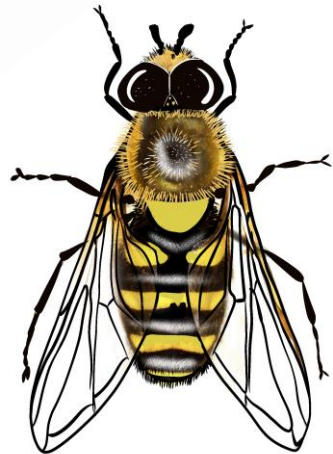
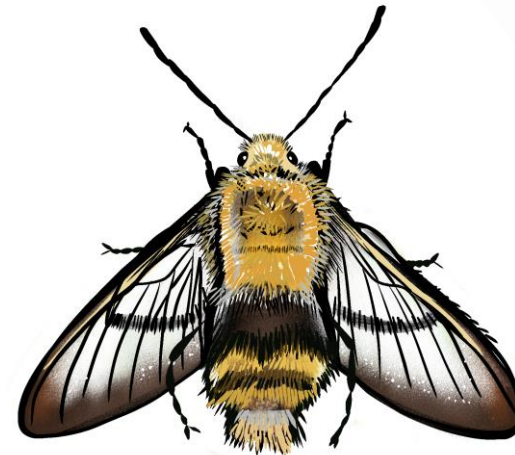
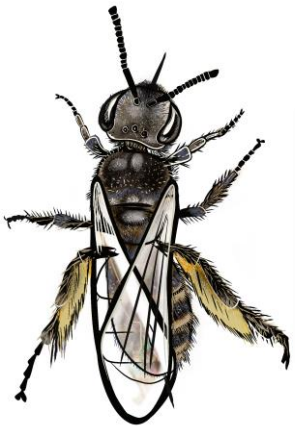
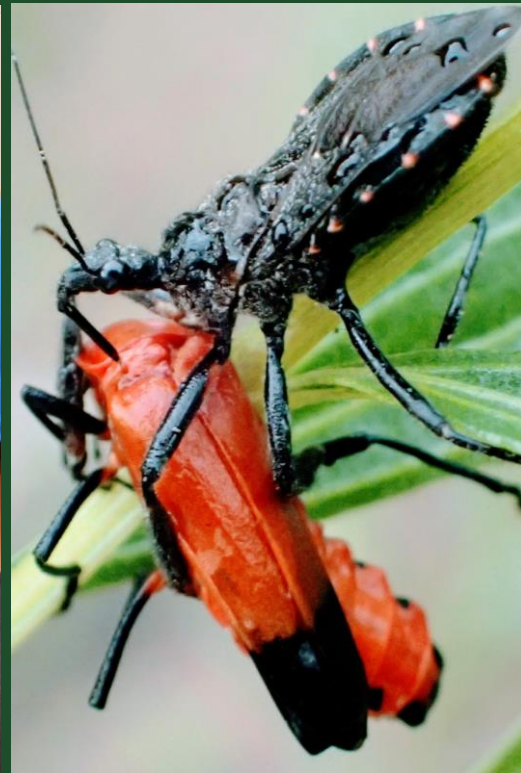


# Colorado Insect Pollinators You Want in Your Garden



Colorado State University  
Extension





# Melissa (Mel) Schreiner

Extension Entomologist  
Phone: (970) 244-1838

Email: [Melissa.Schreiner@colostate.edu](mailto:Melissa.Schreiner@colostate.edu)

Celebrating my 12<sup>th</sup>  
year at CSU!



COLORADO STATE UNIVERSITY  
EXTENSION

**Some  
Underappreciated  
Pollinators!**

# Agenda

Importance of Pollination

*Sphinx Moths*

*Flower Flies*

*Native Bees*

*Solitary Wasps*

Adapting Current Practices



**Colorado obtains diverse climates, ecosystems, agriculture, horticulture, natural resources and habitats that influence our land management**

Photos: Melissa Schreiner



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# Benefits of Insects

- Vital roles in nearly every ecosystem
- Pollinators
- Decomposers – the clean-up crew
- Predators
- Natural enemies against invasive species and pests
- Food for humans and other organisms
- Provide products
  - Honey
  - Silk
  - Shellac (wood finish, primer, etc.)





# Pollinator Power

- Approximately 1/3rd of the world's plants depend on insect pollinators
- Fruits, veggies and nuts
- Bees pollinate up to \$15 billion worth of crops each year
- Pollinate alfalfa and clover used to feed cattle
- 87 crops dependent on pollinators



# Main Groups of Pollinators



Photos: Mace Vaughan, Bob Hammon, David Inouye, Bruce Newhouse



**Pollinators provide a service that enables plants to produce fruits and seeds.**

- **About 70% of the world's plants require a pollinator**
- **35% of crop species, worldwide**
- **Value of crops in U.S.: \$18 to \$27 billion**
- **One in three mouthfuls of food and drink we consume**

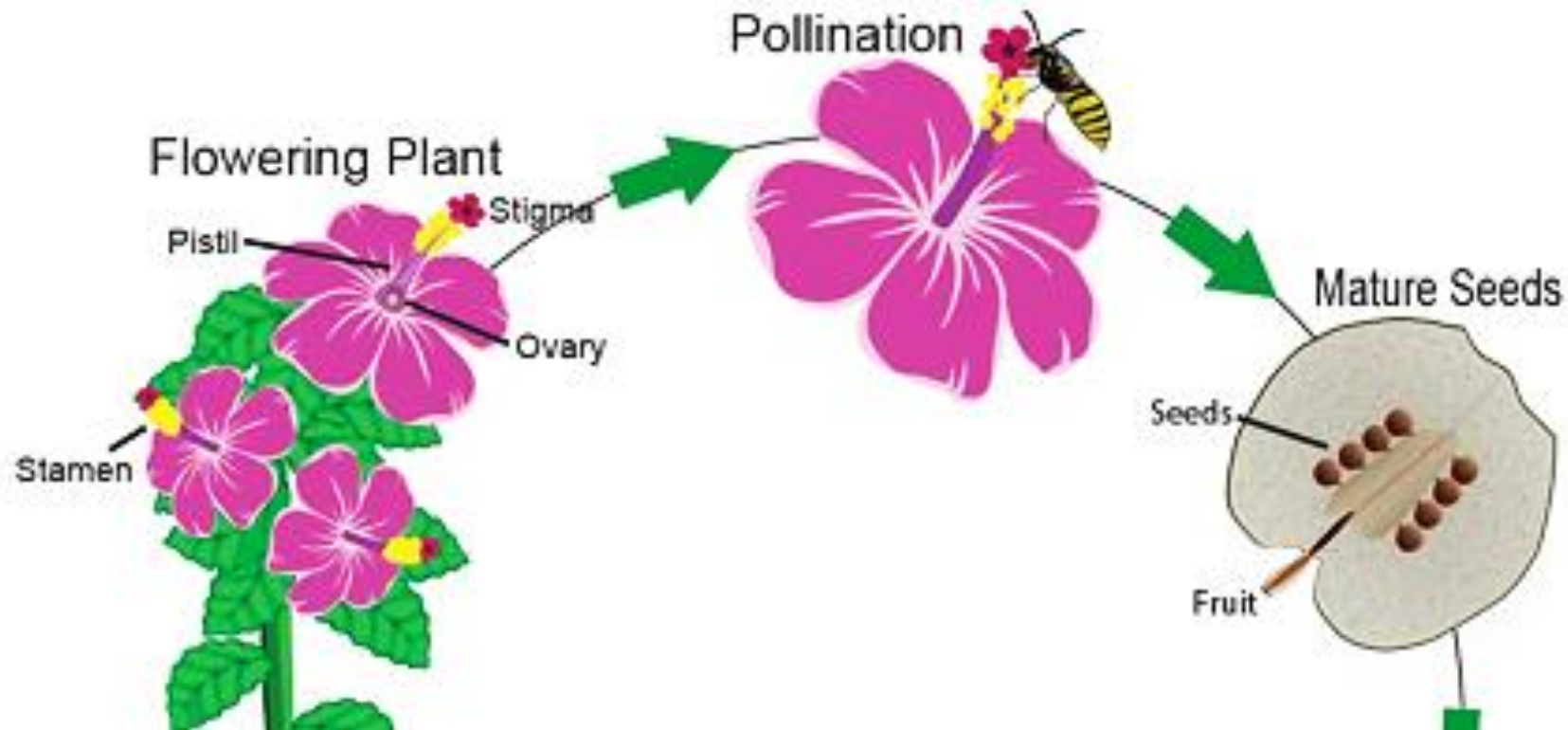
Photo: USDA-ARS/Peggy Greb

# Importance of Pollinators

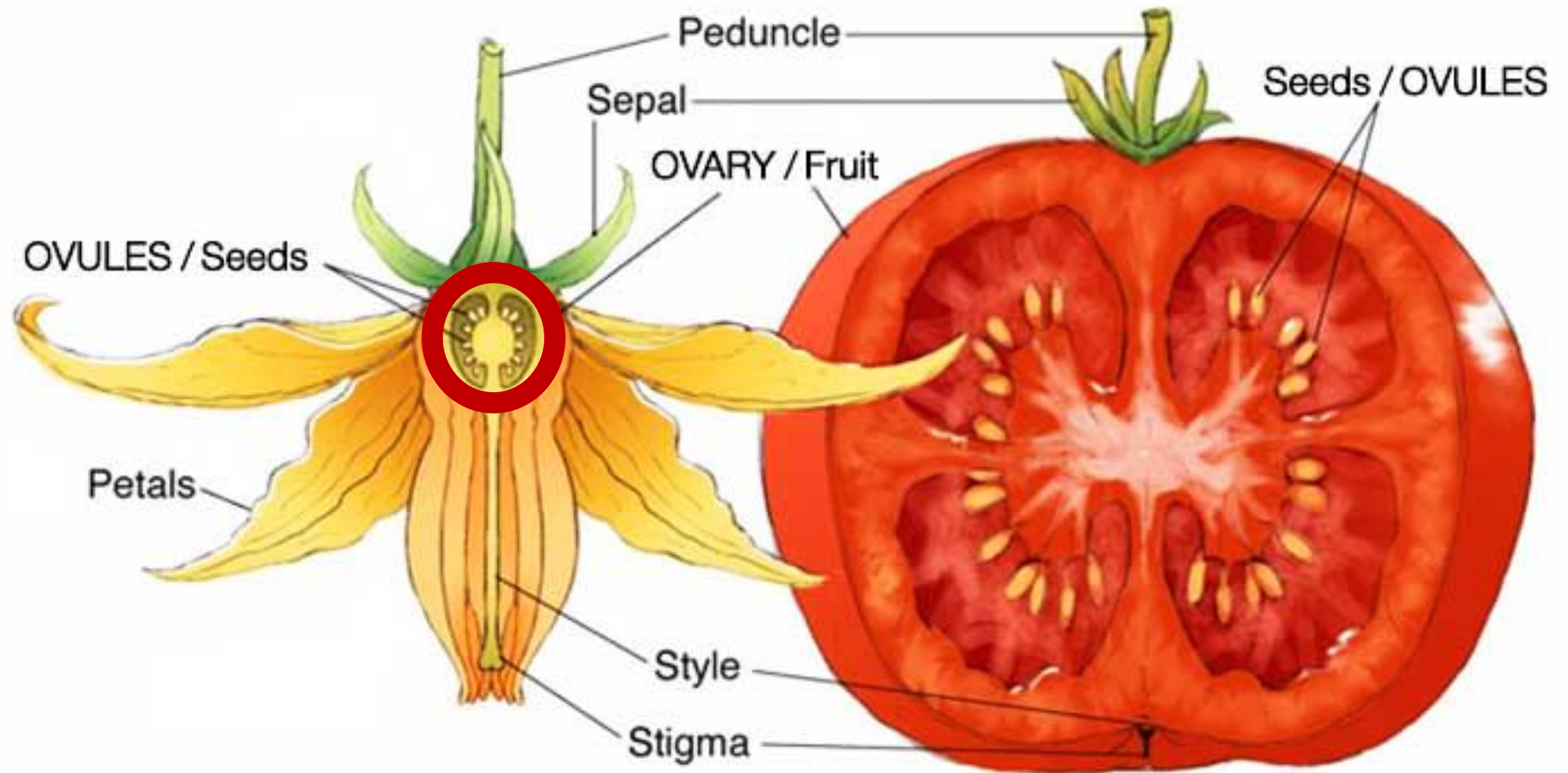
- Fruits and seeds are a major part of the diet of about 25% of birds, and many mammals
- Native plants that depend on pollinators for reproduction are food for a plethora of species



**The movement of plant pollen  
(by pollinators/wind/water/humans)  
results in fruit bearing seeds**



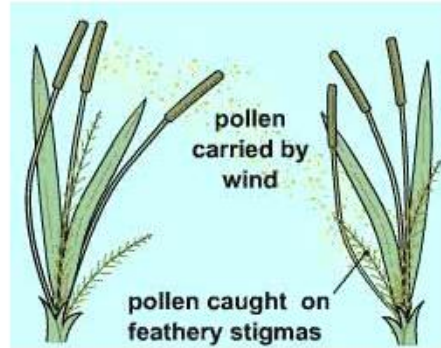
# Flowers turn into fruit that contain seeds



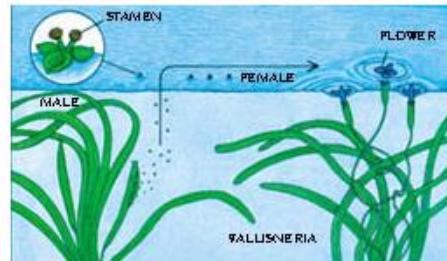
# Pollination Agent

**Abiotic factor**

**Wind**



**Water**



**Biotic factor**

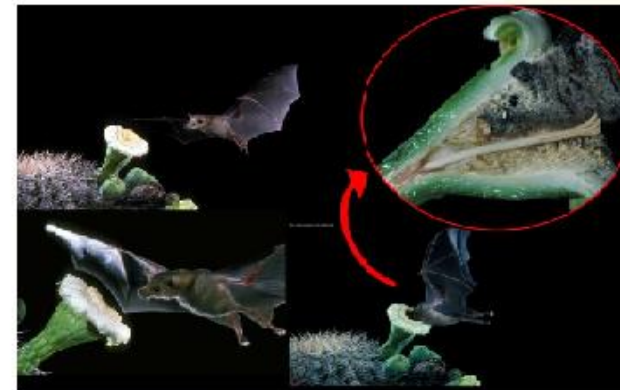
**Bird**



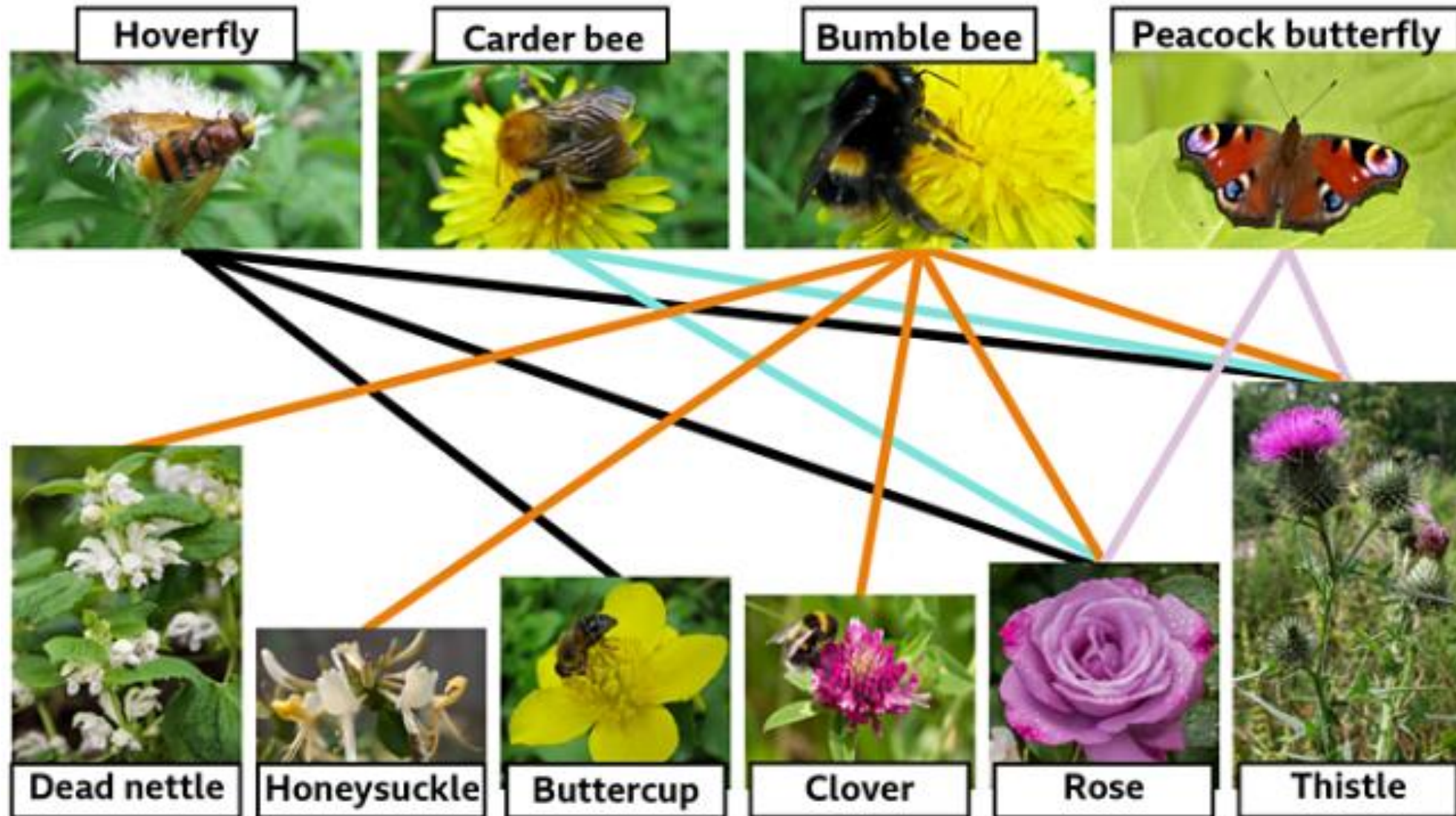
**Insect**



**Bat**



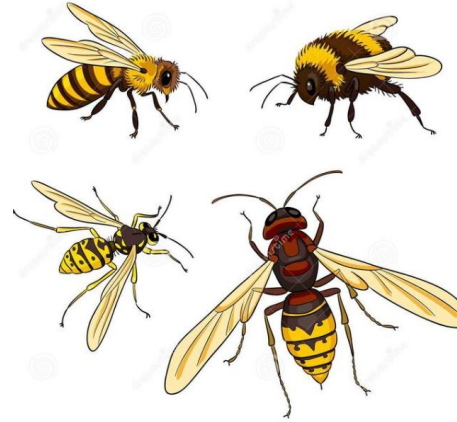
# Pollination allows plants to reproduce (fruit and seeds) and help plants survive over time!





**Pollinators  
help plants  
survive in our  
neighborhoods  
and in our  
gardens!**

# Pollinators help our forest **plant** and **wildlife** biodiversity



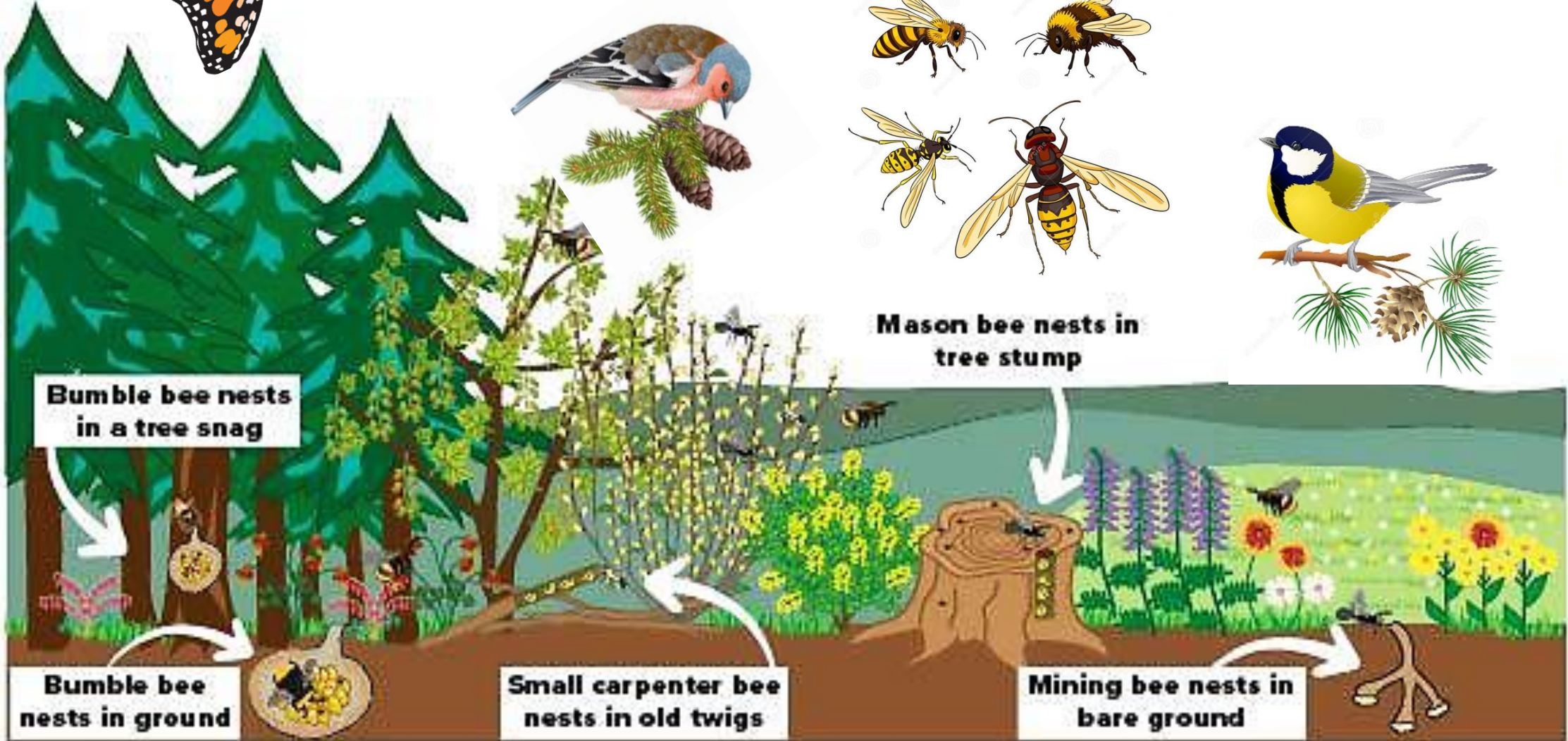
Mason bee nests in  
tree stump

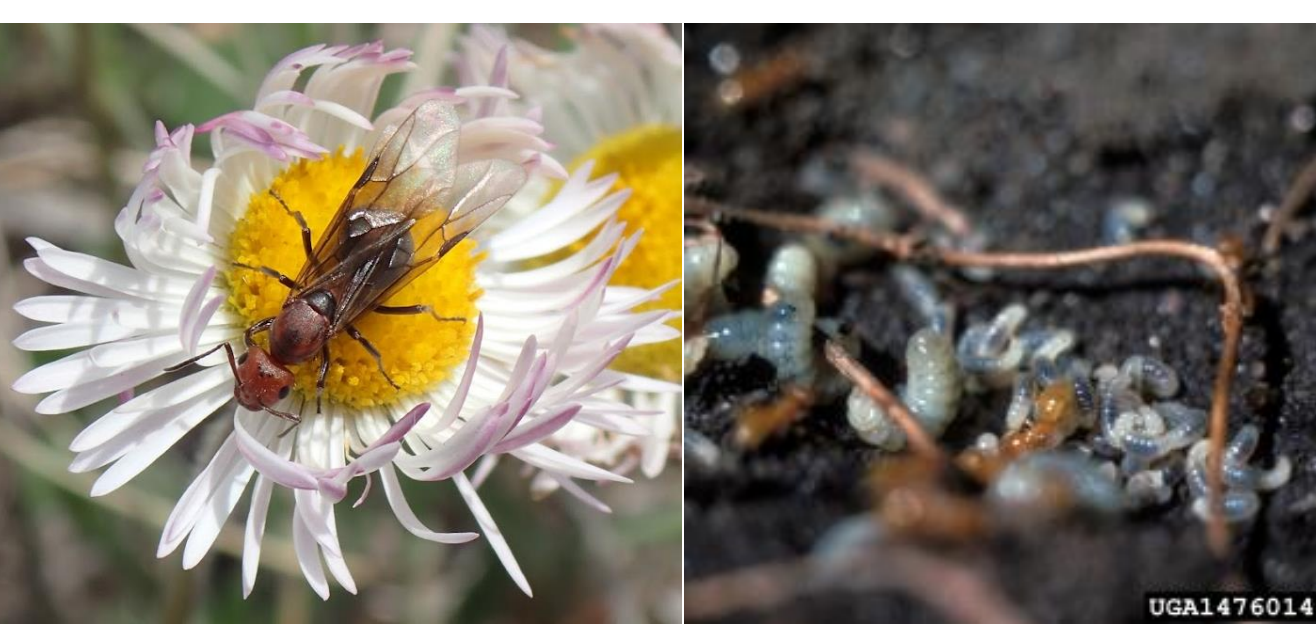
Bumble bee nests  
in a tree snag

Bumble bee  
nests in ground

Small carpenter bee  
nests in old twigs

Mining bee nests in  
bare ground





Insects, including ants, can provide bears with a source of protein and other nutrients.

They use their paws and strong claws to excavate the nests and then use their tongues to lick up the ants!



# Pollinators help plants survive in our cities and urban areas!



② Vegetable gardens



③ Flowering shrubs



④ Shade-loving flowers



⑤ Prairie pocket



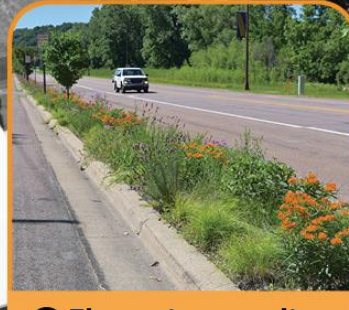
Ground-nesting bee



① Fruit trees



Cavity-nesting bee



⑥ Flowering median



⑦ Native "bee-lawn"

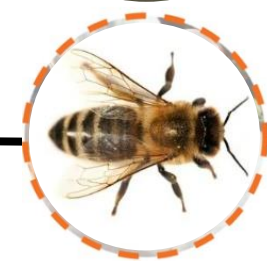
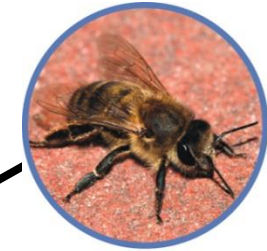


⑧ Rain gardens

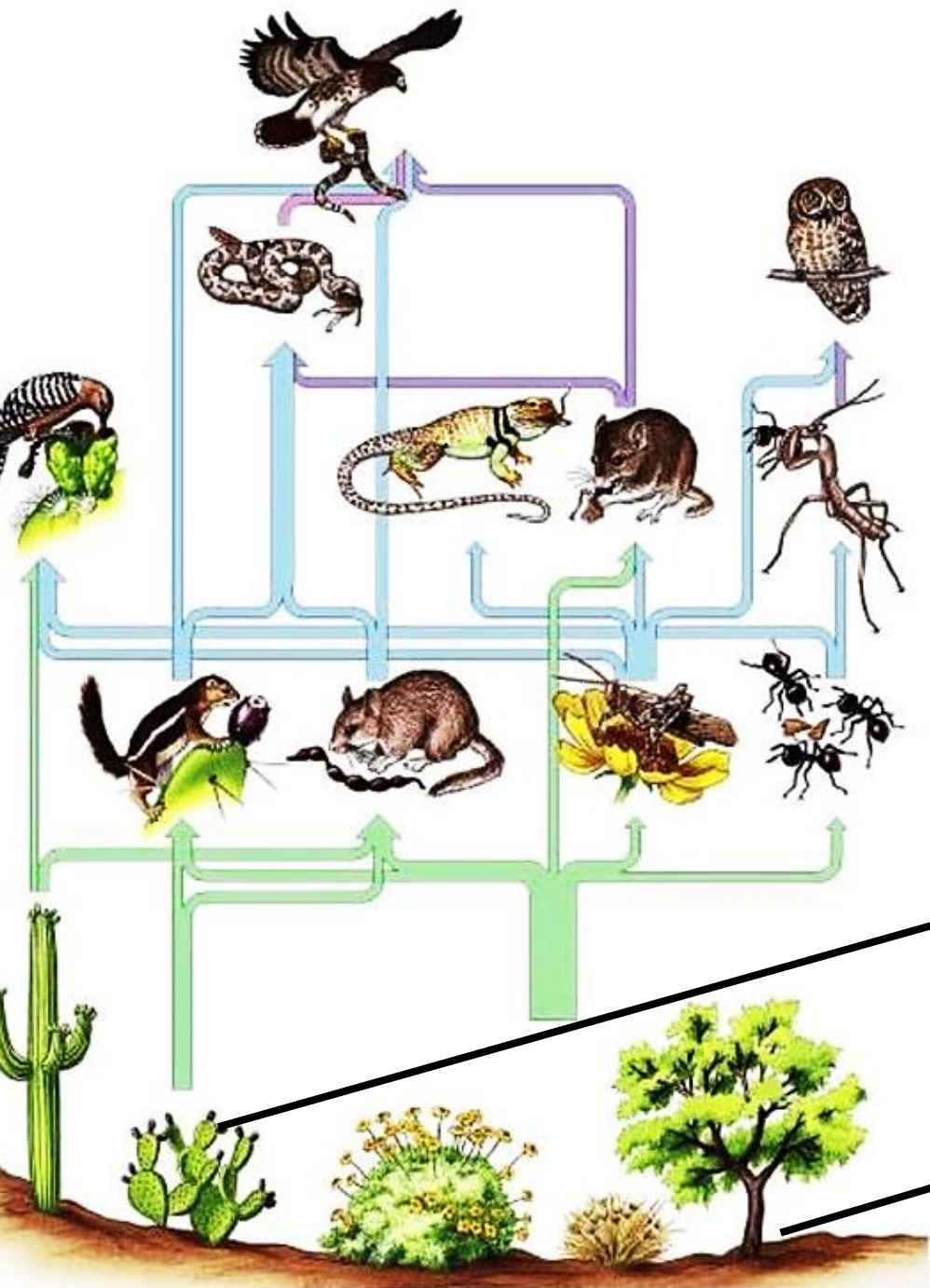


⑨ Flowering curb

# Pollinators help plants survive in our farms and urban areas!



# Pollinators help plants and animals survive in deserts and arid regions!



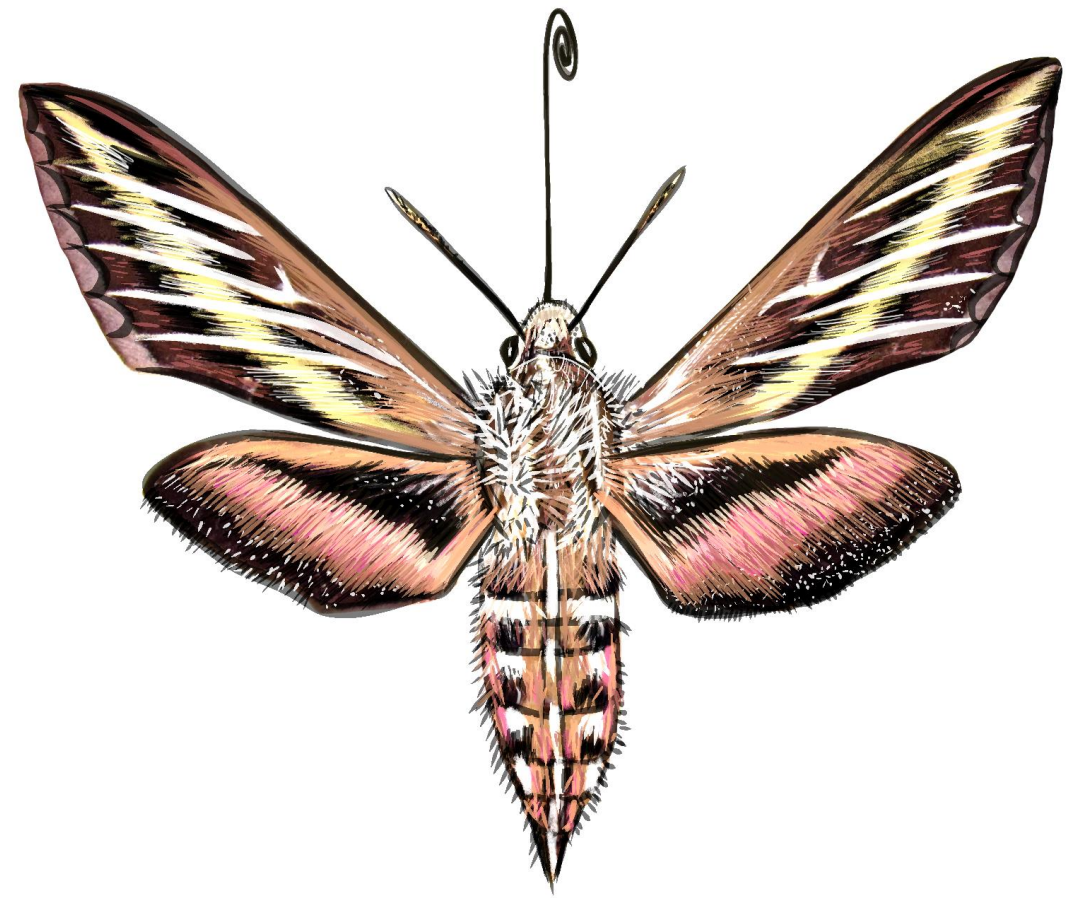
# Pollinators make “the world go round”!

**Food Security**  
**Plant Biodiversity**  
**Resources for Wildlife**  
**Ecosystem Health**  
**Erosion Control**  
**Soil Health**  
**Carbon Sequestration**  
**Raw Material Production**  
**Human Recreation**  
**Water Filtration**



# Hornworms and Hummingbird Moths

Lepidoptera: Sphingidae





**Hornworms are large caterpillars. Most have a “horn” on the end of the body.**



Two species can be damaging pests of tomatoes – the tomato hornworm and the tobacco hornworm

The “horn” is flexible and of no known function  
– *except perhaps to scare a gardener!*



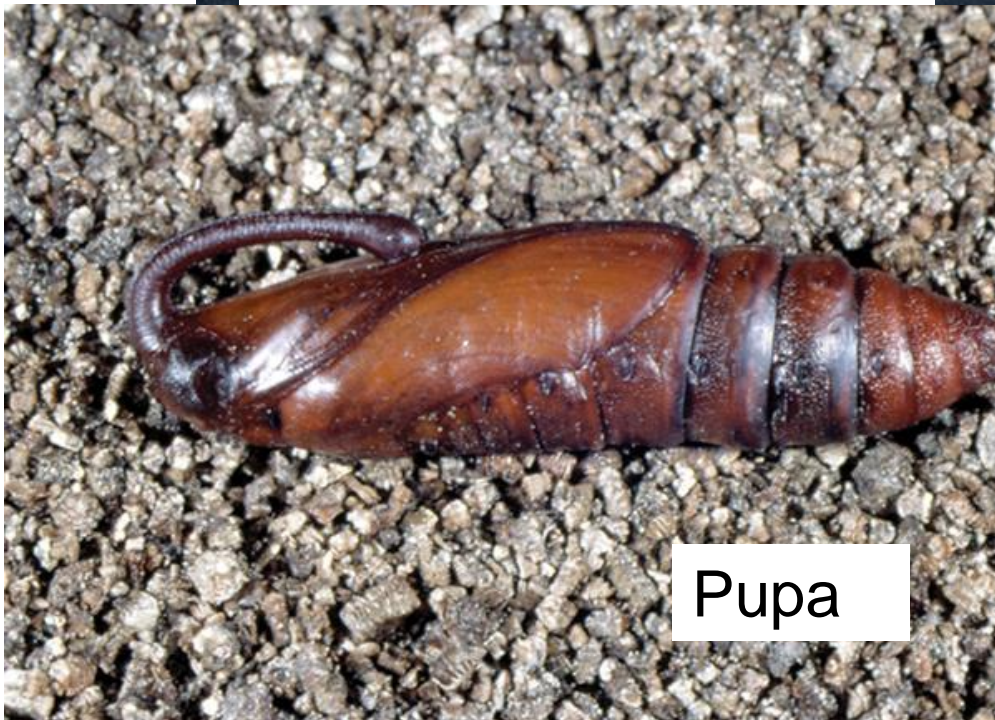


Adult (Sphinx Moth)

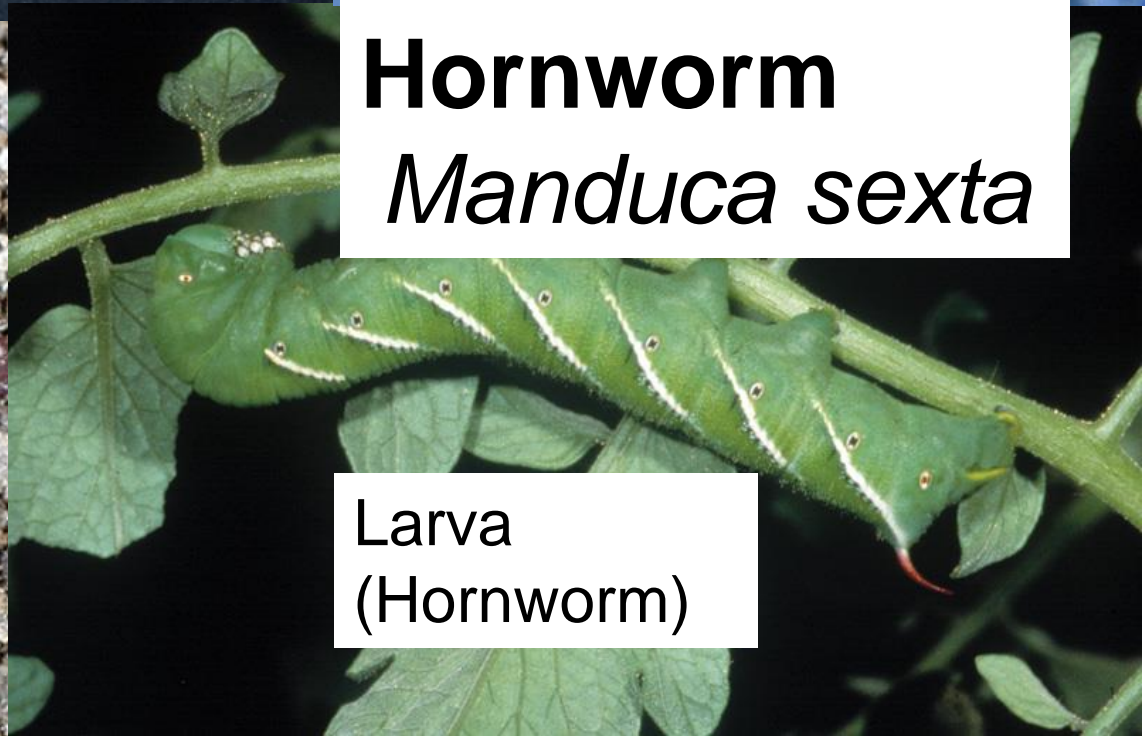


Egg

# **Tobacco Hornworm** *Manduca sexta*



Pupa



Larva  
(Hornworm)

Hornworms  
scatter the  
placement of their  
eggs on leaves of  
their host plant







**The full-grown caterpillars  
burrow into loose soil,  
form a small chamber, and  
pupate**





=



=



**Most  
sphinx  
moths fly  
only at  
night**







# **Whitelined sphinx**

***Hyles lineata***

**The most common  
hummingbird moth  
of the western US –  
and common  
throughout North  
America**



# Hummingbird clearwing sphinx

*Hemaris thysbe*





**Snowberry  
clearwing**  
*Hemaris  
diffinis*



**Some plants most often visited by hummingbird moths include:**

**Four o'clocks**

**Evening primrose**

**Larkspur**

**Gentian**

**Nasturtium**

**Catmint**

**Datura**

**Wild bergamot**

**Red valerian**

**Many *Agastache* spp.**

**Honeysuckle...**



# **Flower Flies (Syrphidae)**

**Adult flower flies sustain themselves on nectar**





# Flower fly larvae eat aphids



Brian Valentine



Brian Valentine



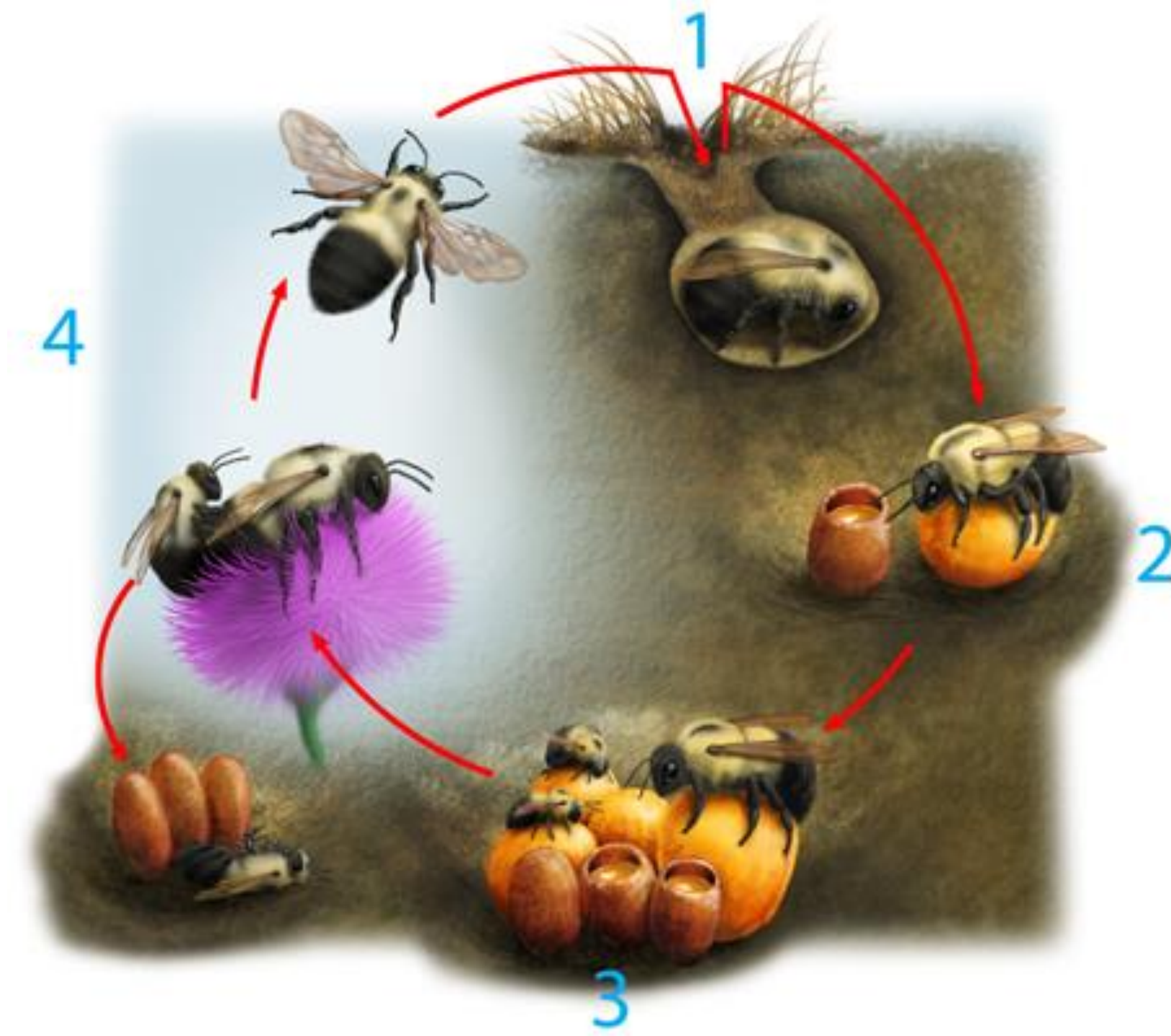
Ken Gray



# Bees: \*debated to be the most important pollinators

- Bees provide for their young
- Bees actively collect and transport pollen
- Bees exhibit flower constancy
- Bees regularly forage in area around nest





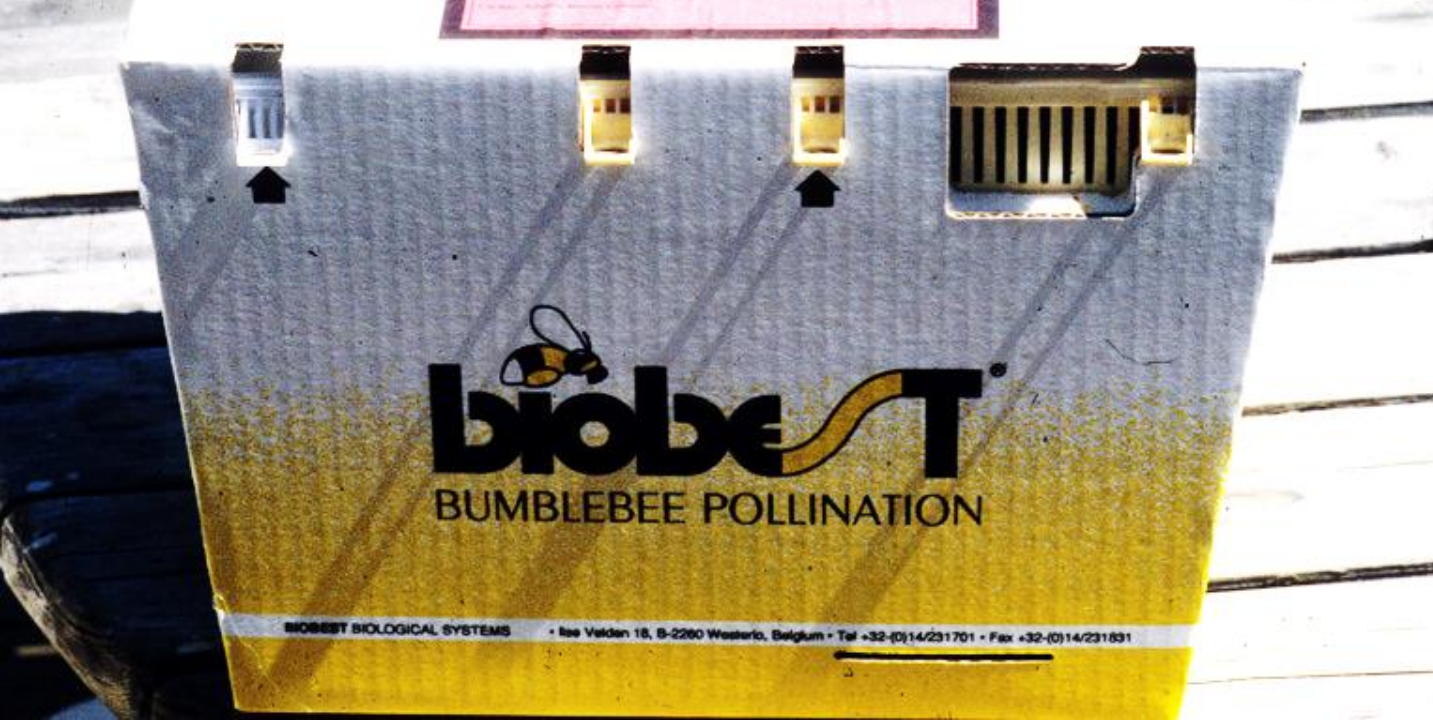
**Bumble  
bees make  
annual  
colonies,**

**Only  
queens  
overwinter**



In the wild, bumble bees nest underground in meadows, grasslands, forests, gardens, alpine/mountain regions, and costal areas of mainly the northern hemisphere





**Bumble bee colonies  
are sold for the  
pollination of certain  
crops by commercial  
insectaries**







**Some plants (e.g. the tomato) are dependent on buzz pollination**



**Bumble bees vibrate at a specific frequency that releases the pollen from the tightly contained tomato anthers**

# **Native bees**

**are very efficient:**

**active earlier and/or later in the day**

- **collect both pollen and nectar**
- **buzz pollination**
- **keep honey bees moving**
- **no rental fees**

**Native bees can supplement honey bees if they are hard to acquire.**

## **Crop Pollination: Native bees**



Photo: Mace Vaughan



**Most bees live as  
solitary organisms**



# Native Bees

Some solitary bees and some solitary wasps nest in the soil





**70% of solitary bees are ground nesters**



# The great majority of Colorado's 900+ species of solitary bees nest in the ground

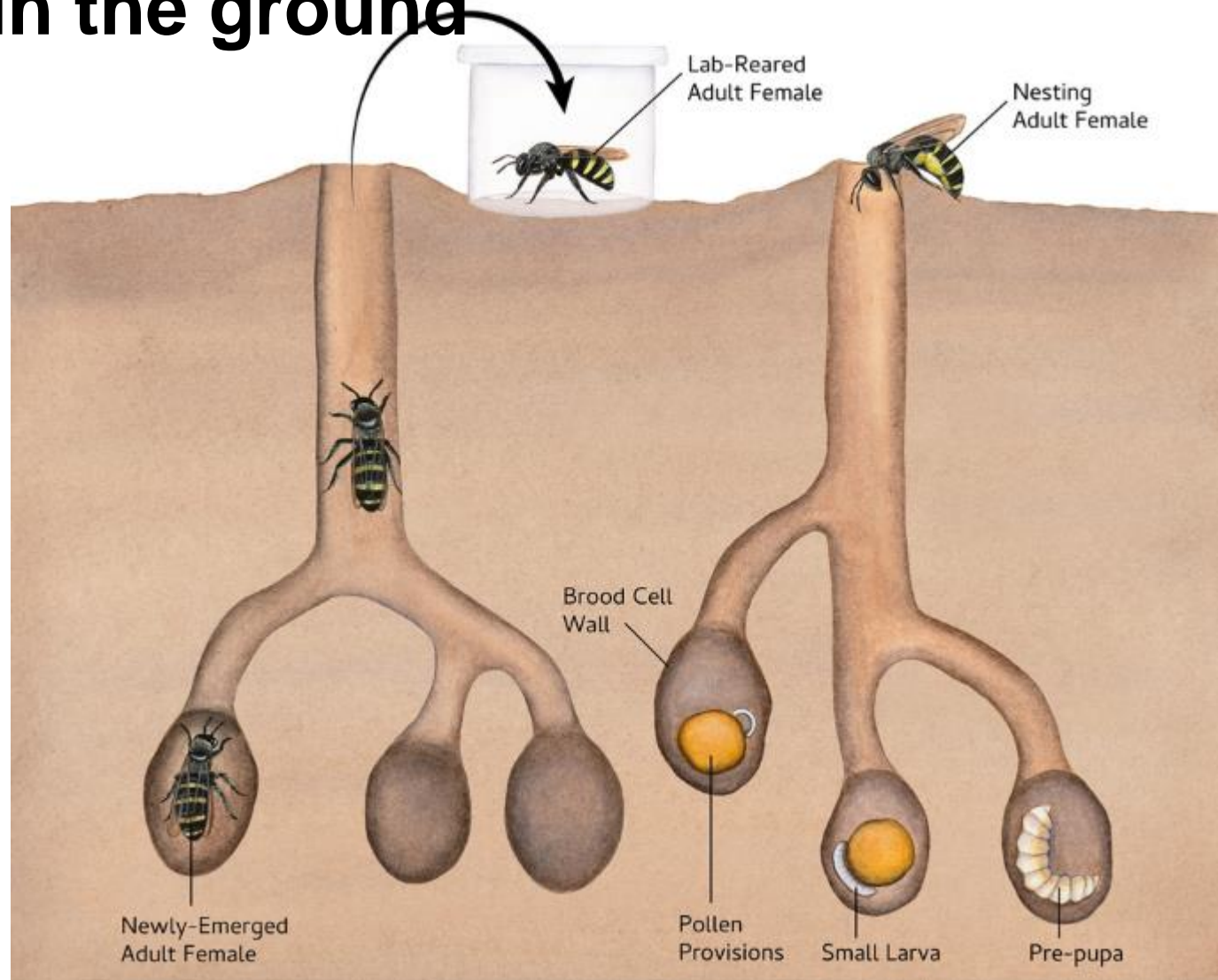


Image published in Nature



# Bee Basics: Life cycle of a solitary bee



Mining bee (*Andrena* sp.): a year in its underground nest as egg, larva, and pupa before emerging to spend a few weeks as an adult.



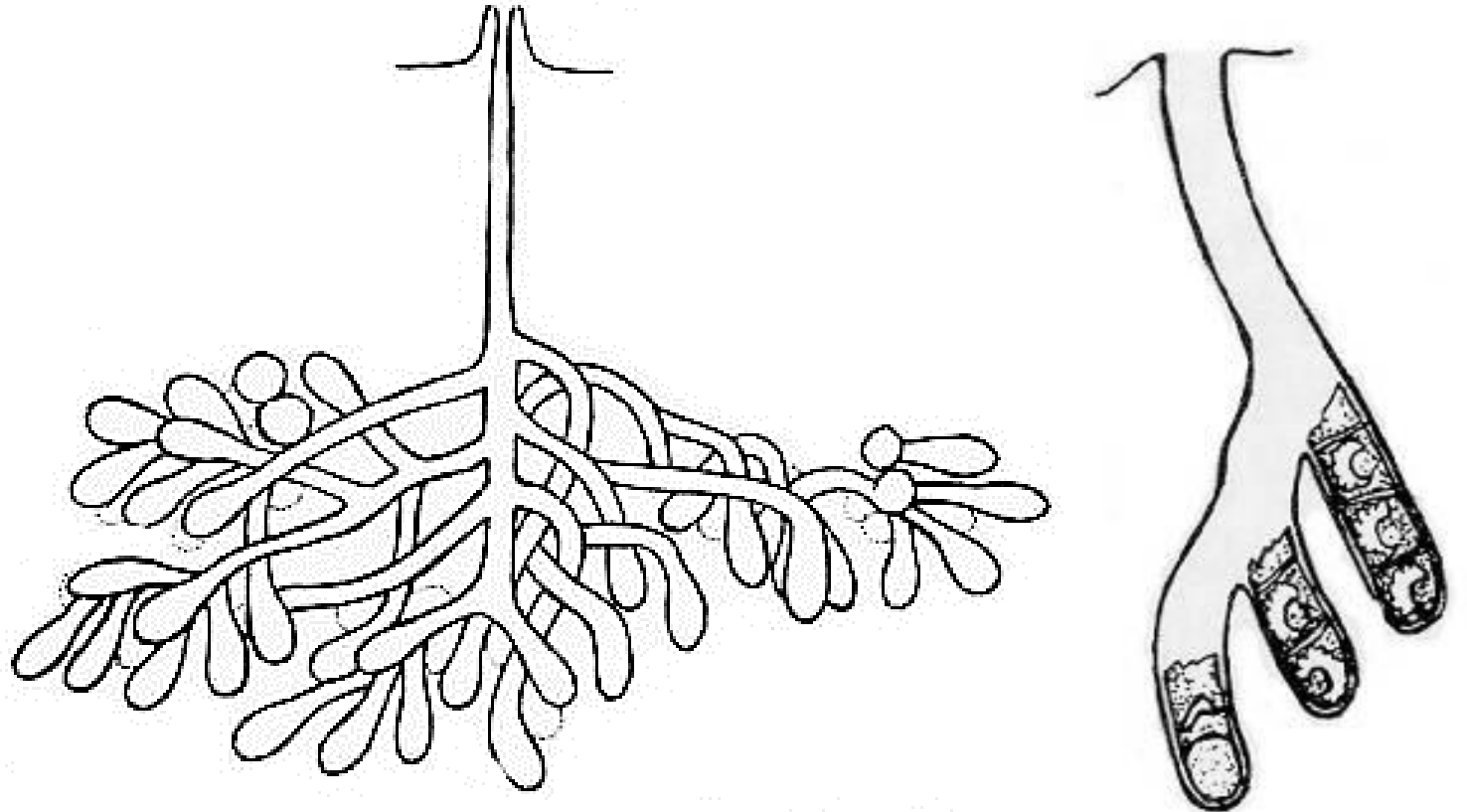
Photos: Dennis Briggs

# Bee Basics: Ground nests

Ground-nesting (~70%)



Photo: Matthew Shepherd



Source: Stephen, Bohart, and Torchio, 1967

# Solitary bee nests are not connected underground



# Bee Basics:

## Cavity nesters

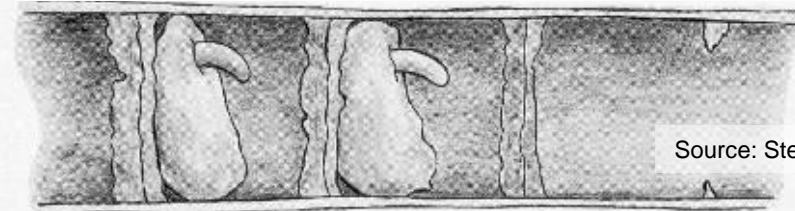
Tunnel-nesting (~30%)



Photo: Matthew Shepherd



© Edward Ross



Source: Stephen, Bohart, and Torchio, 1967



**Leafcutter bee cutting leaf fragment (above) and carrying it back to nest (left)**

A close-up photograph of a rose bush. The green leaves are heavily damaged by leafcutter bees, showing numerous large, irregular holes and jagged edges. Some small, light-colored flowers are visible in the upper left corner. A white text box is overlaid on the right side of the image.

# **Leafcutter Bee Damage to Rose**

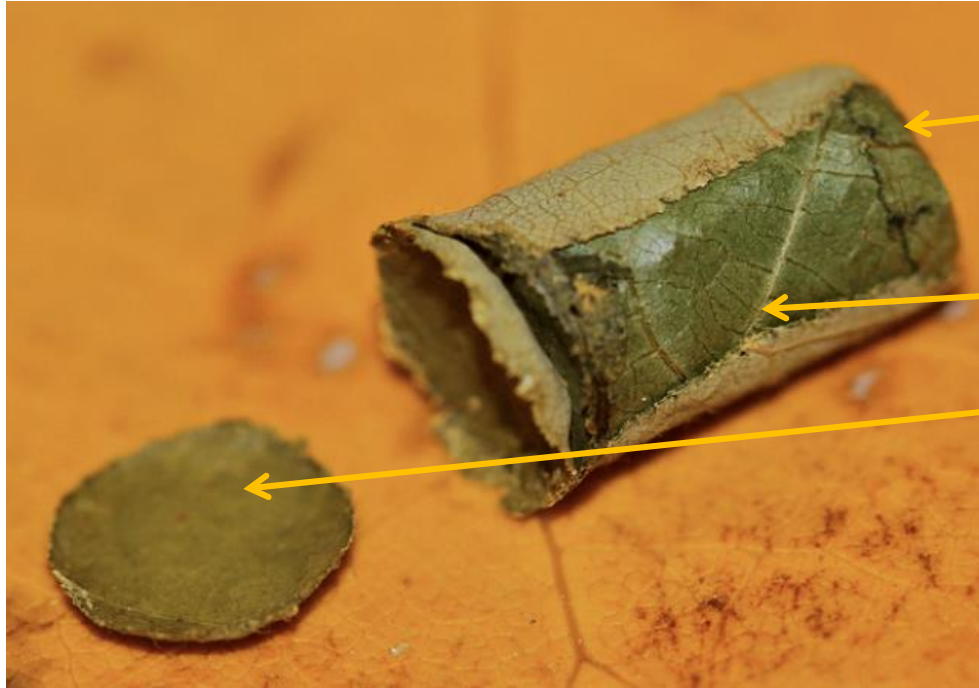
# **Leafcutter Bee Damage to Lilac**





**Leafcutter  
Bee  
Damage to  
Virginia  
Creeper**

# For nest construction:



**3-4 rectangular pieces,  
crimped for the base**

**Oval pieces along the  
sides of the cell**

**Nearly perfect circles  
used to cap the cell**





**For nest  
construction:**

**3-4 rectangular  
pieces, crimped  
for the base**

**Oval pieces along  
the sides of the  
cell**

**Near perfect  
circles used to cap  
the cell**

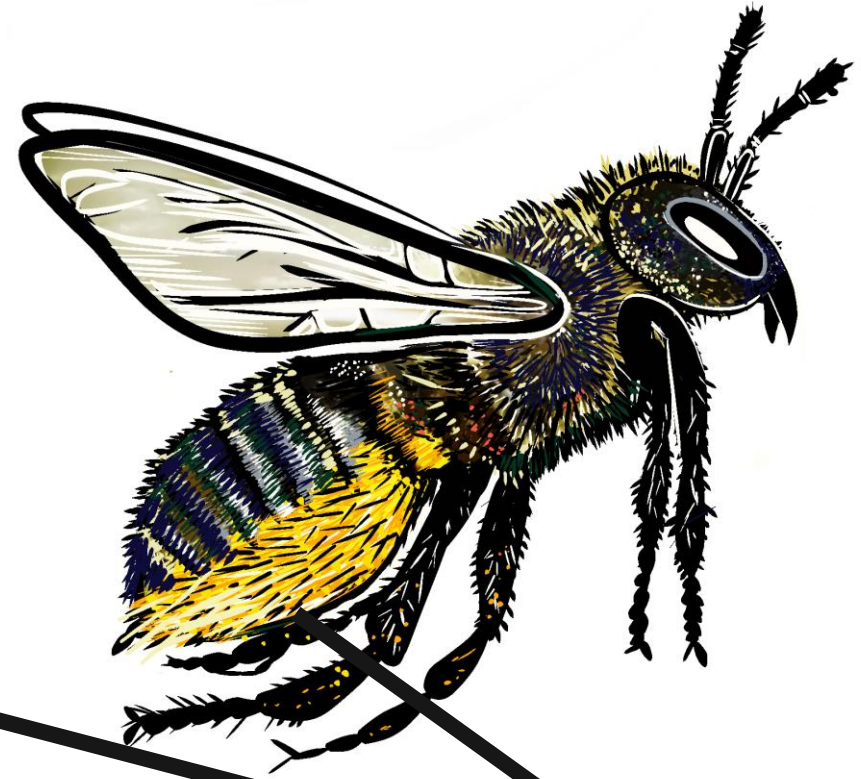
**All leaf fragments  
are oriented with  
the smooth side  
inwards**



**Photograph  
courtesy of  
David Shetlar**



# Leafcutter bees carry their pollen on the underside of the abdomen



**Scopa =  
hairs that  
hold bee  
pollen**

# Leafcutter bee excavation in rotten garden timber



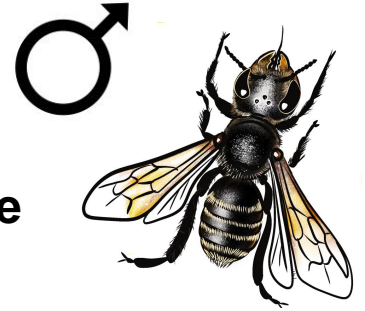
# Leafcutter bee cells in hollowed stem of a weed



**The young bees develop within the nest cell.  
They will remain dormant, emerging as an adult bee the following year.**



**Males  
emerge  
first**



**Females  
emerge  
second**





# Wasps

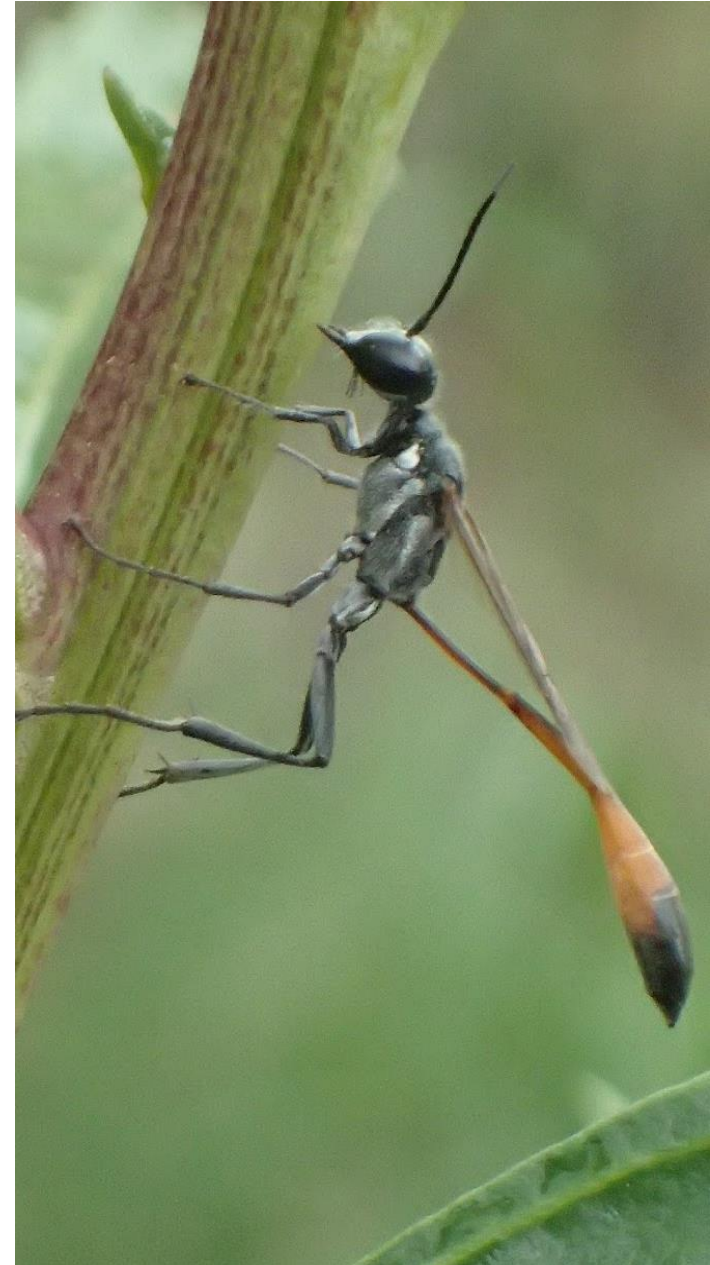
Families Sphecidae,  
Crabronidae, Pompilidae

# **Hunting Wasp Habits**

- **Solitary wasps – no colony structure**
- **Young are fed paralyzed prey**
- **Nests are produced to rear young**
  - **Dug in soil, plant stems**
  - **Constructed of mud**
  - **Existing cavities**

# Family Sphecidae- Sphecid Wasps

- "thread-waisted" appearance
- Sting and swivel for oviposition and mating
- Larvae feed on paralyzed arthropods (the host varies according to wasp species) provided by adult; common hosts include spiders, grasshoppers, and caterpillars.
- Adults feed on nectar from flowers and extrafloral nectaries, honeydew, and body fluids of their prey!



***Ammophila* wasp digging nest**





***Ammophila* wasp carrying  
caterpillar prey**



***Ammophila* wasp at nest entrance**

**solitary wasp, *Bembix***



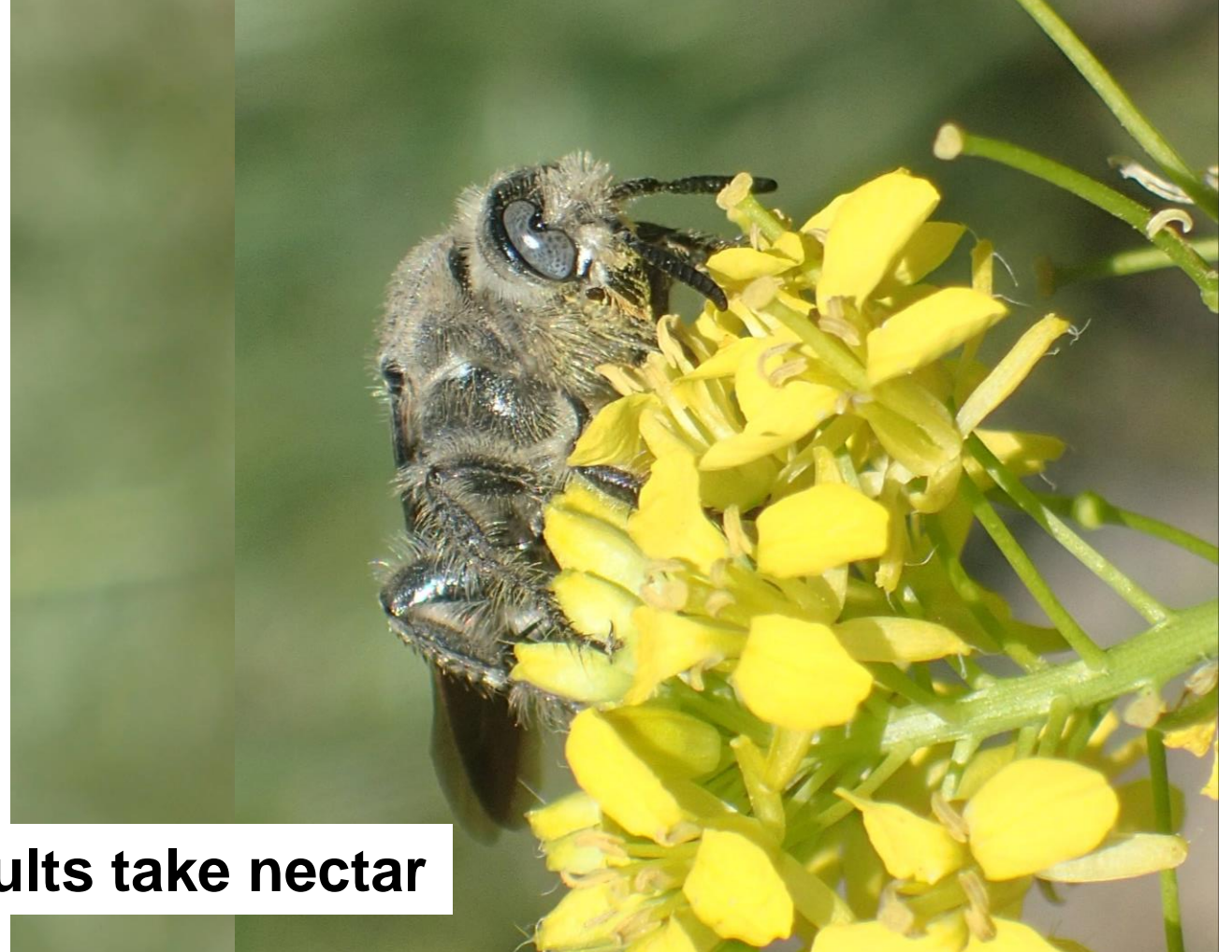
***Bembix* wasp  
digging while  
holding horse  
fly prey**



Larvae are parasitoids of ground-dwelling scarab grubs, esp. *Phyllophaga*; Female digs down to the host grub, stings it, and lays an egg on the paralyzed grub



Scoliid adults take nectar





**Golden Digger Wasp –  
Predator of grasshoppers and katydids**





A close-up photograph showing a steel-blue cricket hunter wasp (Stenobothrus lineator) attacking a field cricket (Gryllus sp.) on a rocky surface. The wasp is dark blue with a metallic sheen and is positioned over the cricket, which has a brownish-orange thorax and dark legs. The background consists of light-colored, rounded rocks and some dry vegetation.

**Steel-blue cricket  
hunter with field cricket**

**Photograph by Bob Hammon**

**Small, accessible  
flowers are most  
commonly used by  
natural enemies of  
garden pest  
insects**



# **Some plants useful for providing food for adult stages of insect natural enemies**

- **Most Apiaceae - (dill, fennel, coriander, Queen Anne's lace, Ammi, etc.)**
- **Many sedums**
- **Spurges**
- **Sweet alyssum**
- **Basket-of-gold**
- **Thyme, several mint family herbs**





**Mooncarrot**

**Two personal  
favorites for good  
insect action**

**Ammi (white cultivars)**



**Flowers can attract beneficial insects and provide them with nectar, pollen**





**Strip  
cropping  
pollinator  
plants next  
to veggie  
beds**

**CSU vegetable trial found that sunflowers  
increased pollination of vegetables  
and activity of arthropod predators**



A photograph of a grape vineyard. In the center, there is a long, narrow strip of yarrow plants with white flowers, planted between the rows of grapevines. The grapevines are trained on a trellis system with wooden posts and wires. The ground is dry and sandy, with some sparse grass. The text "A strip of yarrow to provide floral resources in a grape vineyard" is overlaid on the image in a white box with black text.

**A strip of yarrow  
to provide floral  
resources in a  
grape vineyard**



**Strip cropping floral resources for pollinators  
can be used on a small OR large scale**

## Make simple changes.

- Protect and value habitat
- Create pesticide buffers and adjust application methods to do least harm
- Do not overspray habitat
- Maximize untilled areas
- Maintain floral consistency from year to year
- Allow crops to bolt

# Adapt Current Practices



Photo: Matthew Shepherd



**Areas that support a diversity of native or naturalized plants.**



**Recognize Resource:  
Forage areas**



**Look for plants that already seem to be supporting pollinators**



# Value of Natural Areas



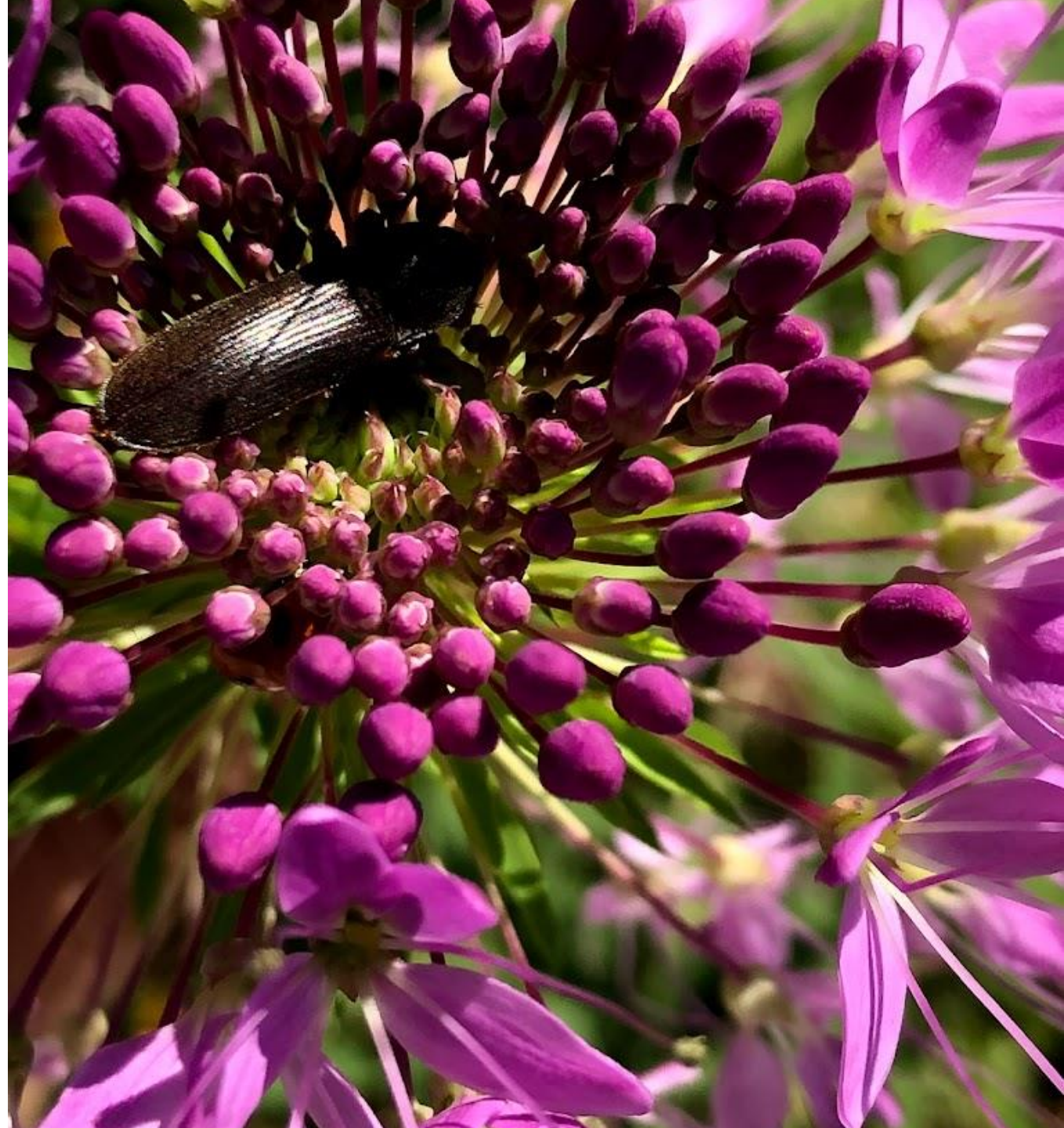
**Pollinators need habitat.**

**The amount of natural areas on or close to the farm is a major influence on diversity and abundance of bees.**

# Enhance Habitat: Forage patches

Choose a diversity of native or naturalized plants that:

- Provide abundant nectar & pollen
- Bloom throughout the year, especially early and late
- Can serve as a “bridge” between crops



# Enhance Habitat

**Retain or create bare soil or cavities.**

- Keep areas of bare ground
- Maximize untilled areas
- Plant native bunch grasses
- Clear away some plants from well drained slopes
- Increase use of no-till farming techniques
- Piles of soil





# Enhance Habitat: Wood nests



Photos: Jeff Adams; Matthew Shepherd; Mace Vaughan

# Enhance Habitat: Bumble bee nests

**Retain or create nest sites.**

- Grassy margins
- Maximize “wild” areas on and around farm
- Provide artificial nests



# Take Home Message

A diverse community of pollinators can provide **significant pollination services** for many crops.

**Habitat** can support wild pollinators and beneficial insects:

- plant forage patches
  - create nest sites
  - minimize pesticide risk
- **Diversify your landscape** and provide for animal pollinators in western Colorado!





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## Attracting Native Bees to Your Landscape

Fact Sheet No. 5.615

Insect Series | Home and Garden

by H.S. Arathi, D. Davidson and L. Mason\*

Of all the pollinators found in gardens, agricultural fields and natural areas, bees are the most common and efficient. There are over 20,000 bee species found throughout the world. Of the approximately 4,000 native species known to occur in the United States, 946 are found in Colorado. They vary greatly



### Quick Facts

- There are over 20,000 bees species found worldwide.
- There are 946 native bee species in Colorado.

# Colorado State University fact sheets involving pollinators



**Colorado State University**  
**EXTENSION**

## Creating Pollinator Habitat

Fact Sheet No. 5.616

Insect Series | Home and Garden

by H.S. Arathi, D. Davidson and L. Mason\*

Pollinators are animal species that provide pollination services to plants in natural/wild landscapes, cultivated gardens and agriculture settings around the globe. They have coevolved with plants and the relationship between plants and pollinators is very intricate;

### Flower Visitor or Pollinator?

Pollinators include bees, wasps, beetles, flies, moths, butterflies, hummingbirds, and bats (Fig. 1a, b and c). However, just because an insect or a bird is visiting a flower, it is not necessarily a pollinator (Fig. 2).



### Quick Facts

- Pollinator species include bees, beetles, flies, moths, butterflies, hummingbirds, and bats.

# Gardening for Native Bees in Utah and Beyond

James H. Cane  
Research Entomologist, USDA ARS  
Pollinating Insect-Biology, Management, Systematics Research

Linda Kervin  
Logan, UT

## Do You Know?

- 900 species of native bees reside in Utah.
- Some wild bees are superb pollinators of Utah's tree fruits, raspberries, squashes, melons and cucumbers.
- Few of our native bees have much venom or any inclination to sting.
- Our native bees use hundreds of varieties of garden flowers, many of them water-wise.
- A garden plant need not be native to attract and feed native bees.

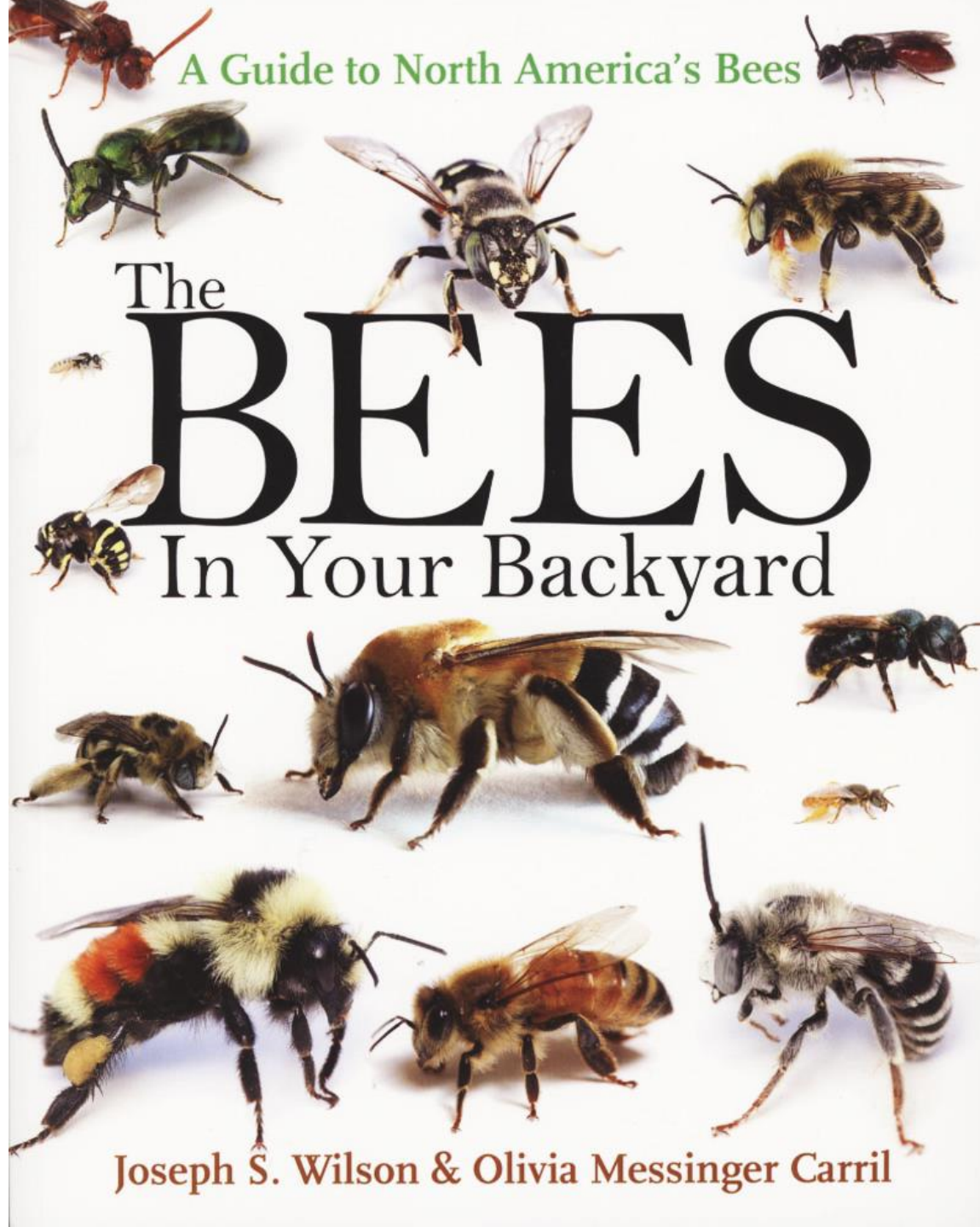
Utah is home to more than 20 percent of the 4,000+ named species of wild bees that are native to North America. Except for bumblebees and some sweat bees, our native bees are solitary, not social, many with just one annual generation that coincides with bloom by their favorite floral hosts. In contrast, the familiar honey-bee is highly social, has perennial colonies



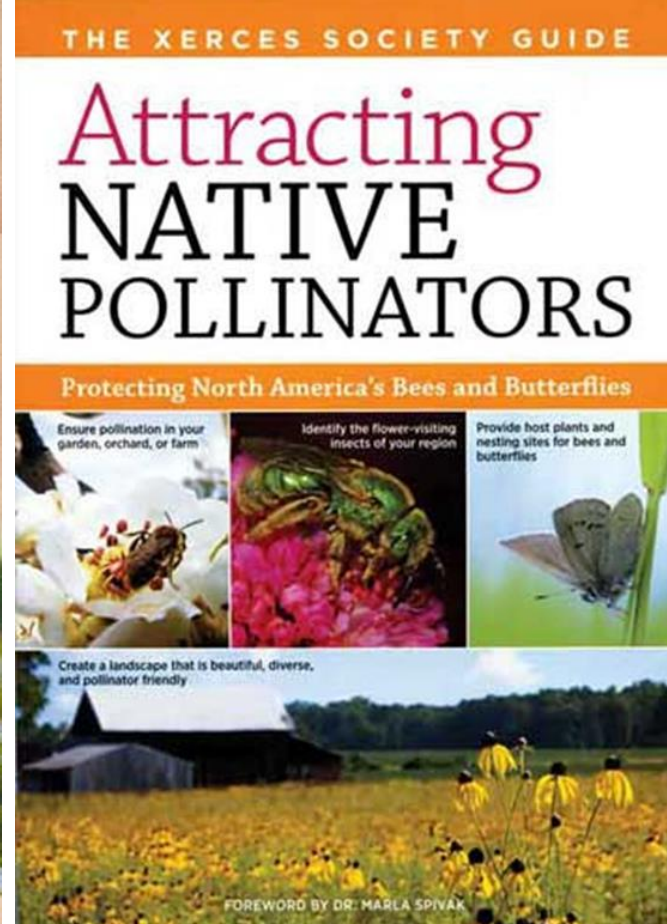
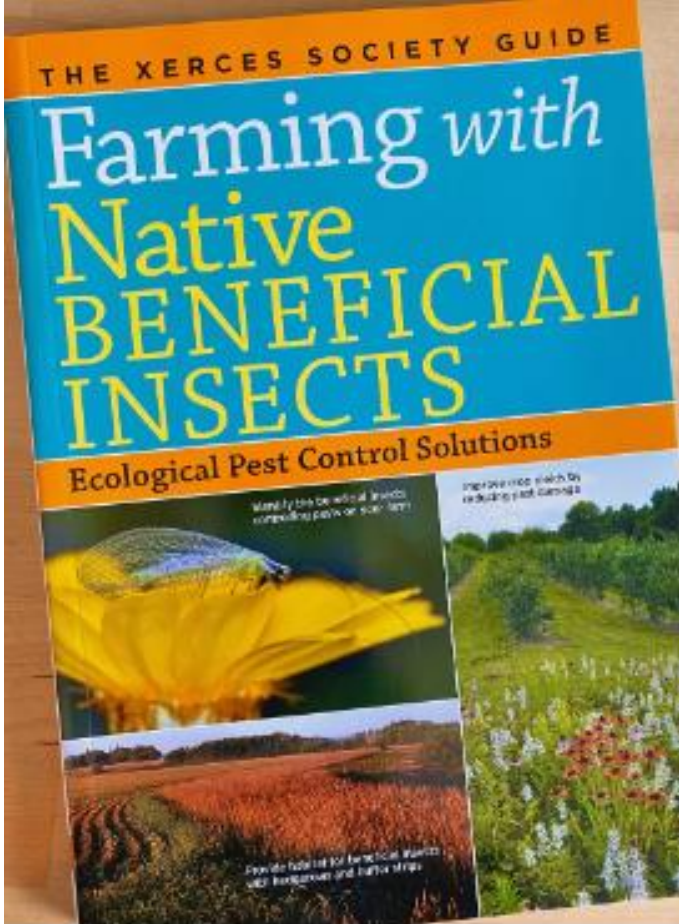
Fig. 1. Carder bee (*Anthidium*) foraging

**An outstanding – *and free* – publication from Utah State University**





**Excellent  
publication  
on the  
subject of  
North  
American  
bees!**



# Excellent publication on how to improve habitat for native pollinators

One of many, many excellent publications – many freely available – produced by the **Xerces Society**



**Are you finding interesting  
“bugs” to photograph on your  
farm or in your garden ?**

**Please share them!**

**Melissa.Schreiner@colostate.edu**

