

Promoting Pollinators

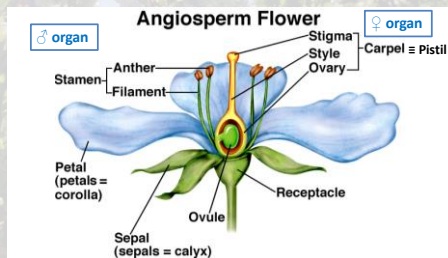


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Pollination definition

In flowering plants, transfer of pollen grains from anther (male part) to stigma (female part); must be pollen of same species



Strategies for pollen movement

1. Wind pollination

- Gymnosperms and some flowering plants (grasses, trees)
- Flowers are small, grouped together
- Not a very efficient method: too chancy and extremely wasteful



Strategies for pollen movement

2. Animal pollination

- Insects – bees, wasps, flies, butterflies, moths, ants
- Birds – hummingbirds, honey creeper
- Mammals – bats, mice, monkeys
- Even some reptiles and amphibians



Animal pollination

Benefits to plant

1. Directed movement, allowing plants to make less pollen
2. Works in low-wind environments or wrong wind direction
3. Can move genes longer distances
4. Can work at low plant density
5. Potential for specialization

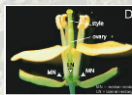
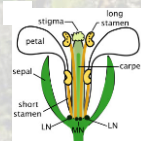
Costs to plant

1. Risk (if no animal available)
2. Resources required as an incentive to attract pollinators (nectar) and cues (flowers)
3. Susceptibility to exploitation

Rewards

Nectar: sugary fluid (15-45% carbohydrates) produced by nectar glands (nectaries) in flower; primarily simple sugars but contains trace amounts of amino acids, vitamins, phenolics,...

Pollen: high in proteins (~25%) & lipids, and trace amounts of minerals, vitamins,...



LN = lateral nectary
MN = median nectary

Why is pollination important?

1. Ecological

~80% of flowering plants rely on animals for gene transfer (seed and pollen). Fruits and seeds comprise ~25% of diets of birds and mammals; so lack of pollination means scarce resources

2. Agricultural

Insects pollinate ~2/3 of world's crops
account for 1/3 of food we eat

3. Economics of insect pollination

~\$15 billion per year to the US economy
\$217 billion worldwide (Science Daily 2008)



Major insect pollinators



> 70% flowering plants (~250,000 spp.) require an insect to move pollen

Most important insect pollinators: Bees

1. Feed on nectar and pollen
2. Pollen collecting structures (scopa, corbicula)
3. Display floral constancy



Why are bees important?

Whole foods and Xerces Society "[Share the Buzz](#)" campaign (2013)

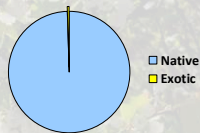


Bees

- At least 20,000 known species of bees (more than birds and mammals combined!)
- Social vs. solitary, 90% being solitary
- ~4,500 solitary spp. in North America
- Wisconsin: ~400 spp.



Smallest North American bee (*Perdita minima*) on largest female carpenter bee



The honeybee

Apis mellifera: the "honey-bearing bee"

Honeybees account for 84% of all insect pollination



- 7 species of honeybees
- Western honeybee, *Apis mellifera* only species in North America
- Non-native, introduced in 1600s
- Social colonies founded by single queen
- Colonies are perennial
- Hive with typically 30 to 50,000 workers

Bumblebees

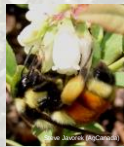
All bumble species in genus *Bombus*, meaning “booming”

- 250 known species (probably most discovered)
- 49 species in U.S. (18 species in WI)
- Social colonies that last one season, queens overwinter
- Most abundant native pollinators of both crops and wild flowers



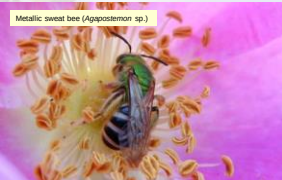
Bumblebee and crop pollination

- Active in cool and wet weather
- Buzz pollination makes them better pollinator of tomatoes, blueberry, cranberry, melons, cucumber, etc...
- Until 1980s, tomato pollination in glasshouses done by hand



Solitary bees

Metallic sweat bee (*Agapostemon* sp.)



Yellow-faced bee (*Hylaeus* sp.)

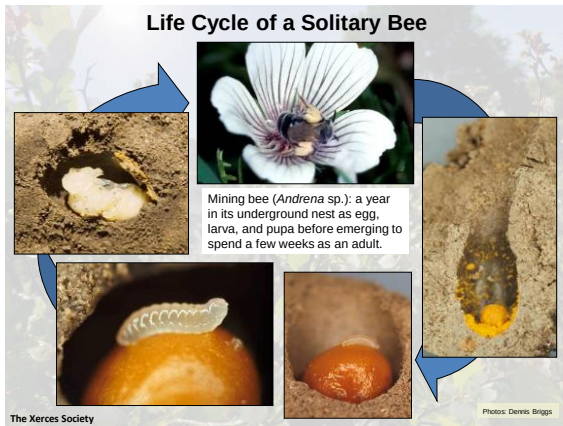


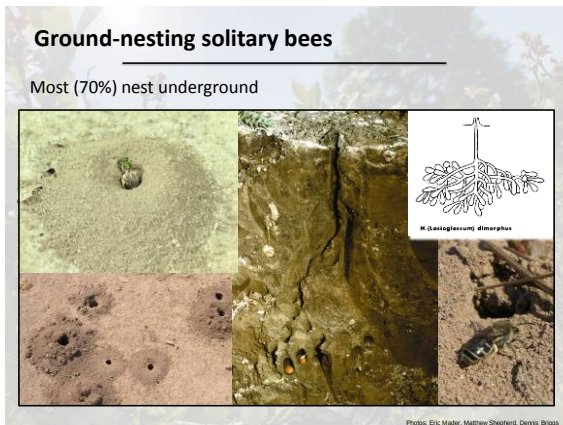
Mason bee (*Osmia* sp.)

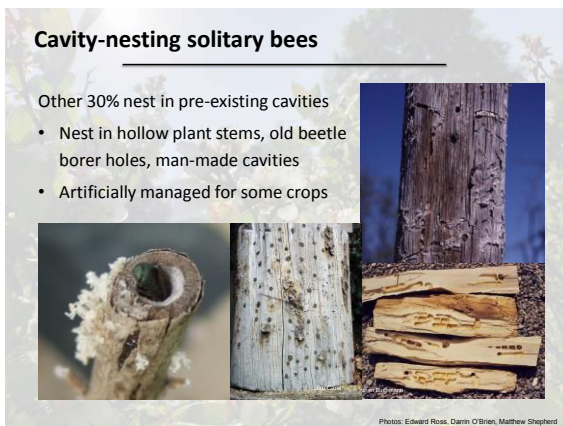


Sweat bee (*Halictus* sp.)

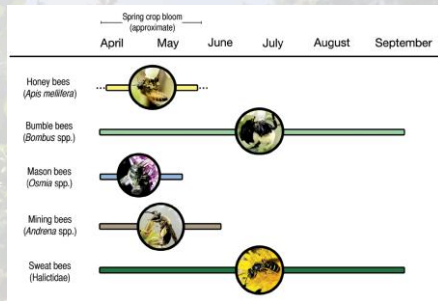








Activity periods of bees



May et al. 2015 MSU Extension Bulletin E3245

Pollinator decline



Politico: Bees bring new buzz to Capitol Hill

Pollinator decline

Colony collapse disorder: Honeybees

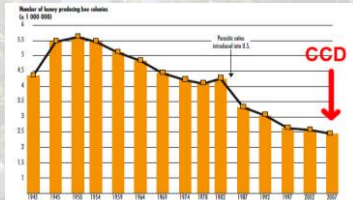
In 2006, U.S. beekeepers reported losses of 30-90% of hives

Main symptoms: very low or no worker bees, queen is alive, with larvae present, and no dead bodies inside or in front of hive (thus hard to study potential causes...)



Honeybees

Currently, estimated 2.62 million colonies of honeybees in USA



Pollinator decline

Factors associated with honeybee declines:

- Arthropod pests and pathogens
- Poor nutrition
- Bee management practices
- Agricultural practices and pesticides
- *Habitat fragmentation*

Not a single factor, but a combination of factors

Pests and pathogens

Since 1984, multiple introduction of invasive species:

- parasitic tracheal mite *Acarapis woodi* (identified 1984)
- parasitic mite *Varroa destructor* (identified 1987)
- Africanized honey bees (1991)
- small hive beetle *Aethina tumida* (identified 1996)
- Israeli Acute Paralysis Virus - IAPV (identified 2007)
- gut parasite *Nosema ceranae* (identified 2007)

Pests and pathogens

Parasitic mite: *Varroa destructor*

- Single most detrimental pest of honeybees
- Introduced from Eastern Asia and identified in U.S. hives in 1987
- Blood sucking parasites that also transmit viruses to bees
- Cause significant colony losses each year



Poor nutrition

Monoculture, i.e. almond and other commercial crops provide no diversity of food



Bee management practices

Not uncommon for beekeeper to travel 37,000-40,000 miles per year to pollinate 4 or more different crop

COMMERCIAL POLLINATION ROUTES



Rucker et al 2001

17

Pollinator decline

Sign of nutritionally desperate bees?



Bees from apiaries near Ribeauvillé in France have acquired taste for processed sugars at local biogas plant that processes waste from Mars chocolate factory

Instead of mining local wildflowers for nectar, bees have been sucking up colorful sugar at factory!



Agricultural/residential practices

Nature Deficit Disorder

- Monocultures
- Lack of cover crops (natural fertilizers)
- Herbicides to kill off weeds (dandelion, clover, etc...)



In 2001, 11% of pesticides were used on lawns and 5% greenhouse gases produced by mowing our lawns

Pesticide exposure

Pesticides: insecticides, fungicides, and herbicides



Pesticides in your garden

Examples of Neonicotinoid Garden Products Used in the United States

Neonicotinoid	Garden & ornamental uses	Garden product trademark names
Imidacloprid	Seed dressing, soil drench, granules, injection, or spray to a wide range of ornamental plants, trees, and turf	Bayer Advanced 3-in-1 Insect, Disease, & Mite Control Bayer Advanced 12 Month Tree & Shrub Insect Control Bayer Advanced 12 Month Tree & Shrub Insect & Feed Bayer Advanced Fruit, Citrus & Vegetable Insect Control Bayer Advanced All-in-One Rose & Flower Care concentrate DVI Tree Care Products Multi-Insect Killer Earth Home 2-N-1 Systemic Hi-Yield Systemic Insect Spray Hurricane Knockout Ready-To-Use Grub Killer Lanico Bandit Marathon Merit Monterey Once a Year Insect Control II Ortho Bug B Gon Year Long Tree & Shrub Insect Control Ortho MAX Tree & Shrub Insect Control Sumner Brand Grub2 Out
	Seed treatment, foliar spray or soil drench for turf, a variety of ornamental trees, and flowers	Bayer Advanced All-in-One Rose & Flower Care granules Green Light Grub Control with Atrina
Thiamethoxam	Soil drench injection, granules, or foliar spray to a wide range of ornamental plants and turf	Flagship Moxide Dual Action Insect Killer Mouder
Acetamiprid	Foliar spray for fruits, vegetables, ornamental plants, and flowers	Ortho Flower, Fruit & Vegetable Insect Killer Ortho Rose and Flower Insect Killer
Dimethoate	Soil drench or foliar spray to newly & existing vegetables, turf, & ornamental plants	Green Light Tree & Shrub Insect Control with Safari 2 G Safari Triumph Dynam 2050 Systemic Turf Insecticide

The Xerces Society for invertebrate conservation

Pollinator decline

Not just honeybees...



Rusty patched bumble bee



Yellow banded bumble bee

Rusty patched: 1st bee added to endangered species list (2017).
Declined by 87% in last 20 years

Potential causes: diseases and pathogens introduced in by commercially reared bumble bee colonies, habitat loss, pesticide exposure, climate change

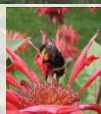
Images: The Xerces Society

Pollinator habitat

- Loss of suitable habitat
- Fragmentation into smaller isolated habitat patches



Rusty patched bumble bee



Yellow banded bumble bee

Extreme pollinator decline...?

China's Sichuan Province, one of the largest apple-producing regions in the world...hand pollination!



Pollinator conservation and protection

- Provide variety of resources for season-long forage
- Provide habitat for ground-nesting and cavity nesters
- Protect pollinators from pesticide exposure (lowest risk, lowest concentration, avoid dusts and long residual products, spray at night)



http://www.xerces.org/wp-content/uploads/2014/09/MidwestPlantList_web.pdf

Pollinator conservation

Provide food

- Add flowering plants to landscape
- Provide a variety of pollen/nectar sources
- Provide season long forage (min. 3 per season)
- Tolerate non-invasive weeds!



Pollinator conservation



Providing nesting sites

Retain or create bare soil for ground nesters:

- Keep some areas of bare ground
- Minimize untilled areas
- Clear away some plants from well drained slopes



Photos: Matthew Shephard

Providing nesting sites

Provide cavities for cavity nesters:

- Prefer wood
- Provide artificial nesting holes



Providing nesting sites

Retain or create nest sites for bumblebees:

- Plant native bunch grasses
- Maximize “wild” areas
- Artificial nests are not effective



Photos: Matthew Shepherd, NRC/Sutton-Bell

Reducing pest and pathogen transmission

- Avoid locating managed bees near conservation areas
- Diseases can be spread through pollen



Pollinator conservation and protection

- Use the lowest risk/lowest concentration
- Avoid dusts and micro-encapsulated products
- Avoid products with long residual (systemic)
- Time applications to avoid bees: spray in evening when bees not active



Pesticides in your garden

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	Seed treatment, foliar spray or soil drench for turf, a variety of ornamental trees, and flowers	Bayer Advanced All-in-One Rose & Flower Care granules Green Light Grub Control with Aerial
Clothianidin	Soil drench injection, granules, or foliar spray to a wide range of ornamental plants and turf	Flagship Moxide Dual Action Insect Killer Mortenson
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Acetamiprid	Soil drench or foliar spray to newly & existing vegetables, turf, & ornamental plants	Green Light Tree & Shrub Insect Control with Safari 2 G Safari Triumph Dynam 205G Systemic Turf Insecticide

The Xerces Society for invertebrate conservation

Bees and insects overall need our love!

Plant some flowers!



Wisconsin Fruit!

www.fruit.wisc.edu

