# A Beginner's Field Guide to Identifying Bees

**Lisa Mason[1], Brooke Sayre-Chavez[2], Colton O'Brien[3], and Arathi Seshadri[4]**

COLORADO STATE UNIVERSITY EXTENSION

USDA United States Department of Agriculture
Natural Resources Conservation Service

USDA United States Department of Agriculture
Agricultural Research Service

[1]Colorado State University Extension, Centennial, CO 80112; [2]Department of Soil and Crop Sciences; [3]Agricultural Biology Department, Colorado State University. Fort Collins CO 80525; [4]USDA ARS/WRRC Invasive Species and Pollinator Research Health Unit, Albany, CA

# Acknowledgments

Special thanks to Deryn Davidson, John Murgel, Andrew Miller, and Dr. Mike Eckhoff for reviewing this field guide.

We also thank the USDA NRCS Conservation Innovation Grant #69-3A75-16-002 for partial funding to complete this project.

Front cover photo: Lisa Mason
Published February 2022



## Contact Information

Lisa Mason
Horticulture Agent
Lisa.Mason@colostate.edu
Colorado State University Extension

Dr. Arathi Seshadri
Research Entomologist
Arathi.Seshadri@usda.gov
Invasive Species & Pollinator Health Research Unit
USDA/ARS/WRRC

## For More Information

To learn more about native bees in Colorado or to get involved in the Native Bee Watch Community Science Program, please visit: NativeBeeWatch.org.

Refer to the complementary publication, *Native Bee Watch: A Colorado Citizen Science Field Guide*, on the website.



# Table of Contents

# Introduction

Pollinators are critical for plant survival in ecosystems around the world. Over 75% of plants rely on pollinators for reproduction. In addition, pollinators provide people with a variety of ecosystem services including: 1) nutritious foods, such as fruits, vegetables, and nuts, representing approximately 1/3rd of the human diet; 2) raw materials, including fibers, lumber, oils; 3) recreational, aesthetic, and cultural values; and 4) economic benefits for a variety of industries, such as livestock and farming. The global production of crops that depend on pollinators is worth up to $577 billion annually (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2016).

Pollinators are facing a variety of challenges including:

- Habitat and nutrition loss due to urbanization and increased agricultural activities,
- Pesticide and chemical use,
- Parasites and disease, and
- Climate change.

Figure 1. A sweat bee, *Halictus* sp. visiting a Cosmos flower. Photo: Lisa Mason

Pollinators include: bees, butterflies, bats, beetles, birds, flies, moths, small mammals, and reptiles. Bees are among the most efficient pollinators due to the hairs on their body that collect pollen grains, which are transferred to other flowers while the bee is foraging for pollen and nectar. Bees depend on pollen for feeding larvae.



In Colorado, over 900 species of bees have been documented. To raise awareness and provide education, this field guide shares some of the most common genera of bees observed along the Colorado Front Range and the Eastern Plains. Many of the genera presented in this guide can be found in other locations in the US.

Genera were selected based on specimens commonly collected and observed in research projects under Dr. Arathi Seshadri at Colorado State University between 2015 and 2019 (Mason and Arathi, 2019; O'Brien and Arathi, 2021; O'Brien and Arathi, 2019; O'Brien and Arathi, 2018).

# How to Use this Guide

## Taxonomy Basics

All organisms are classified into different categories based on common characteristics. Organisms are grouped at a broad level; for instance, "kingdom" includes categories such as: plants, animals, fungi, and more. All subsequent categories focus on finer-level categories of characteristics. For example, the phylum level separates humans from insects and other arthropods. Humans are part of the phylum Chordata, the group of organisms that possess a notochord (better known as a spinal cord in vertebrates). Mammals, birds, reptiles, amphibians, tunicates (sea squirts), and lancelets are examples of organisms with a notochord.

Invertebrates, including insects, arachnids, crustaceans, myriapods, and others, fall under the phylum Arthropoda. These animals are defined as having an exoskeleton, a segmented body, and paired, jointed appendages. Under Arthropoda, organisms are divided into sub-phyla and classes. Insects are grouped into a class called Insecta. All organisms in this category have six legs, three body segments, antennae, and compound eyes. Spiders are in the class Arachnida, having eight legs and two body segments among other shared characteristics. Millipedes and centipedes fall into the class Myriapoda, having many body segments and each body segment has one or two pairs of legs.


Figure 2. Examples of sub-phylum groups under the phylum, Arthropoda. Graphics: Pixabay

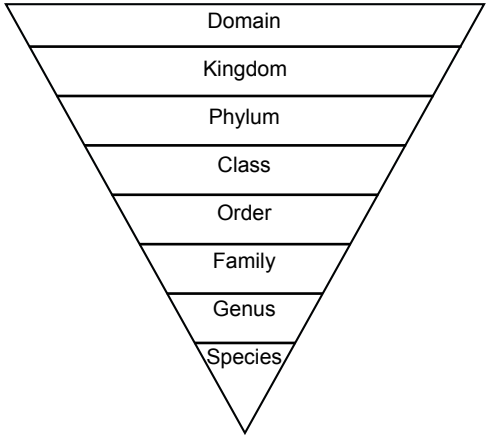
Within a class, organisms are grouped by order. Entomologists use insect orders as a base level of identification. Over 30 orders of insects are recognized, which is still evolving based on new scientific research. Some examples of insect orders include:

- Lepidoptera – butterflies and moths, distinguished as having scales on their bodies and wings,
- Coleoptera – beetles, distinguished as having the front pair of wings hardened,
- Diptera – flies, distinguished as having only one pair of wings, and
- Hymenoptera – bees, wasps, and ants, distinguished as having a special ovipositor for egg-laying; in some species, it is modified into a stinger.


Figure 3. Select insect orders. Photos: Lisa Mason (left), Eric Eaton (middle two), Heidi Eaton (right).

Within each order, insects (and other organisms) are further grouped into families, subfamilies, tribes, genera, and other groups. See Figure 4 for a list of all taxonomic categories from a broad-level to a species-level scale. To assist beginners in bee identification, this field guide will organize bees according to family and genus only. Common names will be included when possible, but not all bees have common names. See Appendix A for the specific taxonomic classification of each bee genera.

Figure 4. Taxonomic levels and a comparison of how a human (*Homo sapiens*) is classified versus the European honey bee (*Apis mellifera*). Note that in this field guide bees we classify bees by family and genus level.




| Human | Honey Bee |
|---|---|
| Domain: Eukaryote | Domain: Eukaryote |
| Kingdom: Animalia | Kingdom: Animalia |
| Phylum: Chordata | Phylum: Arthropoda |
| Class: Mammalia | Class: Insecta |
| Order: Primates | Order: Hymenoptera |
| Family: Hominidae | Family: Apidae |
| Genus: *Homo* | Genus: *Apis* |
| Species: *Homo sapiens* | Species: *Apis mellifera* |



## Why Not Identify Bees to a Species Level?

Many traits that distinguish bees at different taxonomic levels are microscopic and requires inspection of a physical specimen under magnification. They cannot be observed with just the human eye or even with the latest cell phone camera. A microscope and a high-level of taxonomic expertise is needed to identify bees to a species level; therefore, we organize the field guide by bee families and genera. Most of the family-level characteristics are also microscopic-level traits. Genus-level identifications are possible for genera that have distinguishing characteristics visible to the human eye. Note that some genera described in this field guide will be difficult or impossible to identify through observations only. The purpose of this field guide is to learn about the different genera of bees pollinating flowers without a need to catch the specimen and use a microscope.

Figure 5. A *Lasioglossum* sp. can range 0.1-0.4 inches or 3-10 mm. Photo: David Cappaert, Bugwood.org

The photos used are examples of bees that represent each genus. Keep in mind that within each genus, a number of species could look markedly different than the representative photos.

## Scientific Classification vs. Common Names

The most accurate way to name or refer to a type of organism is by using the genera or, when applicable, scientific name. We include the common names of bee genera in this field guide when possible, but notice that many bee genera have the same common name, and some do not have a common name at all.

## Native, Non-Native, and Managed Bees

For the purposes of identification and learning about bees, native, non-native, and managed bees are encompassed in this field guide. The most common managed species observed is the non-native honey bee (*Apis mellifera*) (see Fig. 6). Introduced to the United States in the early 1600s, the honey bee plays a critical role in crop pollination. *Bombus impatiens* is a non-native, managed bumble bee species that pollinates the majority of greenhouse crops, including tomatoes, and they also pollinate field crops such as blueberries and other crops that require buzz pollination.

Other managed bees include some species of *Megachile* and *Osmia*. For instance, the alfalfa bee (*Megachile rotundata*) is a managed species used to pollinate alfalfa plants, a food source for cattle. A common example of an unmanaged, non-native bee is the European Wool Carder bee (*Anthidium manticatum*); females harvest fuzz from plant leaves to line their nest cavities. They are often observed on lamb's ear (*Stachys byzantina*) (see Fig. 7). Most of the other commonly observed bees are native to Colorado. Native bees play a critical role in providing pollination services to wild plants and for human benefit.

Figure 6. Honey bees (*Apis mellifera*) on hive frames. Photo: Lisa Mason

Figure 7. A European wool carder bee (*Anthidium manticatum*). Photo: Lisa Mason

## Definitions

**Buzz pollination** is a pollination technique used by some bee species like bumble bees (*Bombus* spp.). They vibrate their wing muscles to release pollen from the anthers of certain plants, creating a loud "buzz."

**Cavity-nesting bees** lay eggs in holes tunneled in dead wood or create nesting chambers in hollow stems. Some species, such as leafcutter (Fig. 8) and mason bees, use existing cracks in bricks, wood, and other materials.

Figure 8. Leafcutter bees (*Megachile* sp.) building nests in a homemade bee block. Photo: Eric Eaton

Figure 9. Clypeus on a male *Bombus huntii*. Photo: USGS Bee Monitoring and Inventory Lab

They also nest in homemade wood blocks and cardboard tubes. Most cavity-nesting bees are solitary. Honey bees are not solitary, but they can be considered cavity-nesting bees because they build hives in cavities such as hollow tree trunks.

**Cleptoparasites** lay their eggs inside nests constructed by other bee species. Larvae of cleptoparasite bees feed on pollen collected by the host bee. Cleptoparasitic bees and larvae exhibit morphological and behavioral adaptations. They do not forage for pollen and nectar, nor do they have special pollen-collecting mechanisms (see Social Parasitism).

**Clypeus** refers to the plate on the lower part of an arthropod's face (see Fig. 9).



Figure 10a. A corbicula on a bumble bee (*Bombus huntii*). Photo: Lisa Mason

Figure 10b. Scopa on the hind leg of a *Melissodes* sp. bee. Photo: Diane Wilson

**Communal nesting** is when a group of female bees use a single nest to lay eggs. Each female builds her own nest cells where she lays eggs and adds provisions for the developing larvae. Bees in these communal nests do not interact with each other. Mutual tolerance is the behavioral feature that defines communal nesting.

**Corbicula (Corbiculae pl.)** refers to the "pollen basket", a part of the hind legs of some bee species such as bumble bees and honey bees. Corbiculae are used to harvest and carry pollen from flowers to the nest or hive. Other bees have scopae (see Figs. 10a and 10b).

**Eusocial or Eusociality** refers to the highest level of social organization. Eusocial animals are defined by the following characteristics: (i) cooperative brood care (care of offspring from other individuals in the nest), (ii) overlapping generations i.e., adults from different

generations (e.g., mother, daughter, grand-daughter) live together in the same colony and working for the colony, and (iii) reproductive division of labor i.e., clearly defined reproductive and non-reproductive groups (e.g., individuals that reproduce [queens and kings] and those that do not reproduce [workers]). Eusociality is seen in certain insects (ants, bees, wasps, and termites), crustaceans (shrimp), and mammals (naked mole rats).

**Genus (Genera pl.)** in the taxonomic classification is the level just above species and below family. In binomial nomenclature or scientific name, the genus name forms the first part of the binomial. The species name within the genus, also known as the epithet, forms the second part. For example, with *Apis mellifera*, the genus is *Apis,* and the epithet is *mellifera*. See Figure 4.

Figure 11. A *Colletes* sp. bee nest. Photo: MaLisa Spring

Figure 12. A underground burrow of a *Diadasia* sp. bee. Photo: Bill Maynard



**Ground-nesting bees** are solitary bees that live underground in nests burrowed by the female bee where she lays her eggs. The brood overwinter and emerge the following season. The entrances to the nests may be small holes and piles of bare soil. They are usually difficult to spot. See Figs. 11 and 12.

**Integument** is the exoskeleton or protective covering of an insect.

**Mesolectic** refers to bee species that collect pollen from a few plant families or tribes (Cane and Sipes, 2006). They are also referred to as specialists.

**Monolectic** refers to bee species that collect pollen from the flowers of one plant species. They are also referred to as specialists.

**Nesting habits** refer to the preferred nesting behavior of bees, including ground-nesting or cavity-nesting.

**Oligolectic** refers to bee species that collect pollen from one plant genus (Cane and Sipes, 2006).

**Pollination** is the act of transferring pollen grains from the anther (male part) to the stigma (female part) of a flower of the same species. Pollination is the first step for plant reproduction, leading to the development of seeds and fruits. See Figure 13.

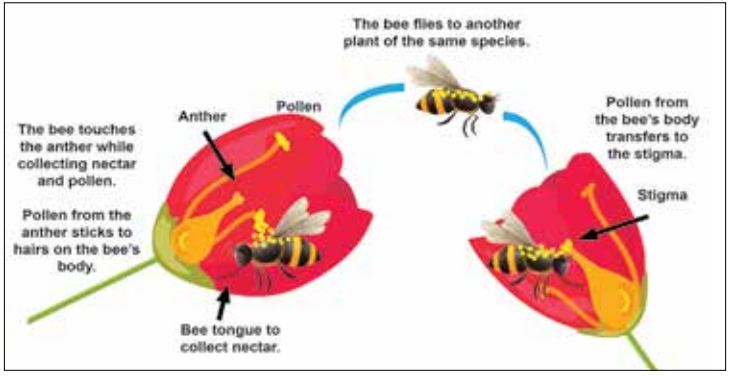



Figure 13. The pollination process. Graphic: Lisa Mason

**Polylectic** refers to bee species that collect pollen from the flowers of several different plant species in multiple families. They are also referred to as generalists.

**Primitively eusocial** refers to insects that nest in colonies where all females are similar in external features. There may be just one or a few reproductive females while others work for the colony. Reproductive castes differ from the others as they have developed ovaries and behavioral features of a queen. Primitively eusocial bees and wasps do not swarm.

**Scientific name** is a name unique to each organism on this planet. It consists of the genus name followed by the epithet (name of the organism). For example, "honey bee"



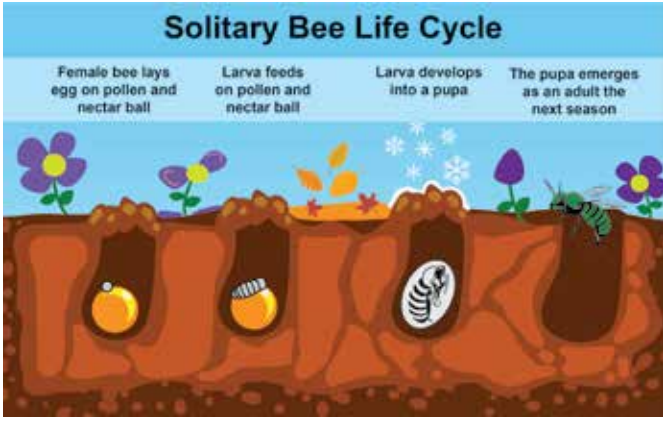



Figure 14. The solitary bee life cycle. Graphic: Lisa Mason

is a common name, while "*Apis mellifera*" is its scientific name. Human is our common name but our scientific name is *Homo sapiens*. In written text, scientific names are represented in italics or underlined. See Figure 4.

**Sociality** is when individuals tend to form social groups or cooperative societies; for bees, these groups are also known as colonies. Members of the group work together to raise the young, gather and store food, and build and defend the nest, hive, or colony.

**Solitary** is when a female bee builds her nest. The brood overwinter and emerge the following season. Solitary bees typically have a one-year lifecycle.

**Scopa (Scopae pl.)** refers to the groups of hairs on the body of some bees that help in pollen collection and transport from flowers to the nest. See Fig. 10b.

**Social parasitism** refers to the process of a parasite insect invading a host colony of a social insect. She kills the queen and lays her own eggs. The host worker insects raise the offspring (see Cleptoparasites).

## Identifying a Bee

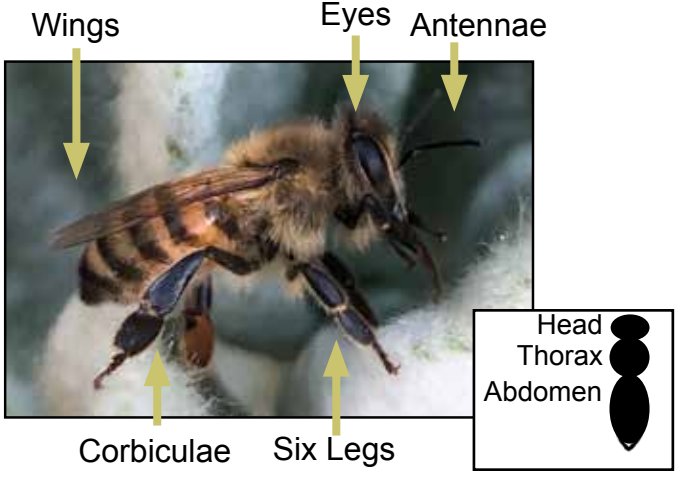



Figure 15. Left: Anatomy of a honey bee (*Apis mellifera*). Photo: Lisa Mason, Right: The three main body parts of insects. Graphic: Laurel Trevino



Bees have the following characteristics (see Fig. 15):

**Four Wings -** Two pairs, sometimes difficult to see; hind wings are often small; wings are often held along side the body, crossed over the body, or at a 45-degree angle

**Hair -** Most have hairy bodies for carrying pollen

**Eyes -** Large, well-separated on top of head

**Antennae -** Long, segmented, and often bent

**Corbiculae -** Many bees have flattened plates used as pollen baskets on hind legs (e.g. honey bees (*Apis mellifera*) and bumble bees (*Bombus* spp.)

**Scopae -** Pollen-carrying hairs usually on the hind legs or the underside of the abdomen, often covered with pollen

**Body Shape -** Rounder bodies than wasps and flies

**Size -** 2 to 25 mm (less than 1/8th inch to 1 inch) or more

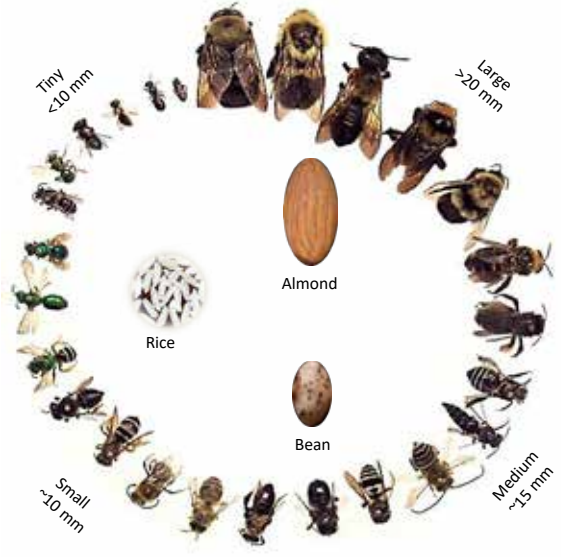
**Body Color -** Can be black, brown, orange, yellow, red, metallic blue or green, or copper-colored

**Stripes -** Body color (exoskeleton) or hair colors (yellow, orange, white, black, or brown) can form stripes

# Bee Sizes

Bees vary in size, and knowing the approximate size can help you identify the bee. Figure 16 outlines bees into four sizes categories.

**Tiny**: Less than 10 mm (0.39 inches)
**Small:** 10-15mm (0.39-0.59 inches)
**Medium:** 15-20mm (0.59-0.79 inches)
**Large:** 20mm or more (.79 inches)




bee ring © T'ai H. Roulston
www.virginia.edu/blandv

page © Laurel Treviño M.
https://w3.biosci.utexas.edu/iha

Figure 16. Bee size categories.



# Bee Body Forms

Bees have different body shapes that have been characterized into general body forms. While the forms are subjective, they can be another tool to help with bee identification (Michener, 2007).

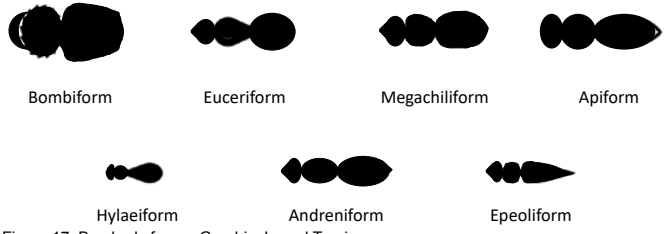



Figure 17. Bee body forms. Graphic: Laurel Trevino

Table 1. Bee body forms and associated genera.

| Bee Form | Genus | Page # |
|---|---|---|
| Andreniform | *Agapostemon* | 74 |
| Andreniform | *Andrena* | 26 |
| Andreniform | *Augochloropsis* | 78 |
| Andreniform | *Augochorella* | 76 |
| Andreniform | *Colletes* | 70 |
| Andreniform | *Halictus* | 82 |
| Andreniform | *Lasioglossum* | 84 |
| Andreniform | *Nomia* | 86 |
| Apiform | *Apis* | 42 |
| Apiform | *Peponapis* | 62 |
| Apiform | *Xenoglossa* | 68 |
| Bombiform | *Bombus* | 44 |
| Epeoliform | *Coelioxys* | 94 |
| Epeoliform | *Epeolus* | 50 |
| Epeoliform | *Triepeolus* | 66 |
| Euceriform | *Eucera* | 52 |
| Euceriform | *Diadasia* | 48 |
| Euceriform | *Melissodes* | 58 |
| Euceriform | *Svastra* | 64 |
| Hylaeiform | *Hylaeus* | 72 |
| Megachiliform | *Anthidiellum* | 90 |
| Megachiliform | *Anthidium* | 92 |
| Megachiliform | *Dianthidium* | 96 |
| Megachiliform | *Lithurgopsis* | 102 |
| Megachiliform | *Megachile* | 104 |

# Wasp Identification

Bees, wasps, and flies look very similar. The first step to bee identification is distinguishing them from wasps and flies.

Wasps belong to the insect order Hymenoptera that also includes bees, ants, and sawflies. They are defined by having four wings, and the females have an ovipositor for laying eggs. In some cases, the ovipositor in wasps has been modified into a stinger. Wasp species can be social, solitary, or parasitoid. Wasp characteristics include:

- Narrower bodies than bees, and not distinctly hairy
- Two pairs (four) of wings, often longer than bees
- Many have a pinched abdomen known as a “wasp waist”
- Often distinct black, yellow, or white color patterns on the exoskeleton
- Do not carry pollen loads

Figure 18. A European paper wasp (*Polistes dominula*). Photo: Lisa Mason

Figure 19. A black and yellow mud dauber (*Sceliphron caementarium*). Photo: Lisa Mason

Figure 20. A female sawfly (*Cimbex americana*). Photo: Eric Eaton

Figure 21. A pollen wasp (*Pseudomasaris vespoides*). Photo: Eric Eaton

Figure 22. A Scoliid wasp (*Dielis pilipes*). Photo: Eric Eaton

Figure 23. A Scoliid wasp (*Scolia dubia*). Photo: Eric Eaton



# Fly Identification

Flies belong to the insect order Diptera. Flies are defined by having only one pair of wings. The second pair of wings evolved into halteres, which are a sensory organ to help the insect with movement in flight. Some flies mimic the appearance of bees and wasps to protect themselves from predators. The colors and patterns appear as a stinging insect, which sends predators a warning. This is known as Batesian mimicry. Fly characteristics include:

- One pair (two) of wings
- Short, thick antennae, usually with three segments
- Large eyes near the front of their head
- Usually not hairy (there are exceptions)
- Flies can hover (most bees cannot)
- Do not carry pollen loads

Figure 24. A robber fly (*Laphria fernaldi*). Photo: Eric Eaton

Figure 25. A soldier fly (*Stratiomyidae*). Photo: Eric Eaton

Figure 26. A syrphid fly (*Eristalis tenax*). Photo: Eric Eaton

Figure 27. A syrphid fly (*Eristalis flavipes*). Photo: Eric Eaton

Figure 28. A bee fly (Family: Bombyliidae). Photo: Lisa Mason

Figure 29. A bee fly (*Villa* sp.). Photo: Eric Eaton

# Bee Families

Note: The characteristics that categorize bees into families are seen under a microscope. Often bees are easier to identify by the genus.

## Andrenidae

Figure 30. A mining bee (*Andrena* sp.). Photo: Lori Nixon

- Ground nesting
- All females create waterproof nests
- The largest bee family with more than 4,500 species
- Found on all continents except Antarctica and Australia

## Apidae

Figure 31. A bumble bee (*Bombus* sp.). Photo: Carol English

- Ground, cavity, and tunnel nesting
- The most economically important group of bees due to honey and bumble bees providing crop pollination
- Found worldwide except for Antarctica

## Colletidae

Figure 32. A cellophane bee (*Colletes* sp.). Photo: Bill Maynard

- Ground nesting and others nest in hollow stems
- Diverse family of bees including some that lack hair on their body and some that carry pollen internally
- Found on all continents except for Antarctica

## Halictidae

Figure 33. A green metallic sweat bee (*Agapostemon* sp.) Photo: Carol English

- Mostly ground nesting, including communal nesting
- Diverse social behaviors from eusocial to solitary
- One of the most abundant group of bees
- Found worldwide except for Antarctica

## Megachilidae

Figure 34. A mason bee (*Osmia* sp.). Photo: Carol English

- Cavity nesting bees; some make their own nest while others may use preexisting tunnels
- All females have scopae underneath their abdomens
- Found worldwide except for Antarctica

Figure 35. Clockwise starting top left: 1) *Andrena* sp. Photo: Lisa Mason, 2) *Andrena prunorum* Photo: Bill Maynard, 3) *Andrena helianthi* Photo: Diane Wilson, 4) *Andrena* sp. Photo: Eric Eaton



## *Andrena* spp. — Mining Bees

**SIZE:** Tiny to medium, 7-18 mm

**ID TIPS:** Head and thorax integument is black with lighter colored hairs usually white, gray, or brown. Hairs may be dense on thorax. Abdomen has black integument, but species such as *Andrena prunorum* have red-orange colors on abdomen. Many species have pale-colored hair bands. Females have facial fovea, or pale-colored, vertical hairlines on face. Males also have hairs on face, and it is usually denser on the lower face giving them a “beard.” The facial hairs are unique to *Andrena*.

**POLLEN-CARRYING METHOD:** Large scopae on hind legs, back sides of thorax, and the joint between legs and thorax

**NESTING:** Ground nesters

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Polylectic, mesolectic, oligolectic

**SIMILAR LOOKING BEES:** *Halictus* spp., *Colletes* spp., *Melissodes* spp.

Figure 36. Facial fovea, or vertical hairlines on a female. Photo: Eric Eaton

**ADDITIONAL NOTES:**

- Common worldwide with 144 species found in Colorado.
- Early to emerge in the spring, often when temperatures are cooler than what most bees can withstand.
- *Andrena prunorum* are efficient pollinators of wild and cultivated onions (*Allium* spp.).

Figure 37. Clockwise starting top left: 1) *Calliopsis zebrata,* male. Photo: Eric Eaton, 2) *Calliopsis* sp. female. Photo: Eric Eaton, 3) *Calliopsis* sp. male Photo: Eric Eaton, 4) *Calliopsis* sp. Photo: Bill Maynard



## *Calliopsis* spp.

**Mining Bees**

**SIZE:** Tiny, 7-9 mm

**ID TIPS:** Face is wider than long. Integument of the thorax sometimes appears shiny. Abdomen appears striped with pale-colored hair bands. Eyes are usually a light color, sometimes greenish. The legs and lower face of male bees are a bright yellow color. Clypeus sticks outwards from a profile view, and females have three linear and parallel yellow markings on face below antennae. Both of these characteristics may not be visible without a microscope.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary

**FORAGING HABITS:** Mesolectic, oligolectic

**SIMILAR LOOKING BEES:** *Halictus* spp., *Perdita* spp.

**ADDITIONAL NOTES:**

- Found in the western hemisphere with 11 species in Colorado.
- They nest in compacted soils and often specialize on the flowers that grow nearby, including plants in the pea family (Fabaceae), spurges (Euphorbiaceae), sunflowers (Asteraceae), and *Verbena* spp.
- Common in dry climates. If drought occurs, some species can wait to emerge when more flowers are present.
- The female waterproofs the nest cell and the pollen and nectar balls to protect her young while in the nest.

Figure 38. Clockwise starting top left: 1) *Macrotera opuntiae*, female. 2) *Macrotera opuntiae*, male. 3) *Macrotera opuntiae*, female. All photos: Casey Delphia (Delphia and Griswold, 2021). 



## *Macrotera* spp. Sandstone Mining Bees

**SIZE:** Tiny to small, 3-10 mm

**ID TIPS:** Some species similar in appearance to *Perdita* spp. (page 35). *Macrotera opuntiae* found in Colorado is about 6mm long, has a black head and thorax, and a reddish abdomen. The body may appear shiny. Sparse hairs on body. Male bees have a yellow clypeus.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, often nesting in sandstone tunnels

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Oligolectic

**SIMILAR LOOKING BEES:** *Sphecodes* spp., *Perdita* spp.

**ADDITIONAL NOTES:**

- Only found in the western US and southwest into Mexico. One species found in Colorado.
- The species in Colorado, *Macrotera opuntiae* (prickly pear mining bee) hosts on the plant genus, *Opuntia* spp. (prickly pear cactus). The females build their nest tunnels in sandstone rock. They can use existing cracks or tunnels, or they can make their own.
- Some species waterproof the nest to protect their young.
- Typically found in dry or desert climates. They will emerge when their host flowers bloom.

Figure 39. *Panurginus* spp. Photo: USGS Bee Inventory and Monitoring Lab

## *Panurginus* spp. Confluent Miner Bees

**SIZE:** Tiny, 5-8 mm

**ID TIPS:** Small bee. Black body sometimes with yellow markings. Sparse hair often not visible. Abdomen usually entirely black with no markings. Male bees have a yellow clypeus.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Polylectic, mesolectic, or oligolectic

**SIMILAR LOOKING BEES:** *Protandrena* spp., *Pseudopanurgus* spp., *Hylaeus* spp., *Perdita* spp., and *Calliopsis* spp.

**ADDITIONAL NOTES:**

- Only found in the northern hemisphere with three species in Colorado.
- Rare to find and can easily be overlooked.
- Some of the species found in Colorado are specialists on cinquefoil (*Potentilla* spp.), strawberry (*Fragaria* spp.), or buttercup (*Ranunculus* spp.) plants.

Figure 40. Clockwise starting top left: 1) *Perdita albipennis.* Photo: Bill Maynard, 2) *Perdita* sp. Photo: Eric Eaton, 3) *Perdita* sp. Photo: Eric Eaton



## *Perdita* spp. Fairy Mining Bees

**SIZE:** Tiny to small, 2-10 mm

**ID TIPS:** Face wider than long, appearing somewhat round. Sparse to no hairs visible on some species. Light-colored hair bands on abdomen appearing as stripes that may or may not be visible. Bodies are sometimes metallic black, blue, or greenish, or may appear shiny. Some species are yellow or orange in color. Lower face on male bees is yellow or white. Females may have light-colored markings on face.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Polylectic, mesolectic, or oligolectic

**SIMILAR LOOKING BEES:** *Calliopsis* spp., *Halictus* spp., *Hylaeus* spp., and wasps

**ADDITIONAL NOTES:**

- Only found in North America with 46 species in Colorado.
- Among the smallest bees in the world (2 mm).
- Common in dry and desert climates.
- Some species specialize on a single plant genus and they emerge when the flowers bloom. Examples in Colorado include sunflowers (*Helianthus* spp.), globe mallows (*Sphaealcea* spp.), willows (*Salix* spp.), blazing stars (*Mentzelia* spp.), and rushfoils (*Croton* spp.). Others may specialize on multiple plant families.

Figure 41. Clockwise starting top left: 1) *Pseudopanurgus* sp. Photo: Eric Eaton, 2) *Pseudopanurgus* sp. Photo: Eric Eaton, 3) *Pseudopanurgus* sp. Photo: Eric Eaton, 4) *Pseudopanurgus aethiops*. Photo: Eric Eaton



## *Pseudopanurgus* spp. Mining Bees

**SIZE:** Tiny to small, 5-12 mm

**ID TIPS:** Small, slender bee but larger than *Panurginus* spp. Black body sometimes with yellow markings. Sparse hair often not visible. Abdomen usually entirely black with no markings. Male bees have a yellow clypeus.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary

**FORAGING HABITS:** Oligolectic

**SIMILAR LOOKING BEES:** *Protandrena* spp., *Panurginus* spp., *Hylaeus* spp., *Perdita* spp., and *Calliopsis* spp.

**ADDITIONAL NOTES:**

- Only found in North America with up to 23 species in Colorado.
- Rare to find and can easily be overlooked.
- Specialist bees on the sunflower plant family (Asteraceae).
- Female creates a waterproof nest.

Figure 42. *Protandrena cockerelli,* female. Photo: Bill Maynard

## *Protandrena* spp. Mining Bees

**SIZE:** Tiny to small, 6-12 mm

**ID TIPS:** Small, slender bee, but larger than *Panurginus* spp. Black body sometimes shiny with yellow markings on face, thorax, and legs. Sparse hair often not visible, though thin, pale-colored hair bands may be visible on some species. Abdomen may have a “ribbed” appearance. Male bees have a yellow clypeus.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Pseudopanurgus* spp., *Panurginus* spp., *Hylaeus* spp., *Perdita* spp., and *Calliopsis* spp.

**ADDITIONAL NOTES:**

- Found in western hemisphere with two species in Colorado.
- Forages on a variety of flowers, but they rare to find and can easily be overlooked.
- Female creates a waterproof nest.

Figure 43. Clockwise starting top left: 1) *Anthophora bomboides*. Photo: Bill Maynard, 2) *Anthophora montana.* Photo: Bill Maynard, 3) *Anthophora terminalis* male. Photo: Eric Eaton, 4) *Anthophora urbana*. Photo: Bill Maynard



## *Anthophora* spp. Digger Bees

**SIZE:** Small to large, 10-21 mm

**ID TIPS:** Robust bees and similar shape to bumble bees (*Bombus* spp.; see page 45). Varied colors and hair patterns. Clear wings usually held next to body or overlapping the body. Males have pale areas on the face and shorter antennae than females.

**POLLEN-CARRYING METHOD:** Scopae on hind legs; longer hairs present on the tibial segment.

**NESTING:** Ground nesters, sometimes in aggregations. *Anthophora terminalis* nests in rotting wood or stems.

**SOCIALITY:** Solitary and communal

**FORAGING HABITS:** Polylectic, some are mesolectic

**SIMILAR LOOKING BEES:** *Habropoda* spp., *Bombus* spp., Eucerini tribe bees.

**ADDITIONAL NOTES:**

- Common worldwide with 23 species found in Colorado.
- Efficient pollinators due to amount of hair on body.
- Fast flyers.
- Similar to bumble bees, some species can buzz pollinate plants in the Solanaceae family (nightshades, including tomatoes and peppers).
- Their common name “digger bees” refers to them using their front legs and mouthparts to dig burrows.

Figure 44. Clockwise starting top left: 1) *Apis mellifera, f*emale worker. Photo: Lisa Mason, 2) *Apis melliera*, queen. Photo: Lisa Mason, 3) A frame in a Langstroth hive containing capped and uncapped honey, brood, and pollen. Photo: Lisa Mason, 4) *Apis mellifera,* male drone. Photo: Christine Webster



## *Apis* spp. Honey Bees

**SIZE:** Small to large, 10-20 mm; female workers most commonly seen are approximately 10-15 mm

**ID TIPS:** Hairs on head and thorax including long hairs coming out of eyes, a key trait visible under a microscope. The integument on the abdomen has stripes with color variations ranging from light orange to dark brown or black. Female workers have hind legs with wide, flattened plates for the corbiculae. Males are rarely seen unless a hive is nearby. Males have eyes that extend to the top of their head similar to a fly. The queen remains in the hive after a mating flight. She has a longer abdomen than workers.

**POLLEN-CARRYING METHOD:** Corbiculae (pollen baskets)

**NESTING:** Cavity nesters often in human-made hive boxes

**SOCIALITY:** Eusocial

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Peponapis* spp., *Xenoglossa* spp., other Apidae bees.

**ADDITIONAL NOTES:**

- The western honey bee (*Apis mellifera*) is the only *Apis* species found in the western hemisphere and therefore Colorado.
- They were brought to the US in the 1600s and are a managed species critical for food crop pollination services. Honey bees face a variety of challenges, most notable may be the varroa mite, a debilitating parasite that kills untreated colonies.

Figure 45. Clockwise starting top left: 1) *Bombus griseocollis*. Photo: Diane Wilson, 2) *Bombus nevadensis*. Photo: Lisa Mason, 3) *Bombus huntii*. Photo: Micaela Truslove, 4) *Bombus fervidus*. Photo: Diane Wilson



## *Bombus* spp. — Bumble Bees

**SIZE:** Small to large, 10-26 mm

**ID TIPS:** Robust bees with hair all over their body. They appear “fuzzy.” Color include yellow, black, and orange/rust, and patterns vary depending on species. Males do not have corbiculae, and their face appears to have a “mustache” with hairs hanging over the mandibles (mouthparts).

**POLLEN-CARRYING METHOD:** Corbiculae (pollen baskets)

**NESTING:** Ground nesters in hollowed cavities, abandoned rodent nests

**SOCIALITY:** Primitively eusocial or social parasites

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Habropoda* spp., *Anthophora* spp., Eucerini tribe bees.

**ADDITIONAL NOTES:**

- Common worldwide, mostly in the northern hemisphere, with 23 species found in Colorado.
- Sometimes confused with carpenter bees (*Xylocopa* spp.), but carpenter bees are not native Colorado.
- Some species live in alpine ecosystems / high elevations.
- Important and efficient buzz pollinators for crops, like in the Solanaceae plant family (nightshades, including tomatoes and peppers).
- Colonies are annual. Newly mated queens hibernate in winter and begin a new colony in the spring.

Figure 46. Clockwise starting top left: 1) *Ceratina* sp. Photo: Diane Wilson, 2) *Ceratina* sp. Photo: Diane Wilson, 3) *Ceratina* sp. Photo: MaLisa Spring



## *Ceratina* spp. Small Carpenter Bees

**SIZE:** Tiny, 5-8 mm

**ID TIPS:** Metallic black, sometimes slightly blue or green. Yellow marking on lower face (clypeus). Hairs not visible except on hind legs of females. Abdomen appears ridged.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Cavity nesters in pithy stems

**SOCIALITY:** Subsocial

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Lasioglossum* spp., *Hylaeus* spp., *Halictus* spp.

**ADDITIONAL NOTES:**

- Common worldwide with four species found in Colorado.
- As a subsocial bee, the females will cohabit and protect the nest with their young until they are adults.
- They need stems that are broken or already have an entrance into the stem. Examples of pithy-stemmed plants in Colorado include: Joe Pye weed (*Eutrochium* spp.), roses (*Rosa* spp.), raspberry (*Rubus* spp.), buckwheat (*Eriogonum* spp.), and sumac (*Rhus* spp.).
- Even though their common name is “small carpenter bee,” they are very different than large carpenter bees (*Xylocopa* spp.). *Ceratina* are very small in comparison. *Xylocopa* can be larger than 20 mm. *Ceratina* also do not nest in wood structures.

Figure 47. Clockwise starting top left: 1) *Diadasia enavata*. Photo: Eric Eaton, 2) *Diadasia australis.* Photo: Bill Maynard, 3) *Diadasia enavata*. Photo: Diane Wilson, 4) *Diadasia* sp., male. Photo: Eric Eaton



## *Diadasia* spp. — Sunflower Bees

**SIZE:** Tiny to large, 7-20mm

**ID TIPS:** Usually hairs on body are pale brown to gold-brown in color. Hair bands are visible on abdomen in some species. Hairs visible on all legs for both males and females, in addition to females having thick scopae on the hind legs. Eyes tend to have a blue or greenish color.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, common to have a chimney-shaped "turret" or tunnel at the nest entrance

Figure XX. A *Diadasia* nest turret. Photo: Bill Maynard

**SOCIALITY:** Solitary, sometimes nest in aggregations

**FORAGING HABITS:** Oligolectic

**SIMILAR LOOKING BEES:**
*Melissodes* spp, others Eucerini tribe bees, *Habropoda* spp., *Anthophora* spp., *Bombus* spp.

**ADDITIONAL NOTES:**

- Only found in the western hemisphere, west of the Mississippi River with seven species found in Colorado.
- Purpose of turrets is unknown, but may provide protection from weather, loose dirt, and/or predators.
- Different species specialize on different plant genera. Examples: Sunflowers (*Helianthus* spp.), mallows (*Malacothamnus* spp.), and cactii (Cactaceae family).

Figure 48. Clockwise starting top left: 1) *Epeolus* sp. Photo: Bill Maynard, 2) *Epeolus* sp. Photo: Bill Maynard, 3) *Epeolus* sp. Photo: Whitney Cranshaw, 4) *Epeolus* sp. Photo: Diane Wilson



## *Epeolus* spp. — Cuckoo Bees

**SIZE:** Small to medium, 5-15 mm

**ID TIPS:** Hairs that are present are short and flat against body. Abdomen has noticeable stripes of short, flat hair often of contrasting colors of black with white, yellow, or orange. The thorax right behind the head sometimes has a “smiley face” pattern. Wings can be held out at a 45° angle or held across body.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Ground nesters

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Triepeolus* spp., *Nomada* spp., and wasps

**ADDITIONAL NOTES:**

- Common worldwide with 12 species found in Colorado.
- Cleptoparasites of *Colletes* spp., the cellophane bees.
- Females have spines on her abdomen that are specialized to slice open the nest cells that are lined with material similar to cellophane. She will lay her egg in between nest linings and the egg will stick to it with a glue-like substance secreted by female bee.
- The *Epeolus* larva feeds on the host bee egg as well as the pollen and nectar reserves.

Figure 49. Clockwise starting top left: 1) *Eucera aragalli,* female. 2) *Eucera aragalli,* female. 3) *Eucera dubitata*, female. All photos: USGS Bee Inventory and Monitoring Lab



## *Eucera* spp. — Long-Horned Bees

**SIZE:** Small to large, 10-20 mm

**ID TIPS:** Large, bumble bee-sized bees. Similar markings to *Melissodes* spp. and *Peponapis* spp. Clypeus protrudes outward. Yellow or pale white on the face of male bees. Males also have long antennae reaching past the wing base on the thorax. Fast fliers.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, mesolectic, oligolectic

**SIMILAR LOOKING BEES:** *O*ther Eucerini tribe bees (see page XX), *Bombus* spp., *Habropoda* spp., *Anthophora* spp.

**ADDITIONAL NOTES:**

- Mostly found in the western US, and the northern hemisphere with 16 species found in Colorado.
- Different from *Svastra* spp. and *Melissodes* spp. because they emerge in the early season versus later summer, and they are not often found on sunflowers.
- Some species are generalist foragers, and others specialize on native plants like *Astragalus* spp. (milkvetch), *Dalea* spp. (priarie clover), and others in the pea family (Fabaceae).
- Identification is difficult. Common photos are pinned specimens identified by a taxonomist.

Figure 50. Clockwise starting top left: 1) *Habropoda* sp. Photo: Bill Maynard, 2) *Habropoda* sp. Photo: Bill Maynard, 3) *Habropoda* sp. Photo: Eric Eaton, 4) *Habropoda* sp. Photo: Eric Eaton



## *Habropoda* spp. Mountain Digger Bees

**SIZE:** Small to large, 10-21 mm

**ID TIPS:** Robust bees and similar in shape to bumble bees (*Bombus* spp.). Varied colors and hair patterns. Clear wings usually held next to next to body (no overlapping). Portions of abdomen may be black and shiny. Males have short antennae, with white markings on face.

**POLLEN-CARRYING METHOD:** Scopae on hind legs; longer hairs present on the tibia segment.

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, some are mesolectic

**SIMILAR LOOKING BEES:** *Anthophora* spp., *Bombus* spp., Eucerini tribe bees.

**ADDITIONAL NOTES:**

- Common in western United States and northern hemisphere with five species found in Colorado.
- The only species found in the eastern United States is the *H. laboriosa*, the southeastern blueberry bee. One female bee can visit up to 50,000 flowers which leads to the growth of 6,000 blueberries (Cane, 1997).
- In some species, the larvae will stay dormant for 2+ years, and sometimes up to 10 years possibly due to cues like rainfall, which predicts floral resources (Wilson and Carril, 2016).

Figure 51. Top: 1) *Holcopasites calliopsidis*. Photo: Diane Wilson, 2) *Holcopasites calliopsidis*. Photo: Eric Eaton



## *Holcopasites* spp. Cuckoo Bees

**SIZE:** Tiny, 4-9 mm

**ID TIPS:** Tiny bees that have short antennae. Head and thorax are black, and the abdomen is red in color. The abdomen may also have patterns of black bands with short hairs that appear as white dots and short white lines. The most common species, *Holcopasites calliopsidis,* has a series of white dots running down both sides of abdomen, and tends to hold its wings under its abdomen while resting.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Ground nesters in bee nests of the subfamily Panurginae

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Sphecodes* spp., and wasps

**ADDITIONAL NOTES:**

- Found in North America with five species in Colorado.
- They parasitize bees in the Panurginae subfamily of bees in the Andrenidae family, most notably in the genera *Calliopsis, Protandrena,* and *Pseudopanurgus.* These genera specialize on specific groups of flowers, and research has shown the adult *Holcopasites* often will visit the same flowers for nectar (Hurd and Linsley, 1972).

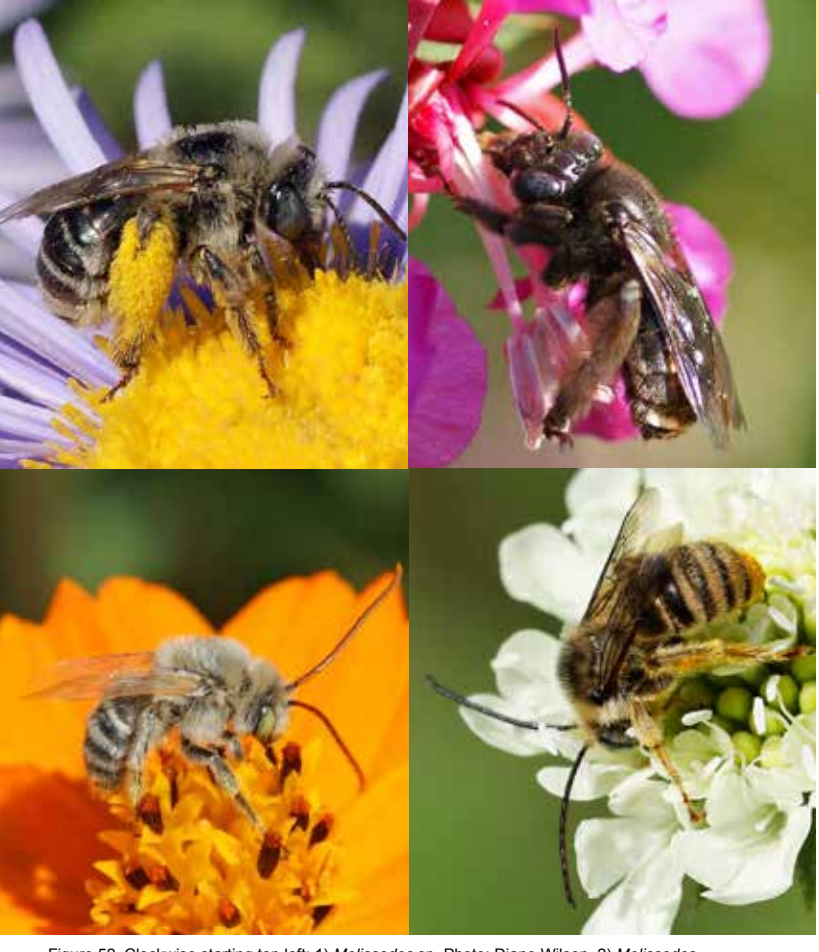


Figure 52. Clockwise starting top left: 1) *Melissodes* sp. Photo: Diane Wilson, 2) *Melissodes bimaculata*, female. Photo: Diane Wilson, 3) *Melissodes* sp. Photo: Bill Maynard, 4) *Melissodes* sp. Photo: Diane Wilson



## *Melissodes* spp. Long-Horned Bees

**SIZE:** Tiny to large, 5-20 mm

**ID TIPS:** Similar markings to *Eucera* spp., *Peponapis* spp., and *Svastra* spp. The head, thorax, and legs often have light-colored hairs. The abdomen often has light-colored bands of hair. Males have yellow markings on the lower face and have long antennae that are the length of the body. Males often seen resting on flowers at night. Fast flyers.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Mesolectic, oligolectic, a few polylectic

**SIMILAR LOOKING BEES:** *O*ther Eucerini tribe bees, *Bombus* spp., *Habropoda* spp., *Anthophora* spp.

**ADDITIONAL NOTES:**

- They range from North to South America with 34 species found in Colorado.
- *Melissodes bimaculata*, a common species in Colorado and a generalist forager, can easily be distinguished because it has an entirely black body, and it is approximately the size of a honey bee.
- Active in the midsummer to early fall and often seen on sunflowers. Many species specialize on plants in the Asteraceae family (asters, daisies, sunflowers, etc.). Some forage on specific genera within Asteraceae.

Figure 53. Clockwise starting top left: 1) *Nomada* sp. Photo: Heidi Eaton, 2) *Nomada* sp. Photo: Bill Maynard, 3) *Nomada* sp. Photo: Diane Wilson, 4) *Nomada* sp. Photo: Diane Wilson



## *Nomada* spp. — Cuckoo Bees

**SIZE:** Small to large, 5-17 mm

**ID TIPS:** Similar appearance as wasps. Most species have yellow and black stripes and markings. Some species are entirely red. Hairs are sparse and often not visible without a microscope. Long, narrow abdomen. Thorax slopes steeply down towards abdomen when viewed from the side. Legs may be reddish. Wings held over body or at a 45° angle.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Ground nesters

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Epeolus* spp. and *Triepeolus* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Common worldwide with 88 species found in Colorado.
- Cleptoparasites of mostly *Andrena* spp., but also *Eucera* spp., and *Agapostemon* spp.
- Bees can be observed searching the ground for nests.
- A female will search for an unattended nest or wait until it is unattended and lay eggs. The first egg to hatch will destroy the host eggs and the other Nomada eggs in the nest before feeding on the pollen and nectar provisions left by the host bee.

Figure 54. Clockwise starting top left: 1) *Peponapis pruinosa,* female. Photo: Eric Eaton, 2) *Peponapis pruinosa,* female. Photo: Eric Eaton, 3) *Peponapis pruinosa,* male. Photo: Eric Eaton, 4) *Peponapis pruinosa,* male. Photo: Eric Eaton



## *Peponapis* spp. Squash Bees

**SIZE:** Small to medium, 11-14 mm

**ID TIPS:** Only seen on squash and pumpkin plants. Lower face (clypeus) projects outward. Hairs on thorax are noticeable and slightly orange/gold. Scopae on hind legs thinner than those of other Eucerini tribe bees. Males have a pale yellow markings on the lower part of their face.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary

**FORAGING HABITS:** Oligolectic on Cucurbitaceae family

**SIMILAR LOOKING BEES:** *Xenoglossa* spp., Eucerini tribe bees, *Bombus* spp., *Apis mellifera*.

**ADDITIONAL NOTES:**

- Found in North and South America. Only one species in Colorado: *Peponapis pruinosa*.
- Found in the early mornings pollinating squash and pumpkin plants. Male bees will often rest in flowers.
- Cucurbitaceae family specialists (squash, pumpkins, zucchini, melons, etc.). More efficient pollinators than honey bees.
- Life cycle coincides with blooming flowers. They nest near their host plants. Tillage of soil can impact nests.

Figure 55. Clockwise starting top left: 1) *Svastra obliqua,* female. Photo: Eric Eaton, 2) *Svastra obliqua,* female. Photo: Bill Maynard, 3) *Svastra obliqua,* male. Photo: Diane Wilson, 4) *Svastra obliqua,* male. Photo: Eric Eaton



## *Svastra* spp. Sunflower Bees

**SIZE:** Small to large, 7-16 mm

**ID TIPS:** Larger, bumble bee-sized bees. Black markings (hairs) on body prominent on females. Her scopae are long, dark orange hairs, usually covered in pollen. Males have long antennae, but not as along as other Eucerini tribe bees.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Oligolectic

**SIMILAR LOOKING BEES:** *Bombus* spp., other Eucerini tribe bees, *Habropoda* spp., *Anthophora* spp.

**ADDITIONAL NOTES:**

- Only found in the western hemisphere with 7 species found in Colorado. The most common species is *Svastra obliqua*.
- This genus is commonly seen on sunflowers (*Helianthus* spp.) or other coneflowers. Some species specialize only on sunflowers (including *Svastra obliqua*) or other plant genera.
- They are important pollinators for crop and wild sunflowers.
- Sometimes nest in aggregations or nest communally. Nest entrances may appear as soil mounds or holes in the ground.

Figure 56. Clockwise starting top: 1) *Triepeolus* sp. Photo: Bill Maynard, 2) *Triepeolus* sp. Photo: Diane Wilson, 3) *Triepeolus concavus* Photo: Bill Maynard



## *Triepeolus* spp. Cuckoo Bees

**SIZE:** Small to large, 5-20 mm

**ID TIPS:** Hairs that are present are short and flat against body. Abdomen has noticeable stripes of short, flat hair often of contrasting colors of black and white. The thorax right behind the head sometimes has a “smiley face” pattern. Wings usually at a 45° angle or held across body. Legs are sometimes reddish in color.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Ground nesters

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Epeolus* spp. and *Nomada* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Common worldwide with 36 species found in Colorado.
- Cleptoparasites of Eucerini tribe bees.
- Sometimes *Triepeolus* is larger that *Epeolus*. Under a microscope, the number of mouth parts distinguishes *Triepeolus* from *Epeolus*. *Triepeolus* has three-segmented mouthparts (known as maxillary palps), hence the name. *Epeolus* has two-segmented mouth parts.
- Bees can be found searching the ground for nests, or they may follow a female host bee back to her nest.

Figure 57. Top: 1) *Xenoglossa* sp. Photo: Bill Maynard, 2) *Xenoglossa* sp. Photo: Bill Maynard



## *Xenoglossa* spp. Squash Bees

**SIZE:** Small to medium, 14-18 mm

**ID TIPS:** Only seen on squash and pumpkin plants. Slightly larger than *Peponapis* spp. and more orange-colored. Lower face (clypeus) projects outward. Thorax hairs are noticeable and dark orange. Scopae on hind legs thinner than other Eucerini tribe bees. Males and females have a pale yellow markings on the lower part of their face. Markings are more prominent on males.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary

**FORAGING HABITS:** Oligolectic on Cucurbitaceae family

**SIMILAR LOOKING BEES:** *Peponapis* spp., Eucerini tribe bees, *Bombus* spp., *Apis mellifera*.

**ADDITIONAL NOTES:**

- Only found in the western hemisphere with two species in Colorado.
- Found in the early mornings pollinating squash and pumpkin plants. Male bees will often rest in flowers.
- Cucurbitaceae family specialists (squash, pumpkins, zucchini, melons, etc.). More efficient pollinators than honey bees.
- Life cycle coincides with blooming flowers. They nest near their host plants. Tillage of soil can impact nests.

Figure 58. Clockwise starting top left: 1) *Colletes* sp., female. Photo: Bill Maynard, 2) A pair of *Colletes* sp. Note the heart-shaped face. Photo: Eric Eaton, 3) *Colletes* sp., male. Photo: Eric Eaton



## *Colletes* spp. Cellophane or Plasterer Bees

**SIZE:** Tiny to medium, 7-16 mm

**ID TIPS:** Face appears heart-shaped because the distance between the eyes decreases starting at the top of the head and moving downward. Most species appear very hairy on head and thorax with light, pale-colored hairs. The abdomen usually has bands of short, pale-colored hairs appearing as thick stripes. Male bees have a hairy head. Females do not have hair on their lower face (clypeus), and their abdomen appears cone-shaped, tapering to the end.

**POLLEN-CARRYING METHOD:** Scopae on hind legs, and sometimes on the sides of thorax and under the abdomen

**NESTING:** Ground nesters, sometimes in aggregations

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, mesolectic, oligolectic

**SIMILAR LOOKING BEES:** *Halictus* spp., *Andrena* spp., *Nomia* spp., *Dieunomia* spp., and some Apidae genera

**ADDITIONAL NOTES:**

- Found in the western hemisphere, Europe, and Africa with 36 species in Colorado.
- Females coat their nest with a strong, waterproof substance similar to cellophane.
- *Colletes andrewsi* forages only on coral bells (*Heuchera* spp.). Others specialize on *Dalea* spp. (prairie clovers), genera in Asteraceae (daisies/asters) family, and more.

Figure 59. Clockwise starting top left: 1) *Hyaeus* sp., female. Photo: MaLisa Spring, 2) *Hylaeus* sp., male. Photo: Eric Eaton, 3) *Hylaeus* sp. Photo: Eric Eaton, 4) *Hylaeus* sp. Photo: Lisa Mason



## *Hylaeus* spp. Yellow-Faced or Masked Bees

**SIZE:** Tiny, 5-7 mm

**ID TIPS:** Black, slender body sometimes appearing shiny with yellowish markings on face, thorax,and portions of legs. Almost hairless, and looks similar to wasps. Females have two yellowish markings on face between the eyes that are mostly vertical. Males have yellow markings that almost completely cover the face.

**POLLEN-CARRYING METHOD:** Nothing visible; pollen and nectar carried internally and regurgitated at the nest site

**NESTING:** Cavity nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, mesolectic

**SIMILAR LOOKING BEES:** *Lasioglossum* spp., *Protandrena* spp., *Panurginus* spp., *Pseudopanarganus* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Worldwide distribution with 16 species in Colorado.
- At least 60 species are only found in Hawaii. Seven of them are protected under the Endangered Species Act.
- Two species were unintentionally introduced to the US from Europe and are now established (*Hylaeus leptocephalus* and *Hylaeus punctatus*).
- They nest in small twigs that have an opening or preexisting tunnels in wood, soil, rocks, etc. Females coat the nest with a cellophane-like material.

Figure 60. Clockwise starting top left: 1) *Agapostemon* sp. Photo: Richard Greene, 2) *Agapostemon virescens*. Photo: Lisa Mason, 3) *Agapostemon virescens*. Photo: Lisa Mason, 4) *Agapostemon* sp. Photo: Lisa Mason



## *Agapostemon* spp. Green Metallic Sweat Bees

**SIZE:** Small to medium, 7-14.5 mm

**ID TIPS:** Bright green or blue. In some species, females are entirely bright green; males have a green head and thorax, and yellow and black striped abdomen. Other species have a black and white striped abdomen.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary, communal

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Augochorella* spp. and *Augochloropsis* spp.

**ADDITIONAL NOTES:**

- Found only in the western hemisphere with seven species in Colorado.
- Found at elevations from sea level to above 10,000 feet.
- Nest in the ground on hillsides, vertical banks, or on even ground. Nest entrances are surrounded by a mound of dirt with a tunnel leading down to it.
- Most nest individually but some species are communal nesters and will nest with other *Agapostemon* species with each female building her own individual nest.
- They do not have a floral preference but are commonly seen on plants in the sunflower family.

Figure 61. Clockwise starting at top: 1) *Augochlorella aurata*. Photo: Bill Maynard, 2) *Augochlorella aurata*. Photo: Eric Eaton, 3) *Augochlorella aurata*. Photo: Diane Wilson



## *Augochlorella* spp. Green Metallic Sweat Bees

**SIZE:** Tiny, 5-7 mm

**ID TIPS:** Entire body is a green metallic color. Varies from dark copper, red, or yellow.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters often in rotting wood

**SOCIALITY:** Primitively eusocial, varies

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Agapostemon* spp. and *Augochloropsis* spp.

**ADDITIONAL NOTES:**

- Range from Canada to South America. Most US species are commonly seen in the eastern US, and one species is found in Colorado, *Augochlorella aurata*.
- Each female builds her own nest and lays eggs that emerge into daughters who will be workers collecting pollen and nectar while the original female (the foundress or queen) continues to lay eggs. The foundress will produce three generations of daughters each year.
- The third generation will consist of reproductives who will mate and become egg layers or queens in the next year.
- The degree of sociality within the genus depends on the elevation and latitude. Bees at higher elevations and latitudes are more likely to be solitary.

Figure 62. *Augochloropsis* sp. Photo: Bill Maynard

## *Augochloropsis* spp. Green Metallic Sweat Bees

**SIZE:** Tiny to small, 8-12 mm

**ID TIPS:** Entire body is a green metallic color, sometimes blue green.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Agapostemon* spp. and *Augochorella* spp.

**ADDITIONAL NOTES:**

- Commonly found in South and Central America with two species known in Colorado.
- Some species are communal nesters.
- Their nests consist of one long burrow with adjoining horizontal burrows that contain the nest cells.
- The pollen masses they provide for their young are shaped into perfect cubes! Other bees generally roll pollen into round or egg-shaped spheres.
- Their nesting habit of having one long burrow with adjoining horizontal burrows and nest cells is a unique trait of this genus.

Figure 63. Clockwise starting at top: 1) *Dieunomia* sp. Photo: Bill Maynard, 2) *Dieunomia heteropoda*. Photo: Bill Maynard, 3) *Dieunomia heteropoda*. Photo: Lisa Mason



## *Dieunomia* spp. Sweat Bees

**SIZE:** Tiny to large, 7-23 mm

**ID TIPS:** Dark-colored, skinny wings. When foraging, wings are held at a 45° angle. The forewing and hindwing overlap. Thorax has thick hair ranging from dark yellow to black, often pollen-covered. Abdomen may have hair bands visible. In males, the last antennal segment is twice as wide as other segments.

**POLLEN-CARRYING METHOD:** Scopae on hind legs, hairs on the abdomen undersides may also carry pollen similar to *Megachile* spp.

**NESTING:** Ground nesters, often in aggregations

**SOCIALITY:** Solitary and/or communal

**FORAGING HABITS:** Mesolectic or Oligolectic

**SIMILAR LOOKING BEES:** *Andrena* spp., *Colletes* spp., *Megachile* spp, *Melissodes* spp., *Nomia* spp., *Svastra*, *Xenoglossa* spp., *Peponapis* spp.

**ADDITIONAL NOTES:**

- Found only in North America with six species known in Colorado.
- They are specialists of flowers in the Asteraceae family (daisies, asters, sunflowers, etc.) and time their emergence when they bloom.

Figure 64. Clockwise starting at top: 1) *Halictus* sp. Photo: Bill Maynard, 2) *Halictus* sp. Photo: Diane Wilson, 3) *Halictus* sp. Photo: Lisa Mason



## *Halictus* spp. Sweat Bees

**SIZE:** Tiny to small, 4.5 - 14 mm

**ID TIPS:** Hair bands appear as white stripes on abdomen. Body color generally brown, black or dark metallic green. Lower part of face and legs on male bee are yellowish.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary and primitively eusocial

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Lasioglossum* spp.

**ADDITIONAL NOTES:**

- Species are found all over the world except for Australia. Some even live in the Arctic circle. Seven species found in Colorado.
- Primitively eusocial colonies can have >200 bees per colony. In the spring, the foundress female (queen) emerges and starts a new nest on her own. The first batch of eggs she lays will all become female worker bees who will then care for the next generation of workers. All female *Halictus* bees retain the ability to lay eggs. If the foundress dies, any one of the worker bees can take over her egg laying. Queens control worker egg laying by limiting the amount of pollen they get fed.

Figure 65. Clockwise starting left: 1) *Lasioglossum* sp. subgenus *Evylaeus*. Photo: Bill Maynard, 2) *Lasioglossum* sp. subgenus *Dialictus*. Photo: Bill Maynard, 3) *Lasioglossum sp*. Photo: David Cappaert, Bugwood.org



## *Lasioglossum* spp. Sweat Bees

**SIZE:** Tiny to small, 3 - 10 mm

**ID TIPS:** All black, sometimes metallic. Sometimes pale-colored bands of hair noticeable on abdomen. Hairs not as prominent as *Halictus* and usually smaller.

**POLLEN-CARRYING METHOD:** Scopae on hind legs (except for the social parasites)

**NESTING:** Mostly ground nesters, some nest in wood or insect tunnels

**SOCIALITY:** Solitary, communal, primitively eusocial, social parasites

**FORAGING HABITS:** Polylectic mostly or oligolectic

**SIMILAR LOOKING BEES:** *Halictus* spp*., Hylaeus spp,*

**ADDITIONAL NOTES:**

- Found worldwide with 89 species in Colorado. More species in this genus than any other genus.
- Common bees around the world and often important pollinators due to their abundance.
- Considered a “sweat bee” just like related genera including *Halictus* spp. and *Agapostemon* spp. due to their attraction to human sweat.
- Some species are social parasites and will parasitize other *Lasioglossum* species.
- The oligolectic species specialize on pollinating plants in the Oenothera, the evening primrose genus.

Figure 66. Clockwise starting top left: 1) *Nomia foxii.* Photo: Paul De Ley, 2) *Nomia foxii.* Photo: Paul De Ley, 3) *Nomia universitatis,* male. Photo: USGS Bee Inventory and Monitoring Lab, 4) *Nomia universitatis,* male. Photo: USGS Bee Inventory and Monitoring Lab



# *Nomia* spp. Alkali Bees

**SIZE:** Tiny to large, 9-22 mm

**ID TIPS:** Ivory-colored pearlescent bands across abdomen, sometimes slightly blue or green. Round faces. Eyes curve down to lower part of face.

**POLLEN-CARRYING METHOD:** Scopae on hind legs

**NESTING:** Ground nesters

**SOCIALITY:** Solitary and/or communal

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Dieunomia* spp., *Colletes* spp.

**ADDITIONAL NOTES:**

- Found in the Western United States, Africa, Asia and Australia. Four species known in Colorado.
- *Nomia melanderi* known as the alkali bee nest in large aggregations. Some aggregations of this species are largest documented among bees. They prefer salty, alkaline soil.
- *Nomia melanderi* is an important pollinator of alfalfa. Since they nest in large aggregations, they can be managed to benefit farmers.

Figure 67. A large aggregation of *Nomia melanderi* in western Colorado. Photo: Bob Hammon, CSU, Bugwood.org

Figure 68. Clockwise starting top left: 1) *Sphecodes* sp. Photo: Heidi Eaton, 2) *Sphecodes* sp. Photo: Eric Eaton, 3) *Sphecodes sp*. Photo: Bill Maynard, 4) *Sphecodes* sp. Photo: Bill Maynard



## *Sphecodes* spp. — Cuckoo Bees

**SIZE:** Tiny to small, 4.5 - 15 mm

**ID TIPS:** Shiny bodies with a red abdomen and a black head and thorax. Sparse hairs may not be visible without microscope.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Ground nesters

**SOCIALITY:** Social parasites, cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Lasioglossum* spp., some *Nomada* spp.

**ADDITIONAL NOTES:**

- Occurs worldwide except Australia with 17 species found in Colorado.
- They parasitize bees in the Halictidae family. As a cleptoparasite, the females kill the host bee egg and lay their own egg. As a social parasite, she will enter a colony, kill the queen, and lay her own eggs. The host workers will raise her young.
- Often observed on the ground scouting for bee nests or foraging on flowers for nectar.

Figure 69. Starting at the top: 1) *Anthidiellum notatum*. Photo: Eric Eaton, 2) *Anthidiellum notatum*. Photo: Eric Eaton



## *Anthidiellum* spp. Rotund Resin Bees

**SIZE:** Tiny to small, 5 - 10 mm

**ID TIPS:** Small bees that are robust and compact. They do not appear very hairy, and the black and yellow integument is easily visible with a distinct pattern. The abdomen on *Anthidiellum notatum* has six yellow squares/dots that may be visible in the field. Wings are black and are often held at a 45° angle while foraging. Scopae may be hard to view without a microscope.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Nest cells made of resin are freestanding and glued to rocks, branches, or even pine needles (Schwarz, 1928).

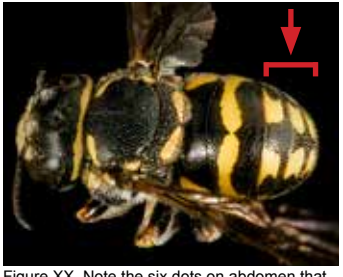


Figure XX. Note the six dots on abdomen that appear square-ish. Photo: Amanda Robinson, USGS Bee Inventory and Monitoring Lab

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Anthidium* spp. and *Dianthidium* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Found worldwide with one species found in Colorado, *Anthidiellum notatum*.

Figure 70. Clockwise starting top left: 1) *Anthidium manicatum*. Photo: Bill Maynard, 2) *Anthidium* sp. Photo: Bill Maynard, 3) *Anthidium maculosum*. Photo: Eric Eaton, 4) *Anthidium manicatum,* male. Photo: Eric Eaton



## *Anthidium* spp. Wool Carder Bees

**SIZE:** Tiny to large, 6 - 20 mm

**ID TIPS:** Compact, round bees that look similar to wasps due to the black and yellow markings on their body. Yellow stripes on abdomen never connect in the middle. Hairs visible on thorax, head, legs. Scopae may be hard to view. Males have a three-pronged structure at tip of abdomen.

**POLLEN-CARRYING METHOD:** Scopae under abdomen

**NESTING:** Cavity nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, mesolectic

**SIMILAR LOOKING BEES:** *Dianthidium* spp. and *Anthidiellum* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Found worldwide mostly in the northern hemisphere with 14 species found in Colorado.
- *Anthidium manicatum*, the most commonly seen species, was introduced from Europe and is well-established.
- Often seen around lamb's ear plants (*Stachys byzantina*) or other fuzzy-leaved plants because the females scrape the plant fuzz off and use it to line their nest cells.
- Males are larger than females, a unique trait in bees, and also aggressive. They defend plants to protect foraging resources and mating territories. Although harmless to humans, males chase or tackle other males, or other insects visiting flowers.
- They often hover in flight, a unique trait mostly seen in flies.

Figure 73. Starting at top: 1) *Coelioxys* sp. Photo: Diane Wilson, 2) *Coelioxys* sp. Photo: Diane Wilson

## *Coelioxys* spp. — Cuckoo Bees

**SIZE:** Tiny to large, 5 - 22 mm

**ID TIPS:** Integument is entirely black with thin bands of white hair on the abdomen, and sparse white hairs on head and thorax. Some species may have red or orange legs. The abdomen tapers to a point, almost creating a triangular or cone-shape with the widest portion closest to the thorax. One of the only bee genera with hairy eyes.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Cavity nesters, mostly in nests of *Megachile* spp.

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Megachile* spp.

**ADDITIONAL NOTES:**

- Found worldwide with 18 species in Colorado.
- Parasites of *Megachile* spp. (leafcutter bees). The females use their pointed abdomen to puncture the leafcutter bee nests protected by leaf pieces. The female *Coelioxys* bee lays an egg inside the nest cell, and that larva will out-compete and kill the host *Megachile* larva.

Figure 71. Clockwise starting top left: 1) *Dianthidium* sp. Photo: Eric Eaton, 2) *Dianthidium* sp. Photo: Eric Eaton, 3) *Dianthidium* sp. Photo: Eric Eaton, 4) *Dianthidium* sp. Photo: Eric Eaton



## *Dianthidium* spp. Pebble Bees

**SIZE:** Tiny to small, 6 - 15 mm

**ID TIPS:** Small bees that are robust and compact. They have slightly longer bodies than *Anthidiellum* spp. They do not appear very hairy, and their entire body is black with yellow spots and patterns. Patterns are variable and often cannot be used as a sole identification characteristic. Scopae may be hard to view without a microscope because the abdomen sometimes slightly curls under the body.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Nest cells are made of plant resin, soil, and small pebbles; are glued to rocks or branches; and are usually considered freestanding.

Figure 72. A *Dianthidium* nest. Photo: Eric Eaton

**SOCIALITY:** Solitary, sometimes nest in aggregations

**FORAGING HABITS:** Mesolectic, oligolectic

**SIMILAR LOOKING BEES:** *Anthidium* spp. and *Anthidiellum* spp. Note: May also resemble wasps.

**ADDITIONAL NOTES:**

- Found in North America, with most species in the western US. Nine species are found in Colorado.
- Some species specialize on plants in the Asteraceae family (sunflower, asters, daisies, etc.).

Figure 74. Clockwise starting top left: 1) *Heriades* sp. Photo: Heidi Eaton, 2) *Heriades* sp. Photo: Bill Maynard, 3) *Heriades* sp. Photo: Bill Maynard, 4) *Heriades* sp. Photo: Eric Eaton



## *Heriades* spp. — No Common Name

**SIZE:** Tiny, 4 - 7 mm

**ID TIPS:** Narrow, cylidrical-shaped body that is entirely black. Abdomen has thin bands of short, white hairs. Bands are not always visible. Sides of abdomen are mostly parallel until the tip of the abdomen tapers to a point, and curves slightly under the body. The abdomen also may appear “ribbed” or wavy instead of smooth. Dents or divots are present all over body, similar to golf ball, including square-shaped divots at the base of the thorax. Divots usually can only be seen under a microscope.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Cavity nesters or in pithy stems

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Hoplitis* spp.*, Osmia* spp.*, Megachile* spp.*, Halictus* spp.

**ADDITIONAL NOTES:**

- Found worldwide with five species found in Colorado.
- *Heriades* bees often prefer to nest in beetle holes and tunnels, and they use plant resin to create dividing walls between nest cells. Occasionally they can be found nesting in pine cones.

Figure 75. Clockwise starting top left: 1) *Hoplitis* sp. Photo: Diane Wilson, 2) *Hoplitis* sp. Photo: Diane Wilson, 3) *Hoplitis* sp. Photo: Diane Wilson, 4) *Hoplitis* sp. Photo: Diane Wilson



## *Hoplitis* spp. — Small Mason Bees

**SIZE:** Tiny to medium, 3 - 18 mm

**ID TIPS:** Narrow and cylidrical body that is entirely black. Some species are a metallic green color. Sparse hairs may be visible on head and thorax. Abdomen has thin bands of short, white hairs. Bands are not always visible. Sometimes the abdomen appears to curve slightly under the body. The abdomen also may appear “ribbed” or wavy instead of smooth. Many species are much larger than *Heriades* spp.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Cavity nesters or in pithy stems

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic

**SIMILAR LOOKING BEES:** *Heriades* spp., *Osmia* spp., *Megachile* spp., *Halictus* spp.

Figure 76. Some species of *Hoplitis* are metallic green. Photo: Diane Wilson

**ADDITIONAL NOTES:**

- Found worldwide with eight species found in Colorado.
- They nest in a variety of cavities, such as beetle tunnels, pithy or hollow stems, ground or rock cracks, etc. The females use soil, chewed-up leaves, or other materials to partition cells and make the nest just the right size.

Figure 77. Clockwise starting top left: 1) *Lithurgopsis apicalis*. Photo: Bill Maynard, 2) *Lithurgopsis apicalis*. Photo: Lisa Mason, 3) *Lithurgopsis apicalis*. Photo: Lisa Mason



## *Lithurgopsis* spp. Orange-Tipped Woodborer

**SIZE:** Tiny to large, 7 - 20 mm

**ID TIPS:** Long, black, rounded bodies. Head and thorax are black with often visible pale-colored hairs. The abdomen has white hair bands appearing as stripes. The tip of the abdomen has reddish brown hairs. Typically larger than other *Megachile* spp.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Cavity nesters in wood

**SOCIALITY:** Solitary

**FORAGING HABITS:** Oligolectic

**SIMILAR LOOKING BEES:** *Megachile* spp.*, Halictus* spp.

Figure 78. Note the reddish brown hairs at the tip of the abdomen. Photo: Lisa Mason

**ADDITIONAL NOTES:**

- Only found in western hemisphere. One species found in Colorado, *Lithurgopsis apicalis*.
- Specialize on cactus flowers (Cactaceae) and are among the most efficient pollinators of cactii. In Colorado, you can find them pollinating *Opuntia* spp. (prickly pear cactus).
- They nest in dead and rotting wood, or woody stems. Unlike most other cavity-nesting bees, they chew and excavate their own tunnels.

Figure 79. Clockwise starting top left: 1) *Megachile melanophaea.* Photo: Bill Maynard, 2) *Megachile* sp., female. Photo: Eric Eaton, 3) *Megachile* sp., female. Photo: Bill Maynard, 4) *Megachile* sp., male. Photo: Lisa Mason



# *Megachile* spp. Leafcutter Bees

**SIZE:** Tiny to large, 5 - 21 mm

**ID TIPS:** Vary in size and shape. Black head and thorax with pale-colored hairs. Abdomen is also black often with pale-colored hair bands. Some species are more hairy than others. Females often angle their abdomens upward showing the scopae covered in pollen.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Cavity nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, oligolectic, mesolectic

**SIMILAR LOOKING BEES:** *Lithurgopsis* spp.*, Halictus* spp.*, Osmia* spp.

Figure 80. Leafcutter bee activity (top) is often confused with root weevil feeding (bottom). Root weevil feeding appears more notched around the leaf edge compared to circular-shaped. The bees do not harm plants. Photo: (top) Lisa Mason, (bottom) Whitney Cranshaw

**ADDITIONAL NOTES:**

- Found worldwide with 59 species found in Colorado.
- Females cut leaf pieces from plants and carry them back to line the nest.
- Commonly nest in bee hotels and human-made cavities.
- Some species were accidentally introduced including *Megachile rotundata*, the alfalfa leafcutter bee which is now established and used to pollinate alfalfa.

Figure 81. Clockwise starting top left: 1) *Osmia* sp. Photo: Heidi Eaton, 2) *Osmia* sp. Photo: Carol English, 3) *Osmia* sp. Photo: Eric Eaton, 4) *Osmia* sp. Photo: Diane Wilson



## *Osmia* spp. — Mason Bees

**SIZE:** Tiny to small, 5 - 14 mm

**ID TIPS:** Short, robust bees. Metallic-colored body can range from blue, green, black, and sometimes copper-colored. Minimal to no hair bands visible on abdomen. Hairs visible on head and thorax.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Cavity nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Polylectic, Oligolectic, Mesolectic

**SIMILAR LOOKING BEES:** *Hoplitis* spp., *Lasioglossum* spp., *Megachile* spp., *Augochlorella* spp., *Augochloropsis* spp., *Agapostemon* spp.

**ADDITIONAL NOTES:**

- Commonly found in Europe and North America with 76 species found in Colorado.
- They are among the first to emerge in the early spring.
- Commonly found nesting in human-made bee hotels.
- The females gather mud to build, create partitions, and seal up each nest cell in existing cavities.
- Several species are managed as important crop pollinators. *Osmia lignaria*, the blue orchard bee, are efficient pollinators of apples, plums, pears, almonds, and more.

Figure 82. Clockwise starting top left: 1) *Stelis lateralis*. Photo: Kamren Jefferson, USGS Bee Inventory and Monitoring Lab, 2) *Stelis* sp. Photo: Heidi Eaton, 3) *Stelis nitida*. Photo: Sara Guerierri, USGS Bee Inventory and Monitoring Lab



## *Stelis* spp. — Cuckoo Bees

**SIZE:** Tiny to large, 5 - 17 mm

**ID TIPS:** Body is entirely black, sometimes metallic. Pale-colored hairs may be visible on body. Some species have yellow markings on body and legs. Abdomen may have yellow stripes similar to a wasp. The face has two yellow stripes running vertically and parallel between the eyes. Other species will have an entirely black body with very few markings. The abdomen may have some pale-colored dots or patches on each side.

**POLLEN-CARRYING METHOD:** None

**NESTING:** Cavity nesters, mostly in Megachilidae nests

**SOCIALITY:** Cleptoparasitic

**FORAGING HABITS:** Forages for nectar only, does not collect pollen

**SIMILAR LOOKING BEES:** *Megachile* spp., *Hoplitis* spp., *Nomada* spp., Anthidiini tribe bees. Note: May look like wasps.

**ADDITIONAL NOTES:**

- Found worldwide with 20 species found in Colorado.
- Parasites of bees in the Megachilidae family. The female will enter a nest and lay an egg while the host bee is foraging for pollen and nectar. After hatching, the *Stelis* bee larva will out-compete and kill the host bee larva.

Figure 83. Clockwise starting top left: 1) *Trachusa* sp. Photo: Bill Maynard, 2) *Trachusa dorsalis*, male. Photo: USGS Bee Inventory and Monitoring Lab, 3) *Trachusa* sp. Photo: Bill Maynard



## *Trachusa* spp. — No Common Name

**SIZE:** Tiny to large, 9 - 20 mm

**ID TIPS:** Round, robust shape. Black and yellow bodies and pale-colored hairs may be visible. Some species may have yellow legs. The abdomen has similar markings to other Anthidiini tribe bees and wasps. Some species may have a black abdomen with thin, pale-colored hair bands.

**POLLEN-CARRYING METHOD:** Scopae on the underside of abdomen

**NESTING:** Ground nesters

**SOCIALITY:** Solitary

**FORAGING HABITS:** Mesolectic

**SIMILAR LOOKING BEES:** *Anthidium* spp. and *Anthidiellum* spp. Note: May look like wasps.

**ADDITIONAL NOTES:**

- Found in the northern and western hemispheres. Rare to see in Colorado, but two species have been documented.
- Unlike most other Megachilidae bees, *Trachusa* nest underground and build their own nests. They use plant resin to line the inside of their nests.
- In the southwestern US and Mexico, *Trachusa larrea* specializes on the creosote bush (*Larrea tridentata*). The female uses plant resin from the bush to build her nest.

# Appendix A - Taxonomic Classification

| Genus | Tribe | Subfamily | Family |
|---|---|---|---|
| *Agapostemon* | Halictini | Halictinae | Halictidae |
| *Andrena* | Andrenini | Andreninae | Andrenidae |
| *Anthidiellum* | Anthidiini | Megachilinae | Megachilidae |
| *Anthidium* | Anthidiini | Megachilinae | Megachilidae |
| *Anthophora* | Anthophorini | Apinae | Apidae |
| *Apis* | Apini | Apinae | Apidae |
| *Augochlorella* | Augochlorini | Halictinae | Halictidae |
| *Augochloropsis* | Augochlorini | Halictinae | Halictidae |
| *Bombus* | Bombini | Apinae | Apidae |
| *Calliopsis* | Calliopsini | Panurginae | Andrenidae |
| *Ceratina* | Ceratinini | Xylocopinae | Apidae |
| *Coelioxys* | Megachilini | Megachilinae | Megachilidae |
| *Colletes* | — | Colletinae | Colletidae |
| *Diadasia* | Emphorini | Apinae | Apidae |
| *Dianthidium* | Anthidiini | Megachilinae | Megachilidae |
| *Dieunomia* | — | Nomiinae | Halictidae |
| *Epeolus* | Epeolini | Nomadinae | Apidae |
| *Eucera* | Eucerini | Apinae | Apidae |
| *Habropoda* | Anthophorini | Apinae | Apidae |
| *Halictus* | Halictini | Halictinae | Halictidae |
| *Heriades* | Osmiini | Megachilinae | Megachilidae |



| Genus | Tribe | Subfamily | Family |
|---|---|---|---|
| *Holcopasites* | Ammobatoidini | Nomadinae | Apidae |
| *Hoplitis* | Osmiini | Megachilinae | Megachilidae |
| *Hylaeus* | — | Hylaeinae | Colletidae |
| *Lasioglossum* | Halictini | Halictinae | Halictidae |
| *Lithurgopsis* | Lithurgini | Megachilinae | Megachilidae |
| *Macrotera* | Panurgini | Panurginae | Andrenidae |
| *Megachile* | Megachilini | Megachilinae | Megachilidae |
| *Melissodes* | Eucerini | Apinae | Apidae |
| *Nomada* | Nomadini | Nomadinae | Apidae |
| *Nomia* | — | Nomiinae | Halictidae |
| *Osmia* | Osmiini | Megachilinae | Megachilidae |
| *Panurginus* | Panurgini | Panurginae | Andrenidae |
| *Peponapis* | Eucerini | Apinae | Apidae |
| *Perdita* | Panurgini | Panurginae | Andrenidae |
| *Protandrena* | Protandrenini | Panurginae | Andrenidae |
| *Pseudopanarganus* | Protandrenini | Panurginae | Andrenidae |
| *Sphecodes* | Halictini | Halictinae | Halictidae |
| *Stelis* | Anthidiini | Megachilinae | Megachilidae |
| *Svastra* | Eucerini | Apinae | Apidae |
| *Trachusa* | Anthidiini | Megachilinae | Megachilidae |
| *Triepeolus* | Epeolini | Nomadinae | Apidae |
| *Xenoglossa* | Eucerini | Apinae | Apidae |

# Appendix B - Index of Common Names

Table B.1. Classification by genus, common name, and morphospecies group. The morphospecies refers to the groups in the Native Bee Watch Community Science program. See Appendix C and D for more information.

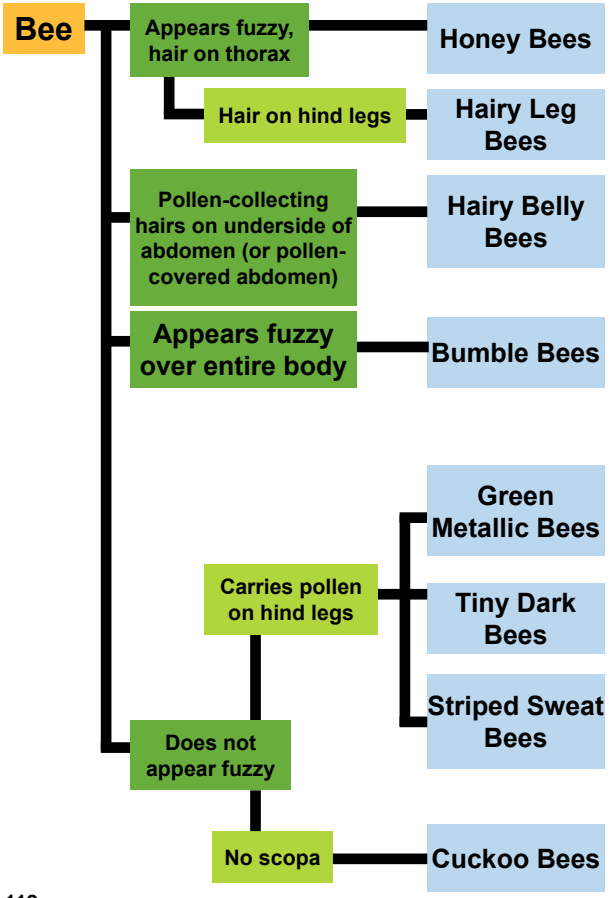
| Genus | Common Name | Morphospecies Group | Page |
|---|---|---|---|
| *Agapostemon* | Green metallic sweat bee | Green metallic sweat bee | 74 |
| *Andrena* | Mining bees | Hairy leg bees | 26 |
| *Anthidiellum* | Rotund resin bees | Hairy belly bees | 90 |
| *Anthidium* | Wool Carder bees | Hairy belly bees | 92 |
| *Anthophora* | Digger bees | Hairy leg bees | 40 |
| *Apis* | Honey bees | Honey bees | 42 |
| *Augochlorella* | Green metallic sweat bee | Green metallic sweat bee | 76 |
| *Augochloropsis* | Green metallic sweat bee | Green metallic sweat bee | 78 |
| *Bombus* | Bumble bees | Bumble bees | 44 |
| *Calliopsis* | Mining bees | Tiny dark bees | 28 |
| *Ceratina* | Small carpenter bees | Tiny dark bees | 46 |
| *Coelioxys* | Cuckoo bees | Cuckoo bees | 94 |
| *Colletes* | Cellophane/ plasterer bees | Hairy leg bees or hairy belly bees | 70 |
| *Diadasia* | Sunflower bees | Hairy leg bees | 48 |
| *Dianthidium* | Pebble bees | Hairy belly bees | 96 |
| *Dieunomia* | Sweat bees | Striped sweat bees, hairy leg bees, or hairy belly bees | 80 |
| *Epeolus* | Cuckoo bees | Cuckoo bees | 50 |
| *Eucera* | Longhorned bees | Hairy leg bees | 52 |
| *Habropoda* | Mountain digger bees | Hairy leg bees | 54 |
| *Halictus* | Sweat bees | Striped sweat bees or tiny dark bees | 82 |
| *Heriades* | No common name | Hairy belly bees | 98 |
| *Holcopasites* | Cuckoo bees | Cuckoo bees | 56 |
| *Hoplitis* | Small mason bees | Hairy belly bees | 100 |
| *Hylaeus* | Yellow-faced or masked bees | Tiny dark bees | 72 |

| Genus | Common Name | Morphospecies Group | Page |
|---|---|---|---|
| *Lasioglossum* | Sweat bees | Striped sweat bees or tiny dark bees | 84 |
| *Lithurgopsis* | Orange-tipped woodborer | Hairy belly bees | 102 |
| *Macrotera* | Sandstone mining bees | Tiny dark bees | 30 |
| *Megachile* | Leafcutter bees | Hairy belly bees | 104 |
| *Melissodes* | Longhorned bees | Hairy leg bees | 58 |
| *Nomada* | Cuckoo bees | Cuckoo bees | 60 |
| *Nomia* | Alkali bees | Striped sweat bees | 86 |
| *Osmia* | Mason bees | Hairy belly bees | 106 |
| *Panurginus* | Mining bees | Tiny dark bees | 32 |
| *Peponapis* | Squash bees | Hairy leg bees | 62 |
| *Perdita* | Fairy mining bees | Tiny dark bees | 34 |
| *Protandrena* | Mining bees | Tiny dark bees | 38 |
| *Pseudopanarganus* | Mining bees | Tiny dark bees | 36 |
| *Sphecodes* | Cuckoo bees | Cuckoo bees | 88 |



| Genus | Common Name | Morphospecies Group | Page |
|---|---|---|---|
| *Stelis* | Cuckoo bees | Cuckoo bees | 108 |
| *Svastra* | Sunflower bees | Hairy leg bees | 64 |
| *Trachusa* | No common name | Hairy belly bees | 110 |
| *Triepeolus* | Cuckoo bees | Cuckoo bees | 66 |
| *Xenoglossa* | Squash bees | Hairy leg bees | 68 |

# Appendix C - Native Bee Watch Key






# Appendix D - Native Bee Watch Morphospecies Traits

## HONEY BEES
- Hairs on head and thorax; black stripes visible on abdomen
- Carries pollen in corbiculae on flattened hind legs

## HAIRY LEG BEES
- Larger bees with dense hairs on head and thorax
- Carries pollen on scopae prominently seen on hind legs

## HAIRY BELLY BEES
- Variations in shapes, sizes, and colors
- Carries pollen on scopae prominently on the underside of the abdomen

## BUMBLE BEES
- Larger, round-shaped bees with hairs all over body
- Carries pollen in corbiculae on hind legs

## GREEN METALLIC SWEAT BEES
- Medium-sized or smaller; oval-shaped; green head and thorax; abdomen may be green, or striped with black, and white or yellow
- Carries pollen on hind leg scopae

## TINY DARK BEES
- Small, black bees, can be metallic-colored
- Most carry pollen on hind leg scopae

## STRIPED SWEAT BEES
- Medium-size or smaller oval-shaped bee
- Black and white stripes on abdomen
- Carries pollen on hind leg scopae

For more details, refer to the *Native Bee Watch: A Colorado Citizen Science Field Guide* at NativeBeeWatch.org.

## CUCKOO BEES
- Variations in size, shape, and color depending on species
- Some have wasp-like markings
- Sparse-to-no hairs visible; no pollen-carrying structure

# Appendix E - Bee Nest Examples

Observing bees on flowers can be a great way to learn more about them. Be sure to look for places where bees may nest in your area. Here are some examples of bee nests you might find.

## GROUND NESTS

Figure 84. *Diadasia* spp. nest aggregation. Photo: Bill Maynard

Figure 85. *Diadasia* spp. nest turret. Photo: Bill Maynard

Figure 86. A nest turret from possibly a *Diadasia* spp. Photo: Carol English

Figure 87. *Agapostemon* spp. nest. Photo: Lisa Mason

Figure 88. *Agapostemon* spp. nest. Photo: Rachelle Stoddard

Figure 89. *Agapostemon* spp. nest. Photo: Grace Wright

Figure 90. *Agapostemon* spp. nest. Photo: Lisa Mason

Figure 91. An *Andrena* spp. nest. Photo: Whitney Cranshaw

Figure 92. A *Colletes* spp. nest. Photo: MaLisa Spring



Figure 93. A bee exiting a ground nest. Photo: MaLisa Spring

Figure 94. Bee nests. Photo: MaLisa Spring

Figure 95. A *Nomia melanderi* nest aggregation. Photo: Bob Hammon

## CAVITY NESTS

Figure 96. A leafcutter bee (*Megachile* spp.) nest. Photo: Nicole Didero

Figure 97. A *Megachile* spp. nest in a bee hotel. Photo: Eric Eaton

Figure 98. *Megachile* spp. in old mud dauber wasp nests. Photo: Eric Eaton

Figure 99. The sealed-up entrance of a *Megachile* spp. nest. Photo: Lisa Mason

Figure 100. *Megachile* spp. making a nest between patio stones. Photo: Lisa Mason

Figure 101. A human-made bee hotel. Photo: MaLisa Spring

Figure 102. A *Ceratina* spp. nest in a twig. Photo: MaLisa Spring

Figure 103. A *Ceratina* spp. making a nest in a twig. Photo: MaLisa Spring

Figure 104. A nest in a twig showing a larva, pollen, and nectar. Photo: MaLisa Spring

## FREE-STANDING NESTS

Figure 105. *Dianthidium* spp. free-standing nest on a rock. Photo: Eric Eaton

Figure 106. *Dianthidium* spp. free-standing nest on flagstone. Photo: Lisa Mason

Figure 107. A *Dianthidium* spp. collecting pebbles for her nest. Photo: Eric Eaton

## HONEY BEE HIVES AND BUMBLE BEE NESTS

Figure 108. Managed honey bee hives in an apiary. Photo: Lisa Mason

Figure 109. A healthy frame within a managed honey bee hive. Photo: Lisa Mason

Figure 110. A bumble bee, *Bombus* spp. nest. Photo: MaLisa Spring

## SOLITARY WASP NESTS SIMILAR TO BEE NESTS

Figure 111. *Pseudomasaris* spp. (pollen wasp) nest. Photo: Eric Eaton

Figure 112. A grass-carrying wasp, *Isodontia* spp. nest in a bee hotel. Photo: Susan Tamulonis

Figure 113. A cuckoo wasp, *Chrysura* spp. scouting solitary wasp nests in a bee hotel. Photo: Lisa Mason



# Appendix F - Habitat for Bees

You can attract a variety of bees and other pollinators to your landscape by providing habitat for them. All pollinators need food, water, shelter, and space. Consider the following tips:

## FOOD

- Plant a diversity of flowers that bloom from spring to fall.
- Consider using a variety of native plants in your landscape.
- Avoid “double flowers” that have extra petals but are sterile and do not offer pollen or nectar resources.
- Plant groups or swaths of the same plant rather than a single plant to allow bees to be more efficient at pollination.

## SHELTER

- For solitary, ground-nesting bees: 1) provide bare soil areas, 2) minimize bark mulch use, 3) remove weed fabric, 4) consider no-till gardening, and 5) decrease turf grass area.
- For cavity-nesting bees: 1) add dead logs or other wood sources, 2) provide a bee hotel, and follow best practices like annual maintenance, 3) avoid removing hollow-stemmed plants in the fall, and 4) leave leaf litter in the fall.

## WATER

- Provide shallow bird baths or water dishes with river rocks.

## SPACE

- Design a landscape that meets your goals and supports bees.
- Consider wildscaping and mimicking natural habitat.
- Avoid or minimize pesticide use.

For more information, refer to CSU Extension Fact Sheet #5.616 - Creating Pollinator Habitat and CSU Extension Fact Sheet #5.615 - Attracting Native Bees to Your Landscape.

# References


Bennett, B., & Breed, M. D. (1985). The nesting biology, mating behavior, and foraging ecology of *Perdita opuntiae* (Hymenoptera: Andrenidae). *Journal of The Kansas Entomological Society, 58*(2), 185–194.

Cane, J.H. (1997). Lifetime monetary value of individual pollinators: The bee *Habropoda laboriosa* at rabbiteye blueberry (*Vaccinium ashei* reade). *Acta Horticulturae, 446*(8):67-70.

Cane, J.H., & Sipes, S. (2006). Floral specialization by bees: Analytical methods and a revised lexicon for oligolecty. In N. M. Waser & J. Ollerton (Eds.), *Plant-pollinator interactions: From specialization to generalization*. Univ. Chicago, Chicago, IL, USA. p. 99-122.

Cane, J.H. (n.d.). *Squash bees*. U.S. Forest Service. Retrieved March 7, 2021, from https://www.fs.fed.us/wildflowers/pollinators/pollinator-of-the-month/squash_bees.shtml

Delphia, C., & Griswold, T. (2021). First records, phenology, habitat, and host-plant associations of *Macrotera opuntiae* (Cockerell) (Hymenoptera: Andrenidae) in Montana. *Journal of Melittology, 102*. https://doi.org/10.17161/jom.i102.13700

Fowler, J. (2020). *Pollen specialist bees of the western United States*. Retrieved July 2, 2021, from https://jarrodfowler.com/pollen_specialist.html

Hurd, P. D., & Linsley, E. G. (1972). Parasitic bees of the genus Holcopasites Ashmead (Hymenoptera: Apoidea). *Smithsonian Contributions to Zoology, 114,* 1–40. https://doi.org/10.5479/si.00810282.114

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. (2017). *The assessment report on pollinators, pollination and food production*. Retrieved December 19, 2021, from https://ipbes.net/sites/default/files/downloads/pdf/2017_pollination_full_report_book_v12_pages.pdf

Iowa State University Department of Entomology. (2022). *BugGuide*. Retrieved January 10, 2022, from https://bugguide.net/

Jha, S., & Treviño, L. (2017). *Bees of central Texas general guide*. The Jha Lab. Retrieved March 8, 2021, from http://w3.biosci.utexas.edu/jha/wp-content/uploads//Texas-Bee-ID-Guide.pdf

Mason, L., & Arathi, H. S. (2019). Assessing the efficacy of citizen scientists monitoring native bees in urban areas. *Global Ecology and Conservation, 17,* e00561. https://doi.org/10.1016/j.gecco.2019.e00561

Mason, L., Arathi H. S., & Kondratieff, B. (2018). *Native Bee Watch citizen science field guide*. Colorado State University. Retrieved December 19, 2021, from https://arapahoe.extension.colostate.edu/wp-content/uploads/sites/10/2022/03/NBW_CitSci_FieldGuide_LowRez.pdf

Michener, C. D. (2007). *The bees of the world* (2nd ed.). Johns Hopkins University Press.

North American Native Bee Collaborative. (2020). *Bees of Ohio: A field guide*. North American Native Bee Collaborative. https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/2/86606/files/2020/06/Bees-of-Ohio_-A-Field-GuideV1.1.1.pdf

O'Brien, C., & Arathi, H. S. (2018). Bee genera, diversity and abundance in genetically modified canola fields. *GM Crops & Food, 9*(1), 31–38. https://doi.org/10.1080/21645698.2018.1445470

O'Brien, C., & Arathi, H. S. (2019). Bee diversity and abundance on flowers of industrial hemp (Cannabis sativa L.). *Biomass and Bioenergy, 122,* 331–335. https://doi.org/10.1016/j.biombioe.2019.01.015

O'Brien, C., & Arathi, H. S. (2021). If you build it, they will come—Agroecosystem-based management practices support pollinators. *Annals of the Entomological Society of America, 114*(3), 322-328

Ollerton, J., Winfree, R., & Tarrant, S. (2011). How many flowering plants are pollinated by animals? *Oikos, 120*(3), 321–326. https://doi.org/10.1111/j.1600-0706.2010.18644.x

Packer, L. (1990). Solitary and eusocial nests in a population of *Augochlorella striata* (Provaneher) (Hymenoptera; Halictidae) at the northern edge of its range. *Behavioral Ecology and Sociobiology, 27,* 339–344.

Rozen, J. G., & Hall, H. G. (2014). Nest site selection and nesting behavior of the bee *Lithurgopsis apicalid* (Megachilidae: Lithurginae). *American Museum Novitates, 3796,* 1–24. https://doi.org/10.1206/3796.1

Schwarz, H. F. (1926). North American *Dianthidium*, *Anthidiellum*, and *Paranthidium*. *American Museum Novitates, 226,* 26.



Scott, V. L., Ascher, J. S., Griswold, T., & Nufio, C. R. (2011). The bees of Colorado. *Natural History Inventory of Colorado, 23,* 1–100.

Strickler, K., Cane, J. H., & Entomological Society of America. (2003). *For nonnative crops: Whence pollinators of the future?* Lanham, Md: Entomological Society of America.

The Alkali Bee (*Nomia melanderi*). (n.d.). U.S. Forest Service. Retrieved March 7, 2021, from https://www.fs.fed.us/wildflowers/pollinators/pollinator-of-the-month/alkali_bee.shtml

The Great Sunflower Project. (2021). *The great sunflower project*. Retrieved from July 23, 2021, from https://www.greatsunflower.org

The Polistes Corporation. (2021). *Discover life*. Retrieved July 23, 2021, from https://www.discoverlife.org

Wilson, J. S., & Messinger, O. (2016). *The bees in Your backyard: A guide to North America's bees*. Princeton University Press.

NATIVE BEE WATCH

COLORADO STATE UNIVERSITY
EXTENSION

NativeBeeWatch.org