while *Bombus perplexus* has dense black hairs covering the ventral and lateral portions of the thorax.

### Identification of *Bombus vagans*:

Illustration by Sarah Ritchie and Tobyn Neame



Size: Worker 11-14 mm Queen 17-21 mm

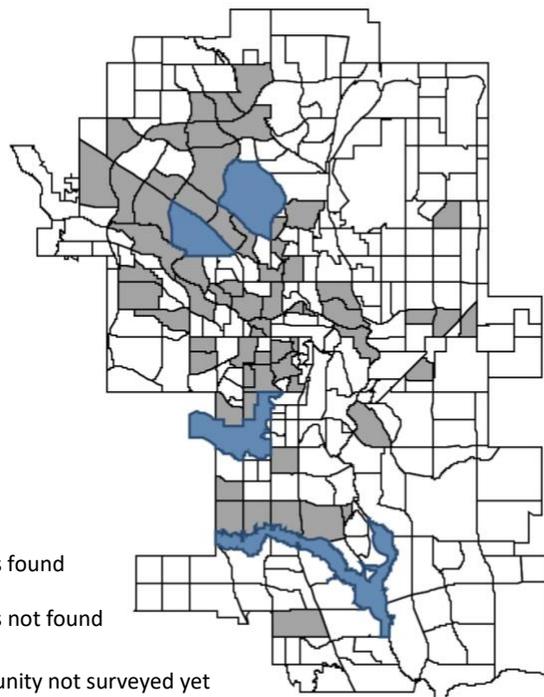
#### Known Plant Interactions:

*Hedysarum alpinum* – Alpine sweetvetch

*Dasiphora fruticosa* – Shrubby cinquefoil

*Symphyotrichum leave* – Smooth aster

*Hieracium umbellatum* – Narrowleaf hawkweed



## ***Bombus vancouverensis nearcticus* (*B. bifarius* s.l.)**

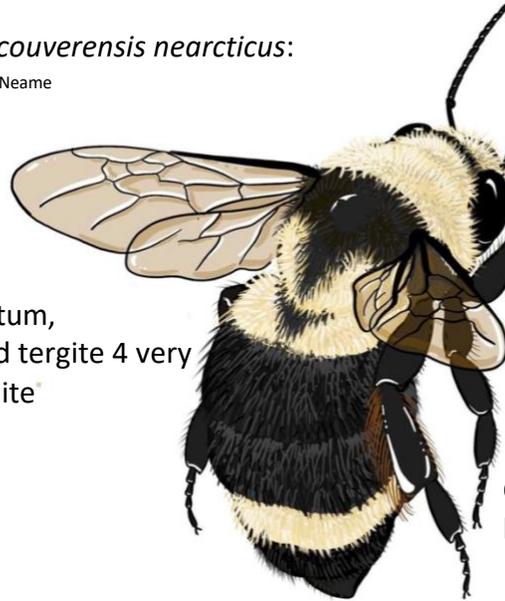
Common Name: Nearctic bumble bee

Uncommon in Calgary

Note about naming<sup>1</sup>: until January of 2020, *B. vancouverensis* was considered the same species as another bumble bee called *B. bifarius*. Recent genomic evidence shows that these are two different species, but it is nearly impossible to distinguish between the two species using physical traits. The two species can be distinguished by their geographic ranges, and it is most likely that the range of *B. bifarius* does not extend into Calgary or even Alberta. *B. vancouverensis* has two subspecies and *B. v. nearcticus* is the subspecies in Calgary.

Identification of *B. vancouverensis nearcticus*:

Illustration by Sarah Ritchie and Tobyn Neame



Hairs of face, head, scutum, scutellum, tergite 1, and tergite 4 very pale yellow or often white

Some intermixed black hairs on head and scutum can make these sections appear greyer

Scutellum bisected with black hairs

Tergite 1 often bisected with black hairs or lacking hairs in the centre of the tergite

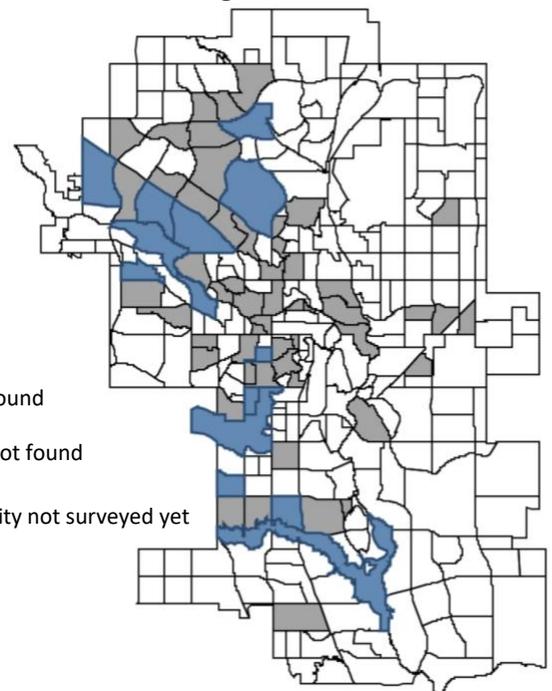
Corbicular fringe hairs dark brownish/orange

Hairs of the inter-alar space, tergite 2, tergite 3, and tergite 5 black

Size: Worker 8-14 mm; Queen 15-19 mm

### **Known plant interactions:**

*Chamaenerion angustifolium* – Fireweed  
*Solidago gigantea* – Giant goldenrod  
*Solidago* sp. – Goldenrods  
*Symphotrichum leave* - Smooth aster  
*Lactuca tatarica* – Blue lettuce  
*Dalea purpurea* – Purple prairie clover  
*Gaillardia aristate* – Common blanket flower  
*Dasiphora fruticosa* – Shrubby cinquefoil



1. Ghisbain, G. *et al.* Substantial genetic divergence and lack of recent gene flow support cryptic speciation in a colour polymorphic bumble bee (*Bombus bifarius*) species complex. *Syst. Entomol.* **45**, 635–652 (2020).

## **Very rare bumble bees in Calgary**

No specimens of these bees could be obtained to create an illustration of, but they have been recorded in the last four years here. They are unlikely to be encountered but it is still possible. If none of the illustrated species in this guide match one that you have found, then consider these species.

### ***Bombus melanopygus***

Common name: Black-tail bumble bee

Subgenus: *Pyrobombus*

Tergite 1 is yellow. Tergites 2-3 are orange with some black hairs in the center. Tergites 4-5 are varying mixes of yellow and black (typically darker). Face, head, and scutum all varying mixes of black and yellow hairs. Scutellum yellow and can have a partial black triangular bisection. Inter-alar is black but often forms a gradient of hairs into the scutum. Can have orange tipped corbicular fringes (scopa).

### ***Bombus fervidus***

Common name: Yellow bumble bee

Subgenus: *Thoracobombus*

Appears similar to the more common *Bombus borealis*. Unlike *Bombus borealis*, *Bombus fervidus* has a black face and top of head. Distal posterior corner of the midleg basitarsus acutely pointed (<45°) and with a narrow spine protruding out. Inter-alar band can appear very narrow due to encroaching yellow hairs, sometimes it is all yellow. Sides of the thorax are yellow. Tergites 1-4 yellow. Tergite 5 black.

## **Unobserved but possible bumble bees in Calgary**

These bees have not been definitively observed here in the last four years. It is still possible they will be observed in Calgary based on past observations and predicted ranges.

### ***Bombus flavidus***

Common name: Fernald cuckoo bumble bee

Subgenus: *Psithyrus*

Appears similar to the related *Bombus insularis* and *Bombus bohemicus*. *Bombus flavidus* has more extensive yellow on the abdomen than either of those. Tergite 4 is yellow with a small central anterior patch of black hairs. The face is black. The top of the head is yellow.

### ***Bombus suckleyi***

Common name: Suckley cuckoo bumble bee

Subgenus: *Psithyrus*

Appears similar to the related *Bombus insularis* and *Bombus bohemicus*. *Bombus suckleyi* has similar amounts of yellow on the abdomen as *Bombus insularis* but *Bombus suckleyi* has a black face and head.

***Bombus sylvicola***

Common name: Forest bumble bee

Subgenus: *Pyrobombus*

Appears similar to *Bombus huntii* and *Bombus ternarius* in pattern but has much longer hairs giving it a messy appearance. *Bombus sylvicola* does have a slight black hairless bisection on the scutellum (unlike *Bombus huntii*) but it does not extend the whole way to the posterior of the scutellum (unlike *Bombus ternarius* and *Bombus bifarius*)

***Bombus terricola***

Common name: Yellow banded bumble bee

Subgenus: *Bombus*

Appears like the related *Bombus cryptarum* but with no white on the abdomen and the yellow band larger and more extensive over the tergites. Listed by COSEWIC as special concern.

## Glossary of anatomy terms

- Abdomen** – the most **posterior** and largest of the three main body regions. Contains most of the internal organs.
- Antenna** – Sensory structure protruding from the head, every bee has two.
- Anterior** – Towards the head
- Basitarsus** – the largest and most **proximal** of the five **tarsomeres** in the **tarsus**
- Cheek** – Section of the **head**, **dorsal** to the **mandible** and **ventral** to the **compound eye**. Length of the cheek is measured from the bottom of the **compound eye** to the top of the **mandible**. Width of the cheek is measured from the **posterior** to the **anterior**.
- Compound eye** – the large main image forming eyes. Every bee has two. These are made of many smaller lenses.
- Corbicula** – the modified **hindleg tibia** of all female bumble bees that are not in the subgenus *Psithyrus* (parasitic cuckoo bumble bees). It is hairless except for the **scopa** that border it. Also called a "pollen basket" as it is used to carry pollen.
- Distal** – Away from the body (used when referring to parts that extend from the main body: legs, wings, etc.)
- Dorsal** – Towards the top of the back
- Face region** – the most **anterior** region of the body that hairs grow. Situated between the two **compound eyes**
- Femur** – the leg segment more **proximal** than the **tibia**
- Flagellomere** – singular for each of the 10 (or 11 in males) "segments" that make up the **flagellum**
- Flagellum** – The most **distal** 10 (or 11 in males) "segments" of the **antenna**. The most **distal** of the three true segments that make up the **antennae**
- Head** – Most **anterior** of the three main body segments. Contains most of the sensory structures and the mouth.
- Inter-alar** – The hair region between the bases of the wings. Only on the **dorsal thorax**, does not extend onto the **lateral thorax**. "Alar" refers to the wings, so "inter-alar" means between the wings.
- Lateral** – Towards the side
- Legs** – Every bee has two of each: **Foreleg** – The most **anterior** leg. **Midleg** --- the middle leg. **Hindleg** – the most **posterior** leg. All bees have segmented legs
- Mandible** - the most **lateral** of the mouthparts, used for grasping and "chewing". Borders the **cheek**
- Ocellus (plural: Ocelli)** – These are simple light and movement sensing eyes. Every bumble bee has three.
- Ovipositor** – not used for identification. Modified into a smooth (non-barbed) stinger with the ability to inject venom for female bumble bees.
- Posterior** – Towards the rear
- Proximal** – Towards the body (used when referring to parts that extend from the main body: legs, wings, etc.)
- Scutellum** – The most **posterior** of the three segments on the **thorax**

**Scutum** – The most **anterior** of the three segments on the **thorax**

**Tarsus** – The most **distal** sections of the leg made up of five **tarsomeres**

**Tergite** – a plate of the exoskeleton on the **dorsal** part of the body – technically the **scutum**, **inter-alar**, and **scutellum** are tergites, but this guide only refers to the **abdominal tergites**

**Thorax** – All six legs connect on the **ventral** portion of the thorax. The wings connect on the **dorsal** portion. The middle region of the three main body regions

**Tibia** – The leg segment between the **femur** and the **tarsus**.

**Top of the head region** – The most **posterior** part of the **dorsal** part of the **head** where hairs grow; also called the vertex

**Ventral** – Towards the underside of the body

**Wings** – every bee has four membranous wings attached to **dorsal** part of the **thorax**

## **Further Resources**

Key resources indicated in bold

### **Books**

**Bumble Bees of North America: An identification guide** by Paul Williams, Robbin Thorp, Leif Richardson, & Sheila Colla

The Bees in Your Backyard: A guide to North America's bees by Joseph S. Wilson & Olivia Messinger Carril

### **Websites**

Alberta Native Bee Council: <https://www.albertanativebeecouncil.ca/>

Bee City Canada: <https://beecitycanada.org/>

BugGuide: <https://www.bugguide.net/>

**Bumble Bee Watch:** <https://www.bumblebeewatch.org/>

City of Calgary Bee A Polli-Neighbour: <https://www.calgary.ca/csps/parks/planning-and-operations/bee-a-polli-neighbour.html>

COSEWIC: <https://www.cosewic.ca/>

Exotic Bee ID: <https://idtools.org/id/bees/exotic/>

iNaturalist: <https://www.inaturalist.org/>

Native Bee Society of British Columbia: <https://www.bcnativebees.org/>

NatureLynx: <https://naturelynx.ca/>

Oregon Bee Atlas: <https://www.oregonbeeproject.org/bee-atlas>

Pacific Northwest Bumble Bee Atlas: <https://www.pnwbumblebeeatlas.org/>

**Pollinator Partnership Canada:** <https://www.pollinatorpartnership.ca/>

Pollinator Partnership USA: <https://www.pollinator.org/>

**University of Calgary Biodiversity Collections:** <https://biodiversity.ucalgary.ca/>

University of Calgary Sustainability: Bee Campus:  
<https://www.ucalgary.ca/sustainability/our-sustainable-campus/bee-campus>

**Wild Bee ID:** <https://www.wildbeeid.org/>

**Xerces Society for Invertebrate Conservation:** <https://www.xerces.org/>

## **References**

- Barua, M., Gurdak, D. J., Ahmed, R. A. & Tamuly, J. Selecting flagships for invertebrate conservation. *Biodivers. Conserv.* **21**, 1457–1476 (2012).
- Bauer, P. J. Bumblebee pollination relationships on the Beartooth Plateau tundra of southern Montana. *Am. J. Bot.* **70**, 134–144 (1983).
- Bowers, M. A. Bumble bee colonization, extinction, and reproduction in subalpine meadows in northeastern Utah. *Ecology* **66**, 914–927 (1985).
- COSEWIC. COSEWIC assessment and status report on the gypsy cuckoo bumble bee *Bombus bohemicus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa (2014)
- COSEWIC. COSEWIC assessment and status report on the western bumble bee *Bombus occidentalis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa (2014)
- COSEWIC. COSEWIC assessment and status report on the yellow banded bumble bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa (2015)
- Environment and Natural Resources. *A Field Guide to Bumble Bees of the Northwest Territories*. (Government of the Northwest Territories, 2017)
- GBIF.org. GBIF Occurrence Download Accessed 9 April 2021  
<https://doi.org/10.15468/dl.gfgwam> (used in conjunction with non-research-grade data from iNaturalist)
- Ghisbain, G. *et al.* Substantial genetic divergence and lack of recent gene flow support cryptic speciation in a colour polymorphic bumble bee (*Bombus bifarius*) species complex. *Syst. Entomol.* **45**, 635–652 (2020).
- Goulson, D. *Bumblebees: their behaviour and ecology*. (Oxford University Press, 2003).
- Grixti, J. C., Wong, L. T., Cameron, S. A. & Favret, C. Decline of bumble bees (*Bombus*) in the North American Midwest. *Biol. Conserv.* **142**, 75–84 (2009).
- Heinrich, B. *Bumblebee Economics: with a new preface*. (Harvard University Press, 2004).
- Kerr, J. T. *et al.* Climate change impacts on bumblebees converge across continents. *Science* (80) **349**, 177–180 (2015).

- Owen, R. E. & Plowright, R. C. Inheritance of metasomal pile colour variation in the bumble bee *Bombus rufocinctus* Cresson (Hymenoptera: Apidae). *Can. J. Zool.* **66**, 1172–1178 (1988).
- Packer, L., Genaro, J. A. & Sheffield, C. S. The Bee Genera of Eastern Canada. *Can. J. Arthropod Identif.* (2007)
- Williams, P., Thorp, R., Richardson, L. & Colla, S. *Bumble Bees of North America: An Identification Guide*. (Princeton University Press, 2014).
- Wilson, J. & Messinger Carril, O. *The bees in your backyard: A guide to North America's bees*. (Princeton University Press, 2015).