Canadian Wildlife Federation Pollination Poster

A Pollinator Patch

repairing our damaged environment

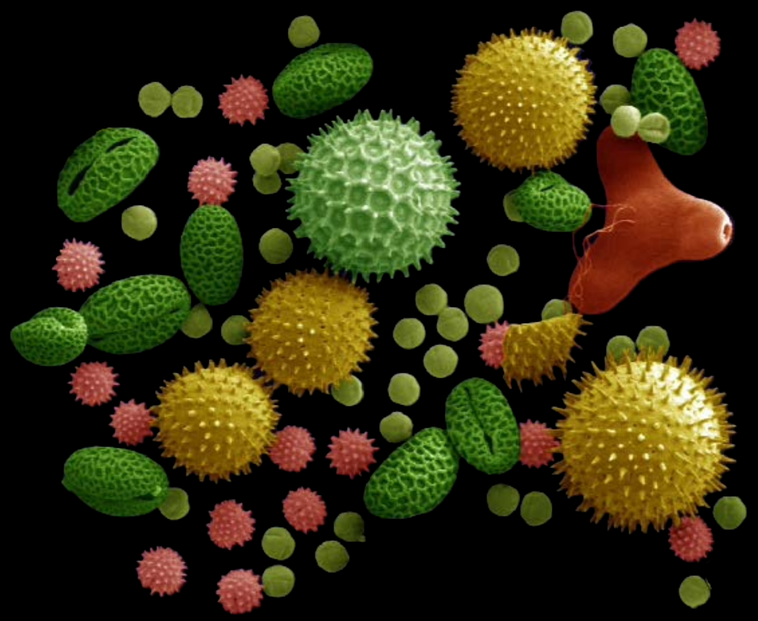
Catherine Kavassalis Oct 2021

Overview

- Pollination
- Pollinators
- Pressures on pollinators
- Patching our broken system
- Meeting pollinator needs
- Keystone native species
- Quick summary

Pollination

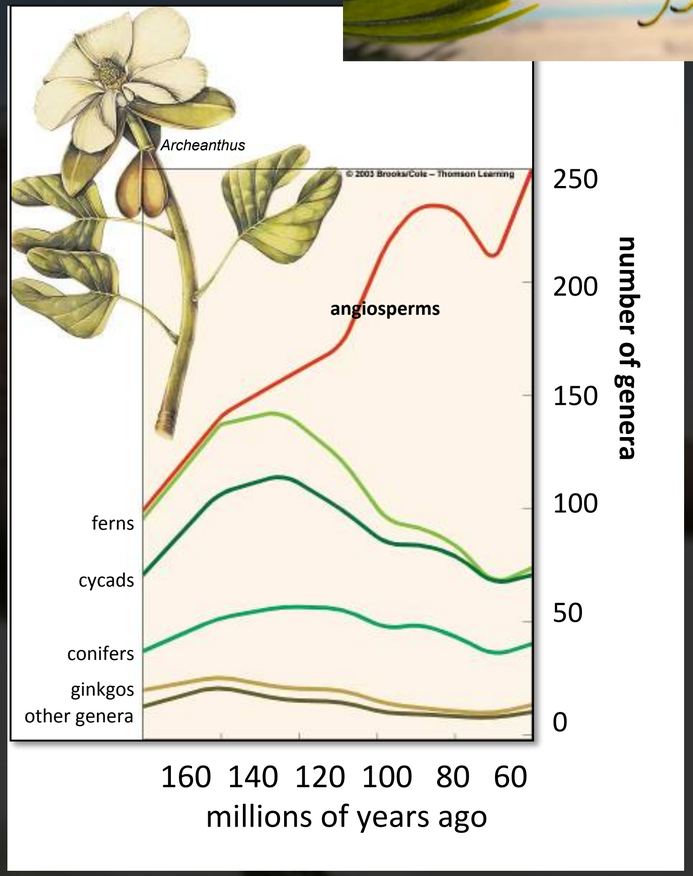
- Reproduction
- Partnerships
- Competition
- Evolution



Obedient plant (*Phystostegia virginiana*) with Eastern bumblebee, bald-faced wasp

How plants share pollen evolves

- Wind, water and or pollination partners
- Gymnosperms are largely wind pollinated
- Angiosperms are largely animal pollinated
- Pollination is about evolving relationships



Ferns and Cycads loose ground to Flowering plants

Wind pollination - *Pinus sylvestris* - pixabay

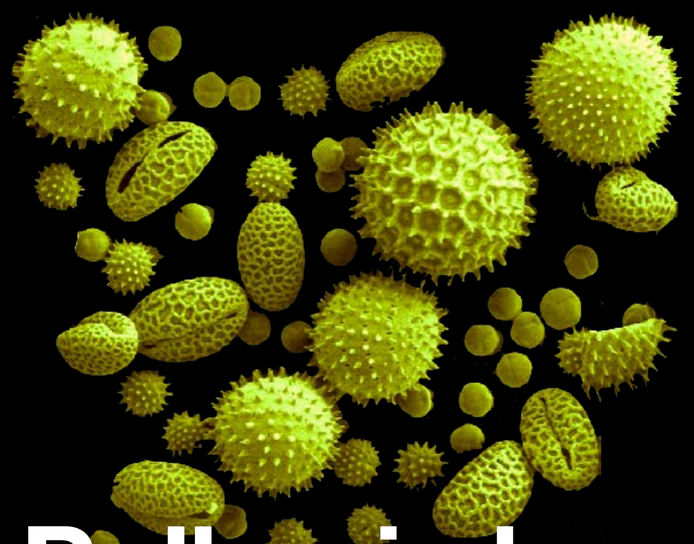
Lichnomesopsyche gloriae
a fly was from 160 million years ago sipping nectar from ancient gymnosperms

50 to 85% of flowering plants rely on animal pollinators to reproduce.

391,000 species of vascular plants currently known, of which about 369,000 species (or 94%) are flowering plants. About 175 000 plant species mostly or completely rely on animal pollinators to reproduce.

Without pollinators, half of flowering plants would suffer an 80% reduction in fertility and a third would produce no seeds.

Wiida Fourie-Basson - Stellenbosch University. "First global estimate of importance of pollinators for seed production in plants: About 175 000 plant species -- half of all flowering plants -- mostly or completely rely on animal pollinators to make seeds and so to reproduce." ScienceDaily. ScienceDaily, 13 October 2021. <www.sciencedaily.com/releases/2021/10/211013152109.htm>.



Pollen is key

Transports reproductive material

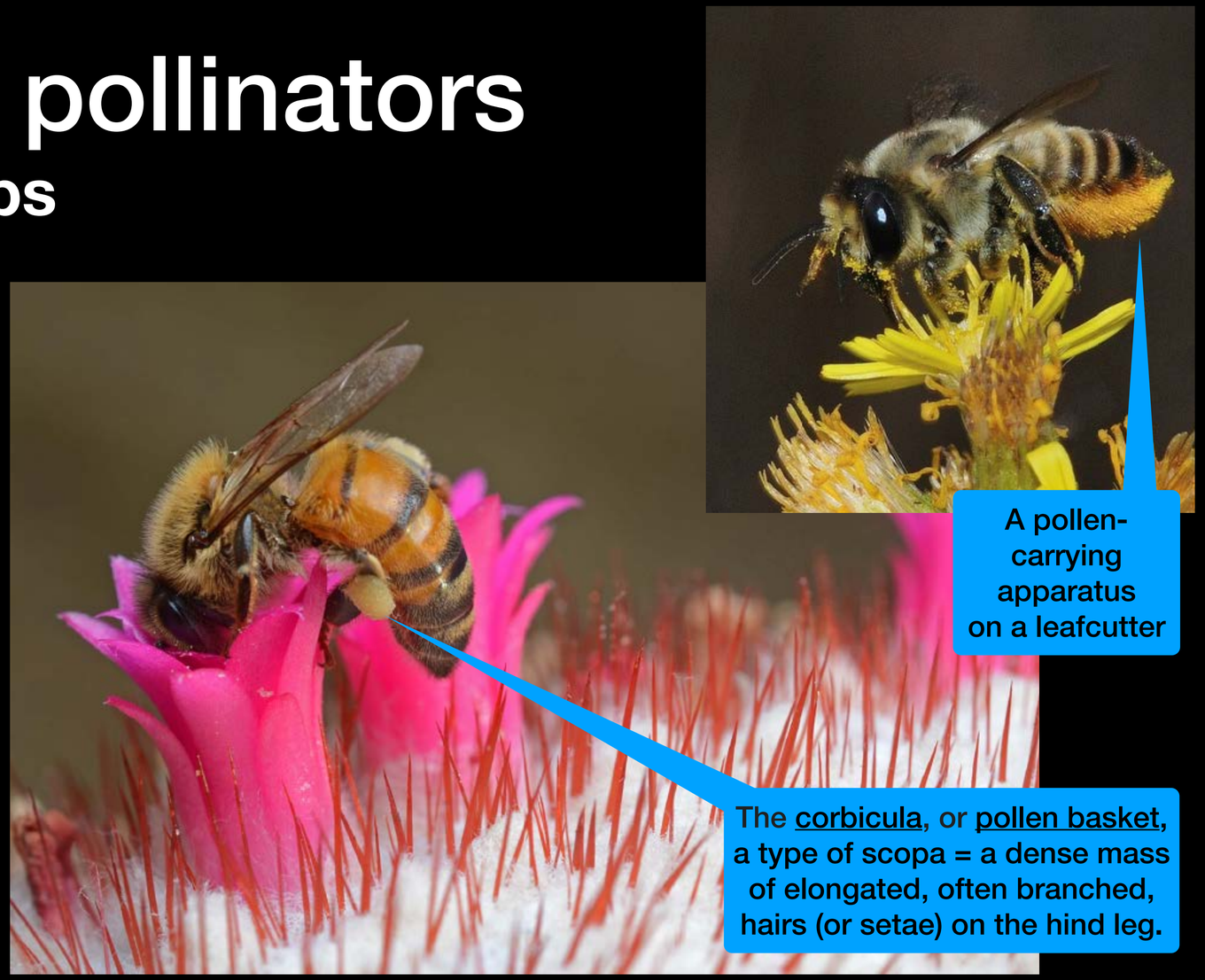
Protein rich source of food

Variations in coverings and nutritional value by species

A Hoverfly (family Sirfidae, insects that mimic a bee) covered in pollen

Plants encourage pollinators
evolving mutual partnerships

- Nutritious pollen
- Sweet nectar
- Fragrant scents
- Colourful petals
- Ergonomic landing pads
- …



***Melocactus intortus*; with honey bee**

Image: Geoff Gallice from Gainesville, FL, USA, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

Above: *Megachile lagopoda* female foraging on *Dittrichia viscosa*, Mount Carmel, IsraelBy Gideon Pisanty (Gidip) CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=13284966

Palynivores

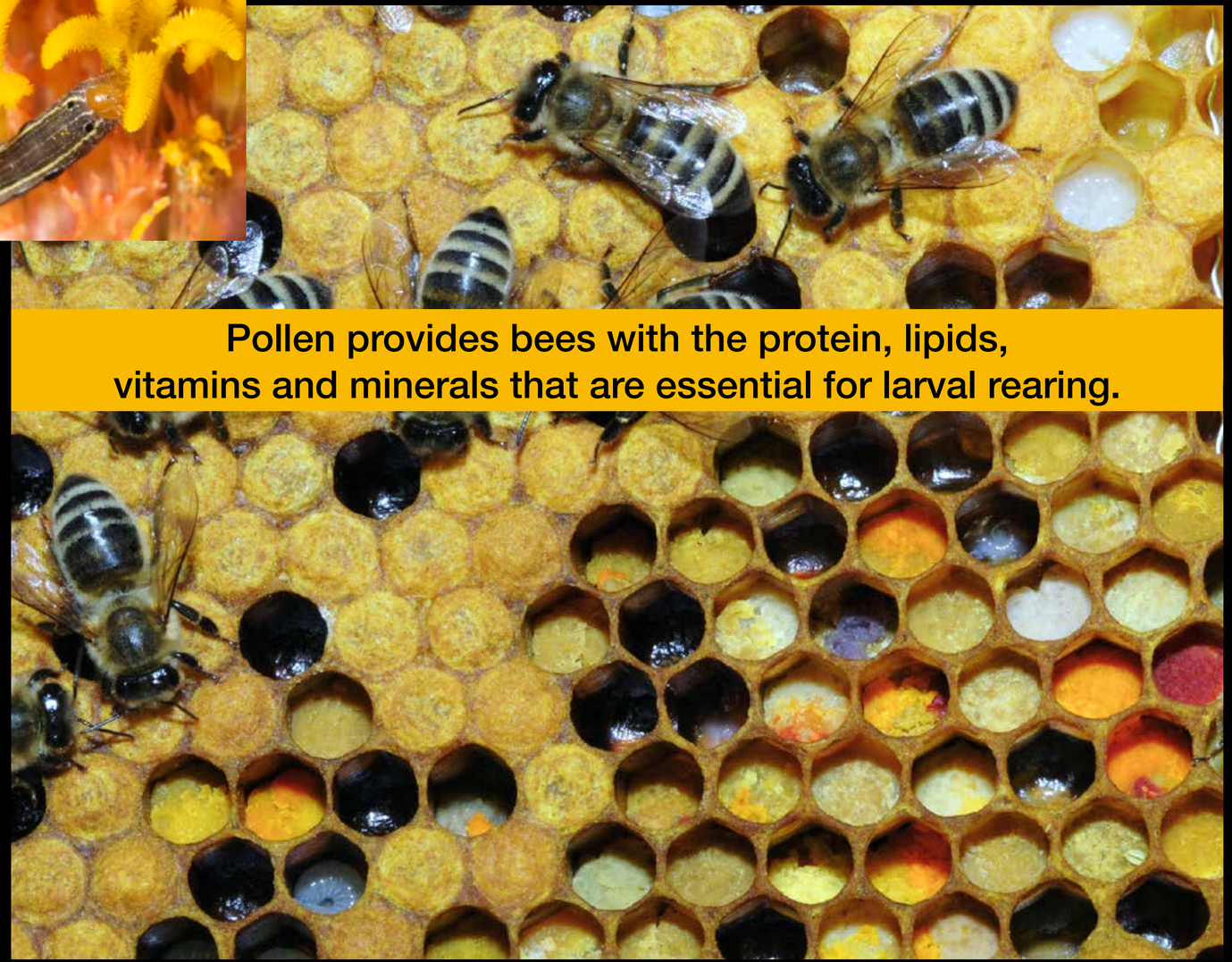
pollen eaters

Caterpillar Eating Pollen on Zinnia: Bill Bumgarner

- Insects: beetles, wasps, ants, and bees, flies, moths and butterflies …
- Spiders
- Birds
- Mites

Jumping spider eating Acacia pollen by Eric Scully, Harvard Univ.

There are vegetarian spiders!



Pollen provides bees with the protein, lipids, vitamins and minerals that are essential for larval rearing.

Bee bread: the bee pollen stored in the combs. By Waugsberg, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2093680

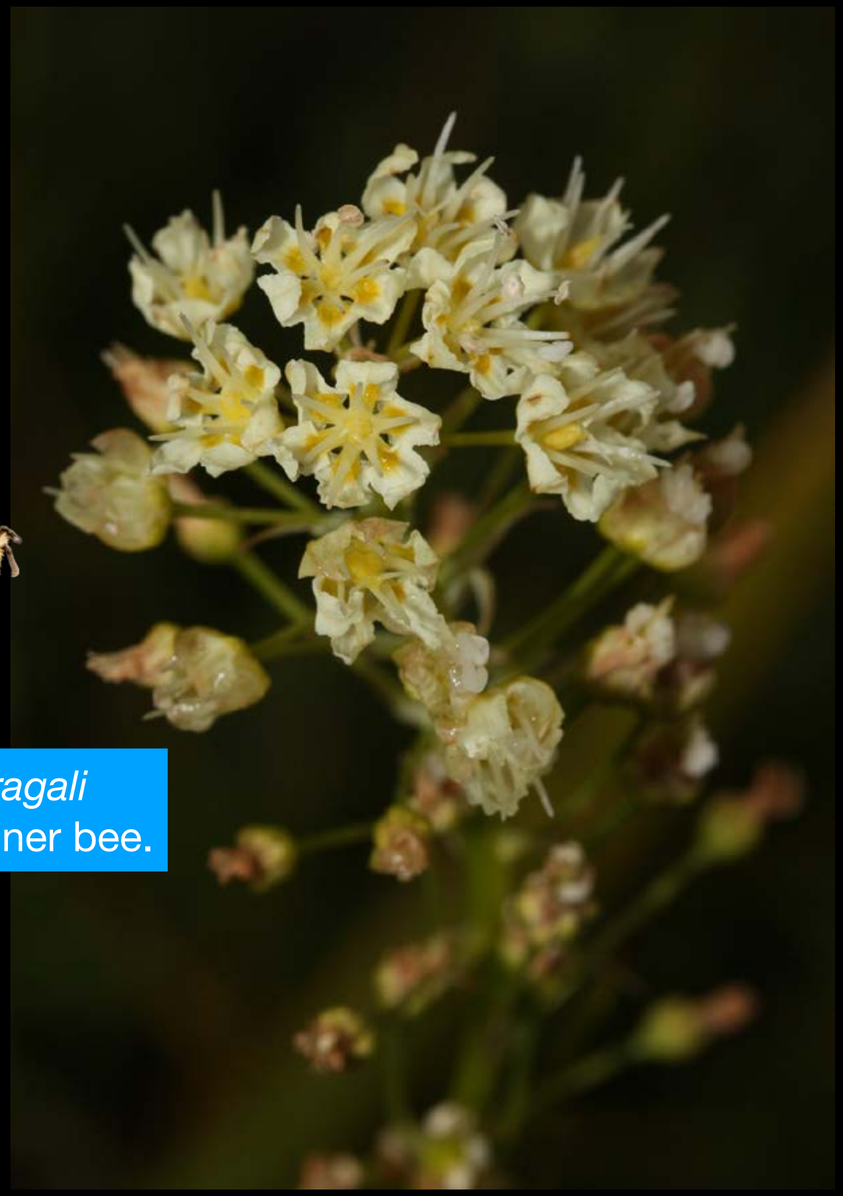
but plants need to protect resources

reduce consumption and cheaters

- Toxic compounds (e.g. *Ranuculus*)
- Less nutritious pollen (e.g. *Asteracea*)
- Pollen walls that resistant digestion

About 25% of our bees are oligolectic - dietary specialists others are polylectic - generalists

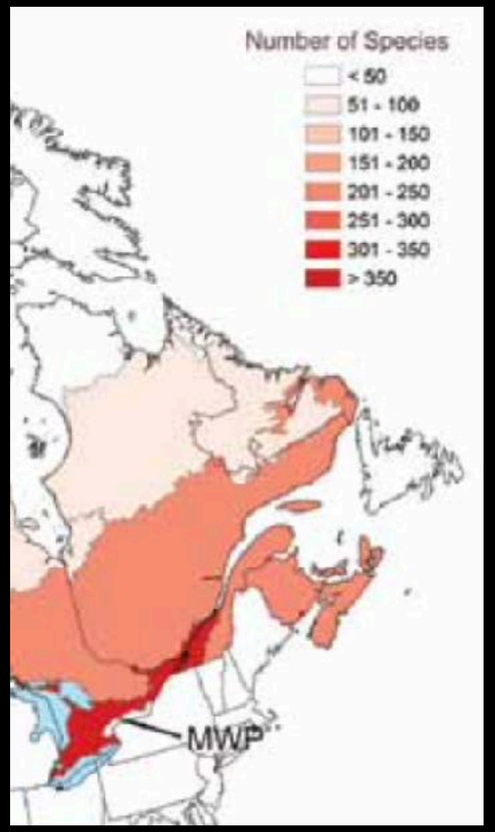
Andrena astragali
Death camas miner bee.



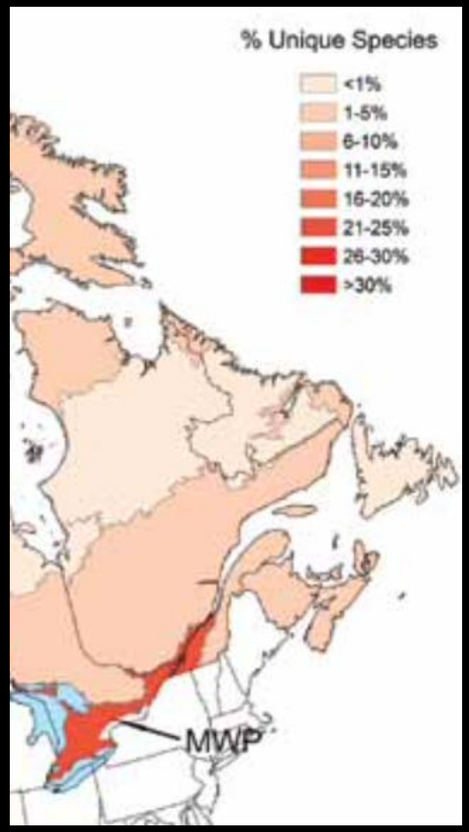
The highly poisonous *Toxicoscordion venenosum*

Our Mixed Wood Plains (MWP) is a bee hotspot

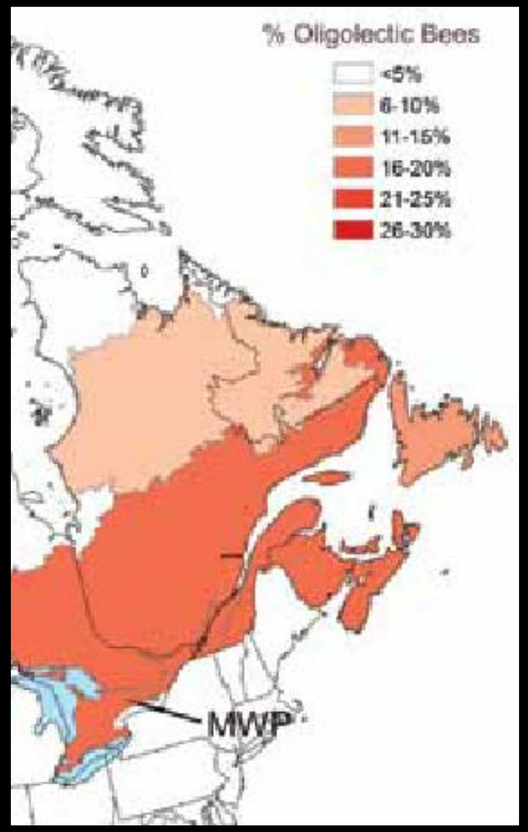
- Over 350 bees in MWP
- >30% unique in Canada
- 26-30% specialists
- More than half tied to the aster family (*Asteracea*)



Number of Species



Number of Unique Species



Number of Oligolectic Bees

Sheffield, Cory & Frier, Danae & Dumesh, Sheila. (2014). The Bees (Hymenoptera: Apoidea, Apiformes) of the Prairies Ecozone with Comparisons to other Grasslands of Canada. 10.3752/9780968932179.ch11.

Nectar
sugar rich food

- Produced in glands called nectaries
- The energy content depends on volume and sugar concentration (typically sucrose, glucose and fructose)
- Sunflowers contain hexose sugars highly attractive to bees
- Nectar can also contain amino acids, minerals, secondary metabolites, yeasts, and microbes
- Nectar robbers are a problem

Most northern high bush blueberries are self-pollinating - Buzz pollination or sonication releases pollen firmly held by the anthers of blueberries

A long tongue is needed to reach the nectar

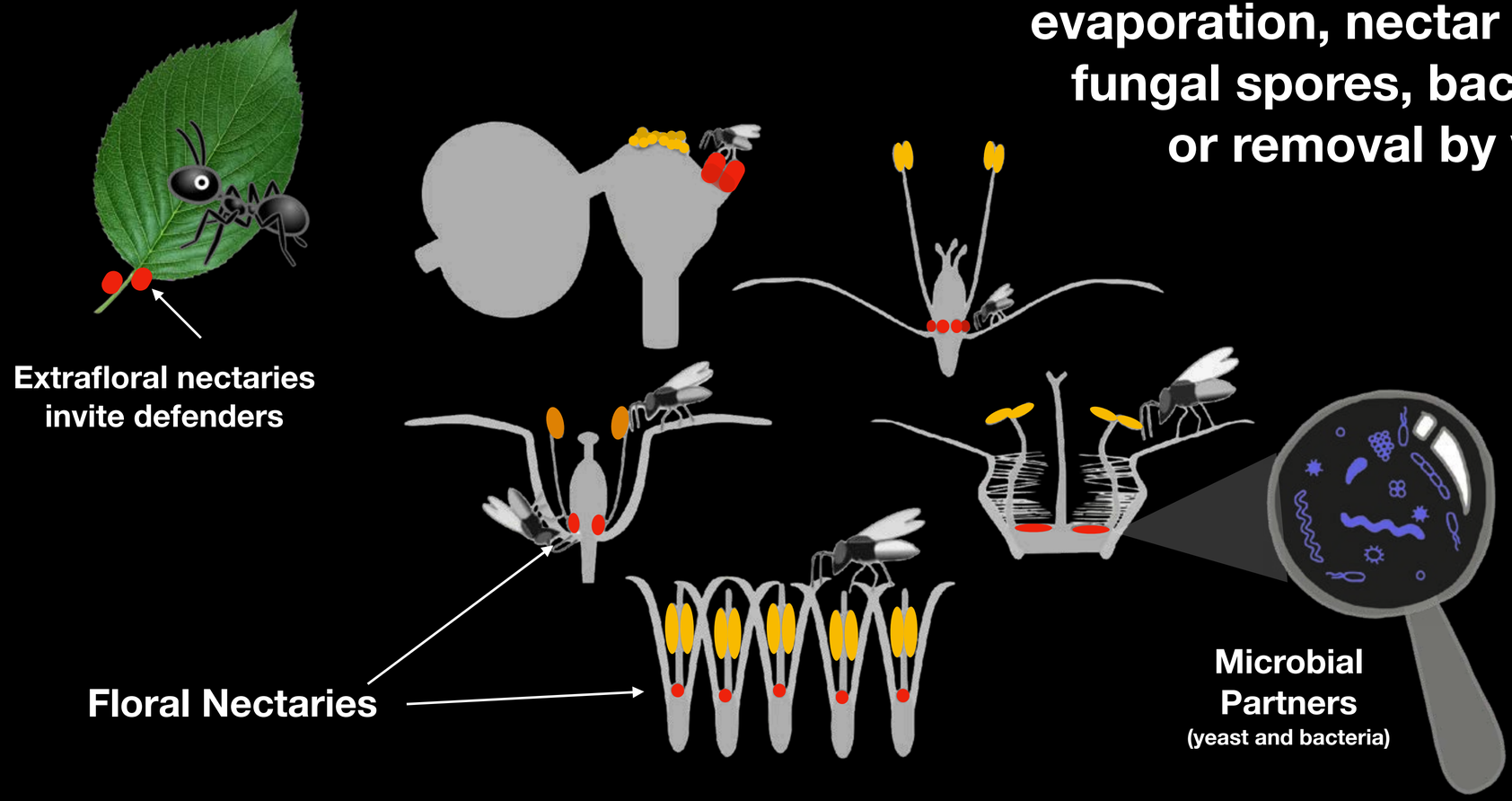
This carpenter bee is a 'thief' bypassing pollen

Capenter Bee on *Vaccinium corymbosum* L. Highbush Blueberry

Photo Julie Cook cookiecrumbstoliveby.wordpress.com/tag/blueberry-bushes/

Nectary placement can improve pollination success

and protect against evaporation, nectar theft, fungal spores, bacteria, or removal by wind.

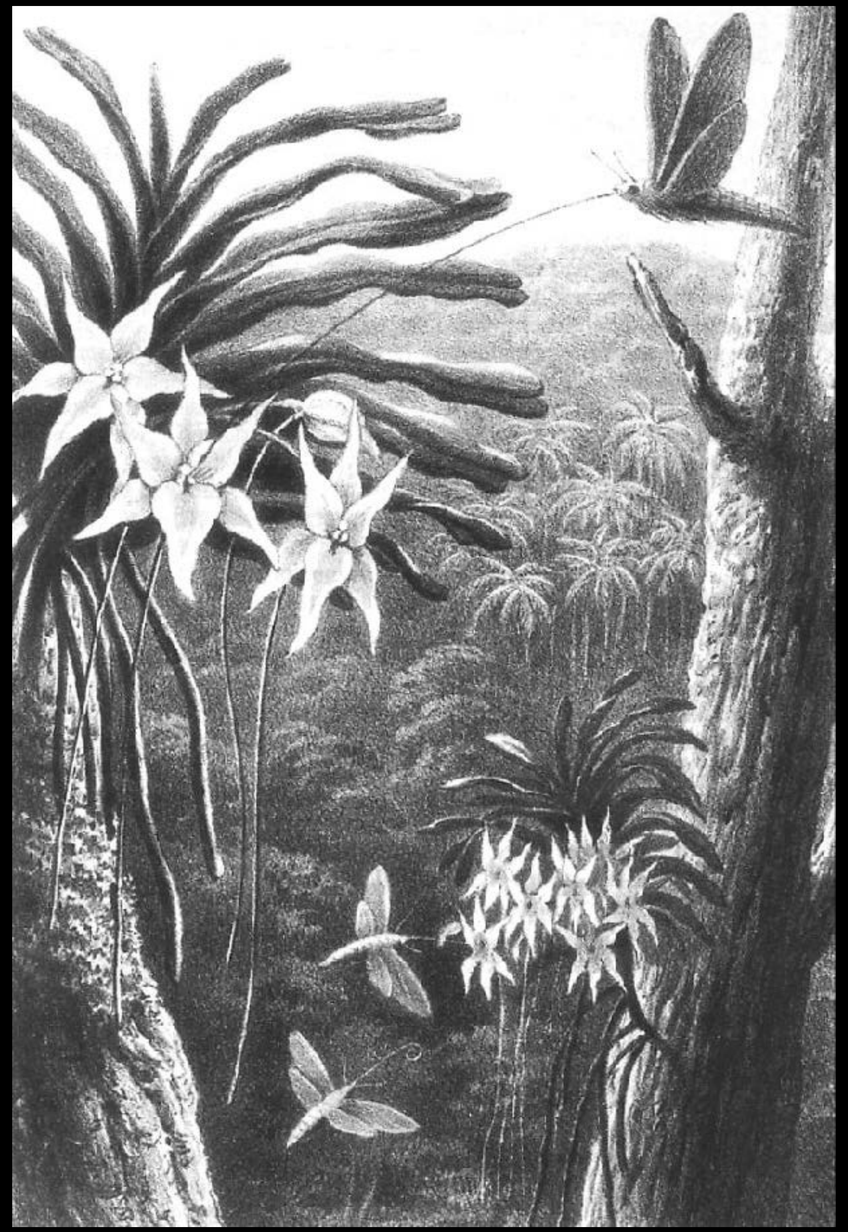


Diagrammatic representation of nectaries

adapted from Patt, Joseph & Rohrig, Eric. (2017). Laboratory Evaluations of the Foraging Success of Tamarixia radiata (Hymenoptera: Eulophidae) on Flowers and Extrafloral Nectaries: Potential use of Nectar Plants for Conservation Biological Control of Asian Citrus Psyllid (Hemiptera: Liviidae). Florida Entomologist. 100. 149-156. 10.1653/024.100.0121.

Co-evolution

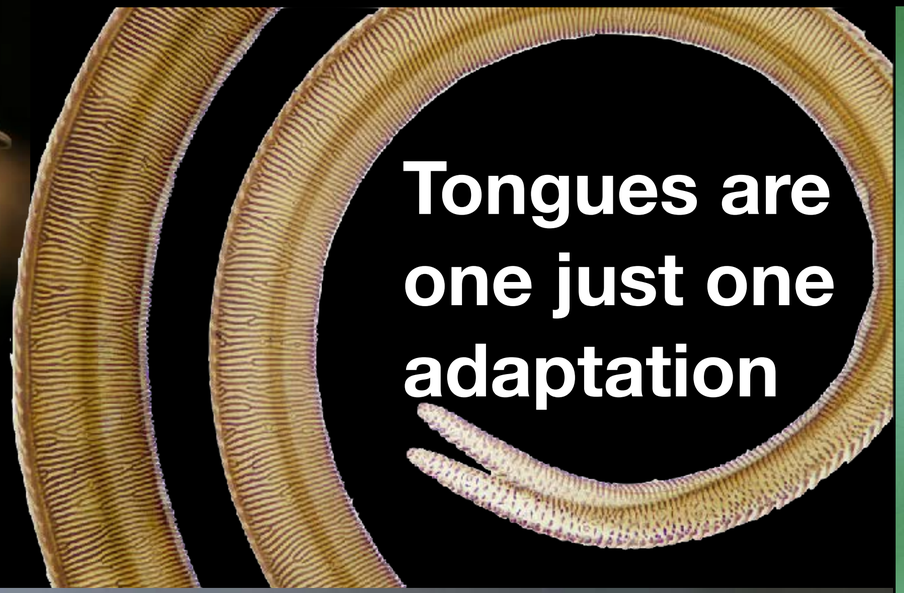
- Madagarscar's Star Ochid (*Angraecum sesquipedale*) has a 30cm (foot-long) nectar spur
- Darwin predictated its pollinator to have a long tongue (proboscis) 1862
- In 1903, that giant hawk moth (*Xanthopa morgali praedicta*) was discovered



By Artist: Thomas William in Wallace, Alfred Russel (October 1867). "Creation by Law". The Quarterly Journal of Science 4 (16): p. 470. London: John Churchill & Sons. Retrieved on 2009-07-30. Public Domain

Above left image - By Esculapio - Own work, CC BY-SA 3.0,

above USGS Bee Inventory
Hoplitis spliata, MD| Flickr



Ruby-throated hummingbird; Photo ehpien Flickr cc by 2.0

Long tongued Bee fly on Apple Blossom

Butterfly proboscis top center: Rylee Isitt

Hummingbird snow wing: Cody Hough

Tongue on fly: kie-ker on Pixabay

rotate, wheel-shaped

campanulate, bell-shaped

urceolate, urn-shaped

salverform, hypocrateriform

funnelform

tubular

ligulate, tongue-shaped

bilabiate

personate

foxgloveform

papilionaceous

capitula

www.askiitians.com/biology/morphology-of-flowering-plants/flower.html

Ruby-throated Hummingbird by Kelly Colgan Azar: Flickr

diversity of form

Floral scents

- Pollinators have chemoreceptors to detect scents … flowers exploit this.
- Every species of flower can produce a unique floral bouquet.
- “Olfactory receptors are most abundant on the antennae, but may also be associated with the mouthparts or external genitalia.”

NCSU Department of Entomology

Speciation and Co-evolution

Red Trillium - fetid smelling flowers attract carrion flies, which act as pollinators.

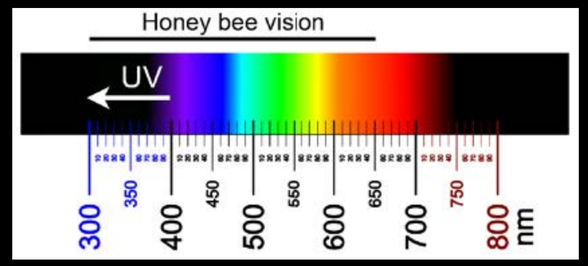
White Trillium attract long-tongued bees (Bombus) with a nectar reward

Prairie Trillium visitors are rare … single pollinator observed - Spotted Pink Ladybeetle Coleomegilla maculata

Photos: *T. erectum* - Plismo wikimedia; *T. grandiflorum* - J631372 Pixabay; T recurvatum - Eric Hunt wikimedia

Pollinators see the world differently

Flowers look very differently to compound eyes that perceive different colours of light.



Black-eyed susans reflect UV light …

Thomas Eisner (2002) An Insect's View of a Flower, *American Entomologist*, 48,(3) 142–143

Every Pollinator has Unique Needs

Bees, flies, butterflies, moths, beetles, birds, …

Canadian Wildlife Federation Pollination Poster

Diversity of plants = diversity of pollinators

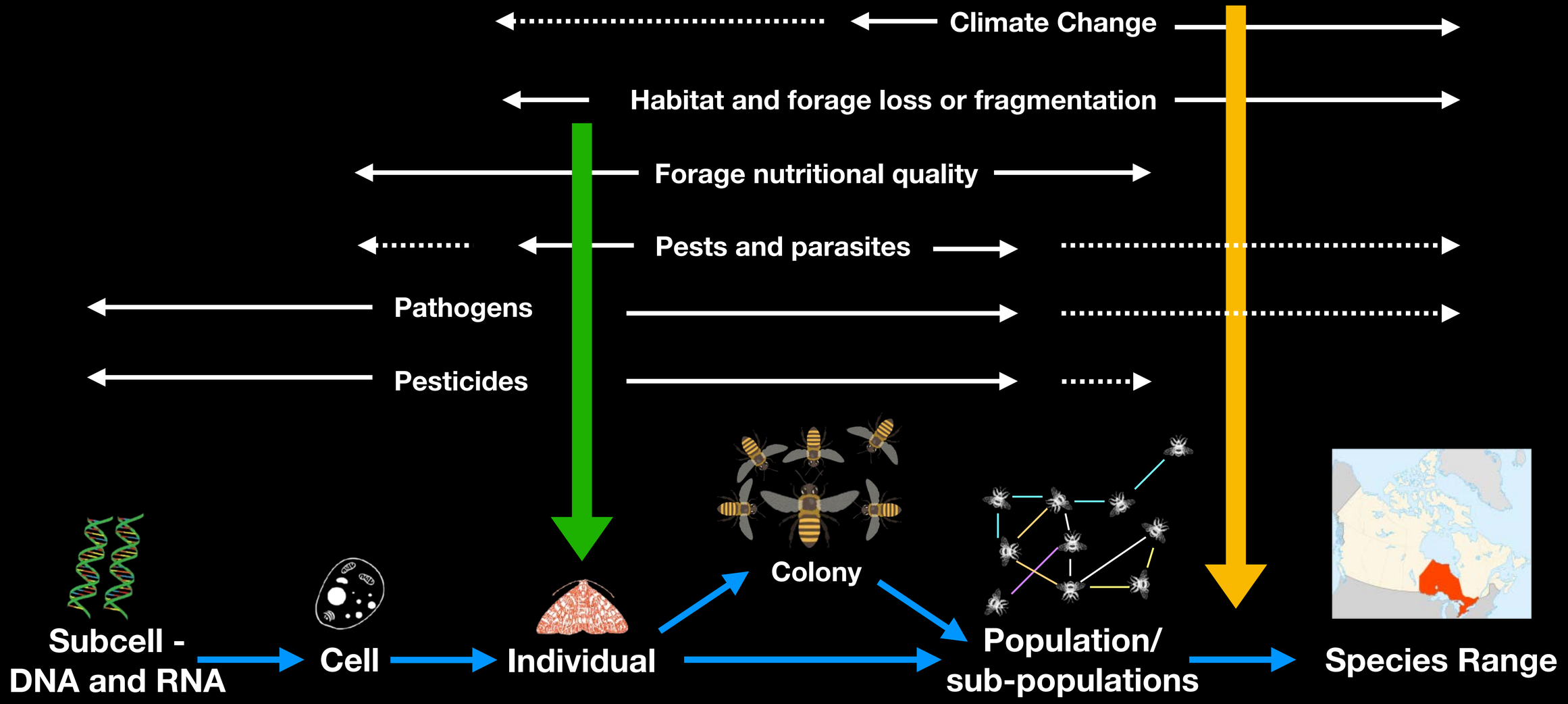
Long tongue

Short tongue

- Bees - Bright colours (not red)
- Butterflies - Bright colours including red with faint sweet scents and a landing pad
- Moths - Night blooming flowers (typically white) with strong, thick sweet smells
- Flies - All of the above plus flowers with resembling of rotting fruit or dung or carrion
- Beetles - Strongly fruity white or green flowers

Moisset, B., Buchmann, S. (2012) Bee basics: An introduction to our native bees, Washington, DC: USDA Forest Service and Pollinator Partnership.

Pressures on pollinators - Pollinators are in trouble



adapted from Vanbergen, Adam et al. 2013. Threats to an ecosystem service: pressures on pollinators Frontiers in Ecology and the Environment. (11) 5

Meta-analysis reveals an average decline of terrestrial insect abundance by ~9% per decade

van Klink, Roel & Bowler, Diana & Gongalsky, Konstantin & Swengel, Ann & Gentile, Alessandro & Chase, Jonathan. (2020). Meta-analysis reveals declines in terrestrial but increases in freshwater insect abundances. Science (New York, N.Y.). 368. 417-420. 10.1126/science.aax9931.

source:
University of Florida
Thompson Earth
Systems Institute

You can help patch our fractured ecosystems

Pollinators need

- Nesting habitat
- Shelter
- Water
- Nutrition (pollen, nectar, …)
  - ✦ Trees and shrubs
  - ✦ Flowering plants (from spring to fall)
  - ✦ Grasses and sedges

Create a pollinator patch

Habitat diversity = Pollinator diversity

About 30 % of North American bee species are solitary wood-nesters using twigs with soft pithy centers (e.g. box elder, elderberry, or various cane berries)

Think layers: trees, shrubs, flowering plants, grasses …

Adapted from *M. Vaughan and S. Black. 2006. USDA National Agroforestry Center. AF Note-34: Enhancing Nest Sites for Native Bee Crop Pollinators.*

Solitary Bees

- Make up the majority of our bees
  (Bumblebees and domestic bees are social)
- 70% of them nest in the ground (bare ground … not mulch)
- 30% nest in plant stems or holes in wood
- Some are specialists who can only feed on specific flower species

Illustration (left, Sarina Jepsen) showing ground nesting bees. Photo (right, Katharina Ullman) showing cavity nesting bees in a hollow stem. Xerces.org

A Digger Bee, *Anthophora* sp. Photo: Rollin Covill

Moths secret pollinators
most are nocturnal

- Overall, limited knowledge is available on the role of moths as pollinators in natural ecosystems.
- A number of plants are specialized for moth pollination
- Some seed eaters are very attentive pollinators

Yucca *Yucca filamentosa* (Liliaceae)

Yuccas and the yucca moths (species of Tegeticula or Parategeticula) are so interdependent that one cannot live without the other. After placing her eggs into an ovary, the moth inserts pollen gathered from another flower into the specially shaped stigma, ensuring that her babies will have seeds.

https://ohioplants.org/flowers-pollination/

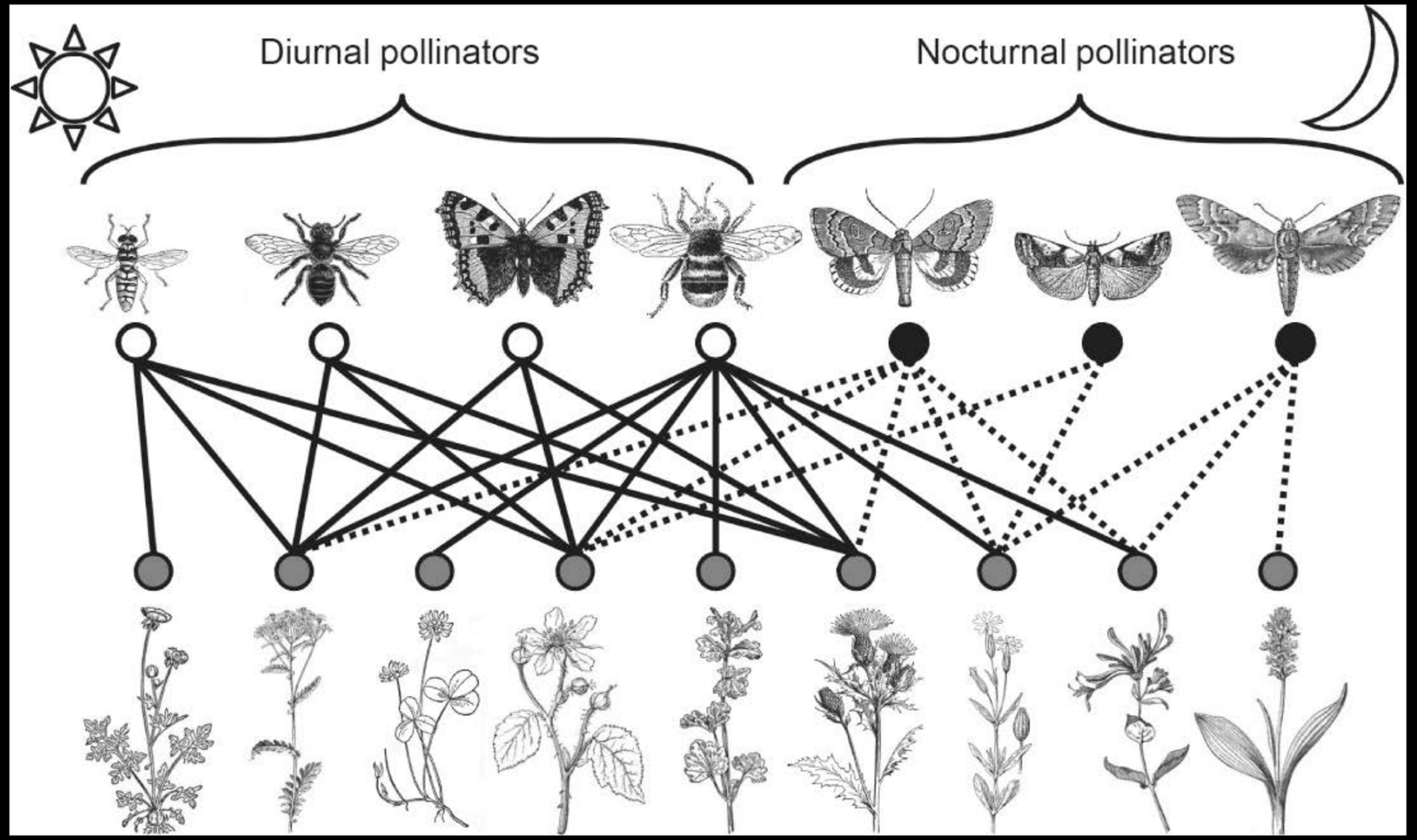
Hahn, Melanie & Brühl, Carsten. (2016). The secret pollinators: an overview of moth pollination with a focus on Europe and North America. Arthropod-Plant Interactions. 10. 10.1007/s11829-016-9414-3.

Artificial light at night is a threat to all pollination

Knop, E. & Zoller, Leana & Ryser, Remo & Gerpe, Christopher & Hörler, Maurin & Fontaine, Colin. (2017). Artificial light at night as a new threat to pollination. Nature. 548.

artificial light at night generally leads to a reduction of plant–pollinator interactions during daytime

Giavi, S., Fontaine, C. & Knop, E. Impact of artificial light at night on diurnal plant-pollinator interactions. *Nat Commun* **12,** 1690 (2021).



Macgregor, C.J., Pocock, M.J.O., Fox, R. and Evans, D.M. (2015) Pollination by nocturnal Lepidoptera, and the effects of light pollution: a review. Ecol. Entomol. 40, 187–198

Oaks are hosts to over 400 moths and butterflies in the Eastern Temperate Region

Red oak - *Quercus rubra*

Keystone species for moths and butterflies

for Lepidoptera in the Eastern Temperate Region

436 • **Oaks**

340 • **Cherries**

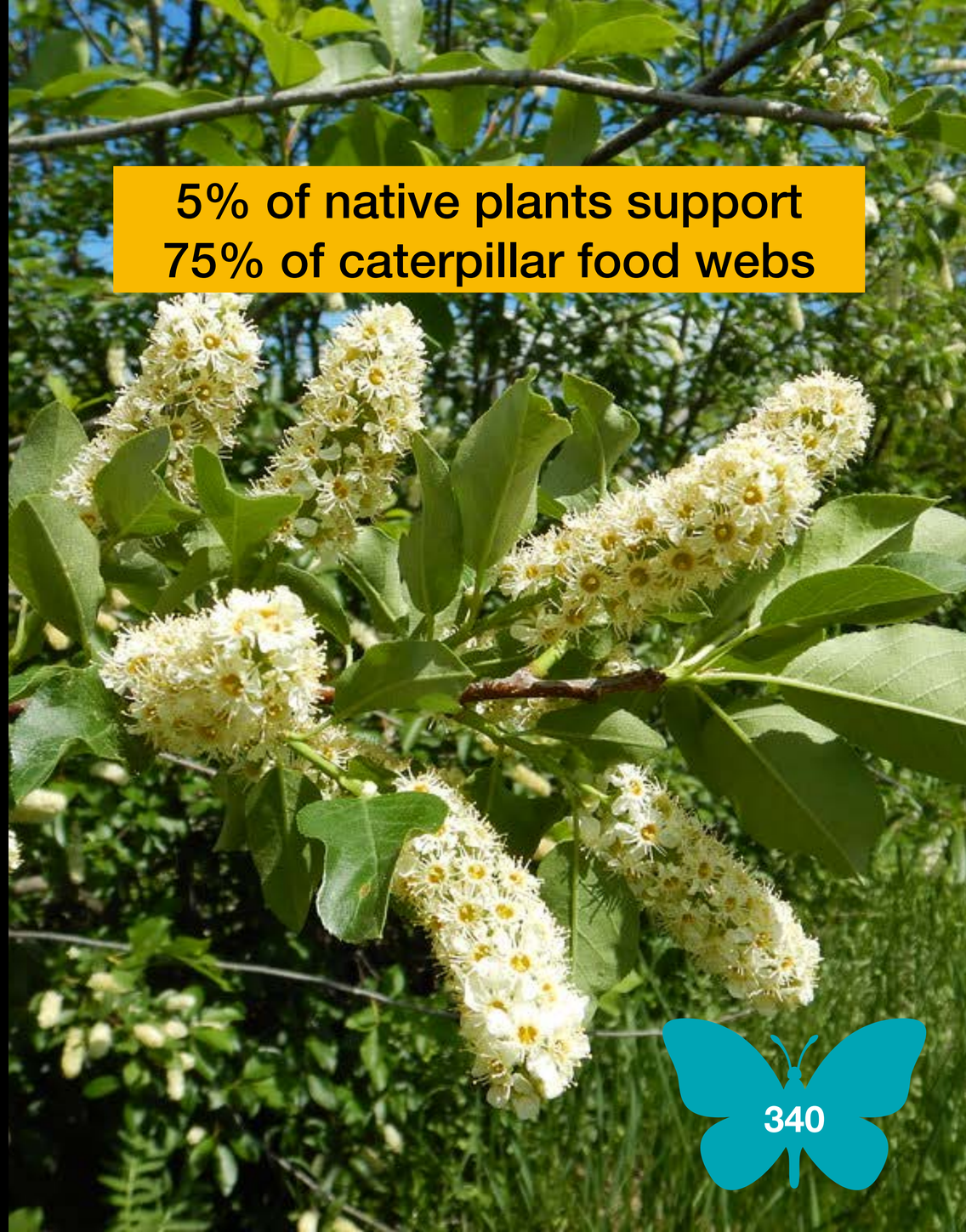
14 289 • **Willows**

284 • **Birches**

249 • **Poplars**

238 • Maple

Keystone Plants by Ecoregion - National Wildlife Foundation
https://www.nwf.org/Garden-for-Wildlife/About/Native-Plants/keystone-plants-by-ecoregion



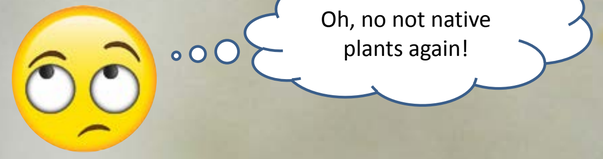
Choke cherry - *Prunus virginiana*
Photo: Matt Iavin

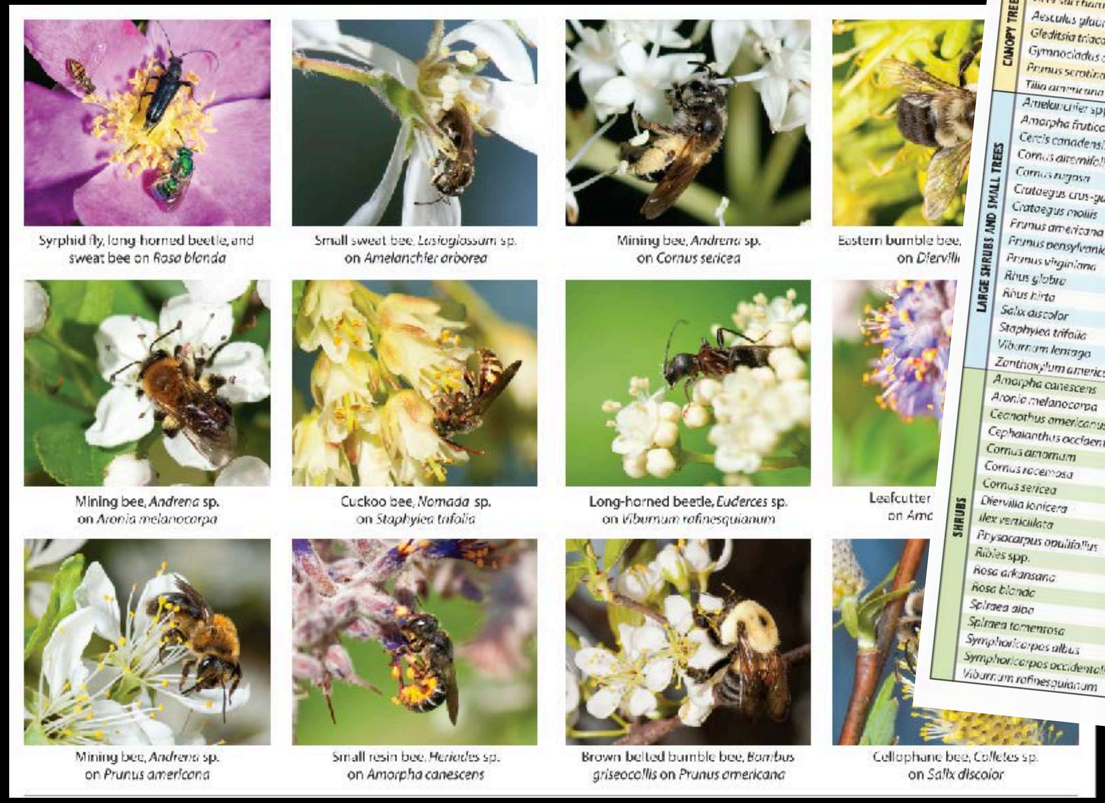
Choose Ontario Native Species

Native landscapes

compared to traditional landscaping

- 3x more butterfly species
- 2x higher abundance of native bees





NATIVE TREES AND SHRUBS FOR POLLINATORS

	BOTANICAL NAME	COMMON NAME	COLOR	MOISTURE	HEIGHT	BLOOM					POLLINATORS					
						APR	MAY	JUN	JUL	AUG	SEP	BEES	BUTT/MOTH	WASPS	FLIES	BEETLES	OTHER
CANOPY TREES	*Acer rubrum*	Red Maple	red/yellow	m	to 95 ft							x	butterflies	x	x		sawflies,
	Acer saccharum	Sugar Maple	yellow	m	to 100 ft							x	butterflies	x	x		sawflies,
	Aesculus glabra	Ohio Buckeye	yellow	m	to 35 ft							x					hummingbirds
	Gleditsia triacanthos	Honey Locust	yellow	m,d	to 45 ft							x					
	Gymnocladus dioicus	Kentucky Coffeetree	white	w, m	to 75 ft							x	butterflies		x		hummingbirds
	Prunus serotina	Black Cherry	white	m,d	to 100 ft							x	butterflies	x	x	x	ants
	Tilia americana	American Basswood	white	m	to 95 ft							x	moths	x	x	x	sawflies
LARGE SHRUBS AND SMALL TREES	*Amelanchier* spp.	Serviceberries	white	w, m, d	10-25 ft							x			x	x	
	Amorpha fruticosa	False Indigo	purple	w	12 ft							x				x	
	Cercis canadensis	Eastern Redbud	pink	m	to 25 ft							x	butterflies	x	x	x	
	Cornus alternifolia	Pagoda Dogwood	white	m	to 25 ft							x		x	x	x	
	Cornus nuttallii	Mountain Dogwood	white	m,d	5-18 ft							x				x	
	Crataegus crus-galli	Cockspur Hawthorn	white	m	to 25 ft							x	butterflies	x	x	x	
	Crataegus mollis	Downy Hawthorn	white	w, m	to 40 ft							x	butterflies	x	x	x	
	Prunus americana	Wild Plum	white	m,d	8-20 ft							x	both	x	x	x	
	Prunus pensylvanica	Pin Cherry	white	m,d	10-35 ft							x					
	Prunus virginiana	Chokecherry	white	m,d	10-30 ft							x					
	Rhus glabra	Smooth Sumac	lime/yell	m,d	5-20 ft							x	butterflies	x	x	x	
	Rhus hirta	Staghorn Sumac	lime/yell	m,d	10-35 ft							x	butterflies	x	x	x	
	Salix discolor	Pussy Willow	white/yell	w	12-35 ft							x	butterflies	x	x	x	
	Staphylea trifolia	American Bladdernut	white	m	8-20 ft							x					
	Viburnum lentago	Nannyberry Viburnum	white	m,d	8-30 ft							x	butterflies	x	x	x	
	Zanthoxylum americanum	Prickly Ash	yellow	m,d	5-20 ft							x	moths	x	x	x	sawflies
SHRUBS	*Amorpha canescens*	Leadplant	lavender	m,d	2-4 ft							x	both	x	x	x	
	Aronia melanocarpa	Black Chokeberry	white	w, m	2-4 ft							x			x		
	Ceanothus americanus	New Jersey Tea	white	m,d	2-6 ft							x	butterflies	x	x	x	
	Cephalanthus occidentalis	Buttonbush	white	w,m	5-15 ft							x	both	x	x	x	sawflies
	Cornus amomum	Silky Dogwood	white	w	10-15 ft							x	butterflies	x	x	x	
	Cornus racemosa	Gray Dogwood	white	m,d	10-18 ft							x	butterflies	x	x	x	
	Cornus sericea	Red Osier Dogwood	white	w,m	5-15 ft							x	moths	x	x	x	
	Diervilla lonicera	Dwarf Bush Honeysuckle	yellow	m,d	2-4 ft							x					
	Ilex verticillata	Winterberry	white	w, m	5-15 ft							x	butterflies				
	Physocarpus opulifolius	Ninebark	white	m,d	5-10 ft							x	both	x	x		
	Ribes spp.	Currant/Gooseberry	wh/yell	w, m, d	2-10 ft							x					
	Rosa arkansana	Prairie Wild Rose	pink	m,d	1-3 ft							x			x		
	Rosa blanda	Smooth Wild Rose	pink	m,d	3-7 ft							x			x		
	Spiraea alba	Meadowsweet	white	w	3-7 ft							x			x		
	Spiraea tomentosa	Hardtack	pink	w	3-6 ft							x	butterflies		x		
	Symphoricarpos albus	Snowberry	white/pink	d	2-5 ft							x	butterflies		x		
	Symphoricarpos occidentalis	Wolfberry	white/pink	d	3-6 ft							x	both	x	x		
	Viburnum rufinesquianum	Downy Arrowwood Vib.	white	d	3-10 ft							x	both	x	x		

Native trees and shrubs

Visit Heather Holm’s pollinatorsnativeplants.com

KEYSTONES

The majority are tied to *Asteraceae* - the aster family

Top genera for specialist bees

for the Eastern Temperate Region

- Sunflowers, Goldenrods, Asters, Rudbeckia, Tickseed, Bidens, Fleabanes, Evening primrose, Sneezeweed, False sunflower, dogwoods…

- U.S. National Wildlife Federation has lists of genera online.

www.nwf.org/-/media/Documents/PDFs/Garden-for-Wildlife/Keystone-Plants/NWF-GFW-keystone-plant-list-ecoregion-8-eastern-temperate-forests.ashx?la=en&hash=1E180E2E5F2B06EB9ADF28882353B3BC7B3B247D

Bee Feeding on Sunflower-

Specialists

life cycles are tied to particular native species or families

Distinct mason bee (Osmia distincta) on Penstemon.

By tomwood734 i Naturalist

Host Plants for Pollen Specialist Bees of the Eastern United States Jarrod Fowler (2020) https://jarrodfowler.com/host_plants.html

Trout-lily Andrena (*Andrena erythronii*)

Conrad Vispo bigguide.net

Spring Beauty Bee - *Andrena erigeniae* on *Claytonia*

By Judy Gallagher - https://www.flickr.com/photos/52450054@N04/16411539534/,

Dufourea monardae, on bee balm

Photo © jgibbs (CC BY-NC 4.0)

Primrose Sweat Bee - Lasioglossum oenothera - on *Oenothera*

By Mary Anne Borge https://the-natural-web.org/tag/lasioglossum-oenotherae/

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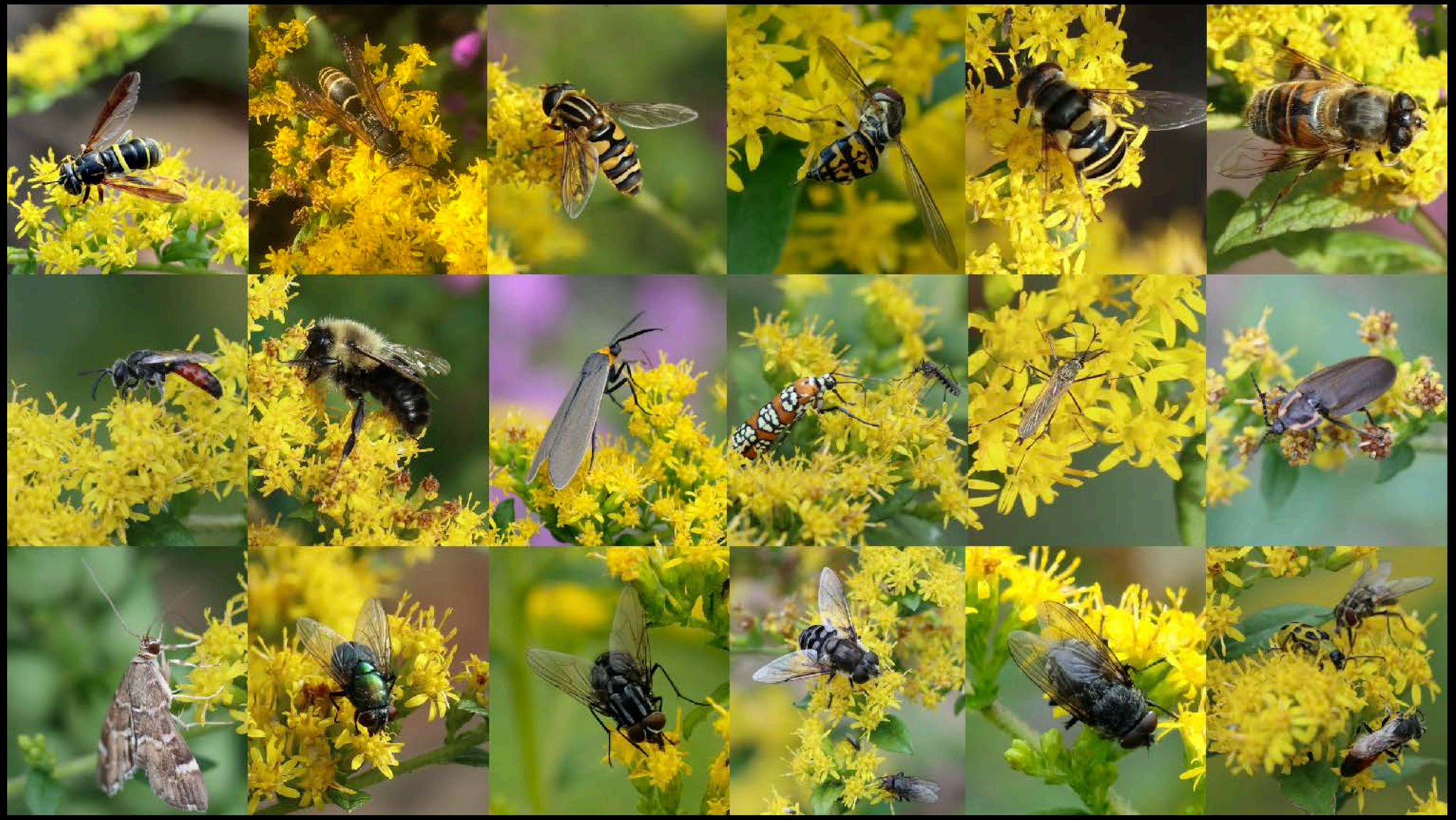
Pollinator activity on Asters - *Symphytrichum* spp. October 10, 2021 C. Kavassalis



Pollinator activity on Solidago rugosa 'Fireworks' October 14, 2021 C. Kavassalis

… so many native Goldenrods (Solidago species)

Numbers are for the general Eastern Temperate Region

KEYSTONE SPECIES

S. arguta

S. altissima

S. bicolor

S. caesia

S. canadensis

We don't know lot about keystones for flower flies or beetles

S. caesia X S. canadensis

S. flexicaulis

S. gigantea

S. hispida

S. juncea

S. nemoralis

S. ohioensis

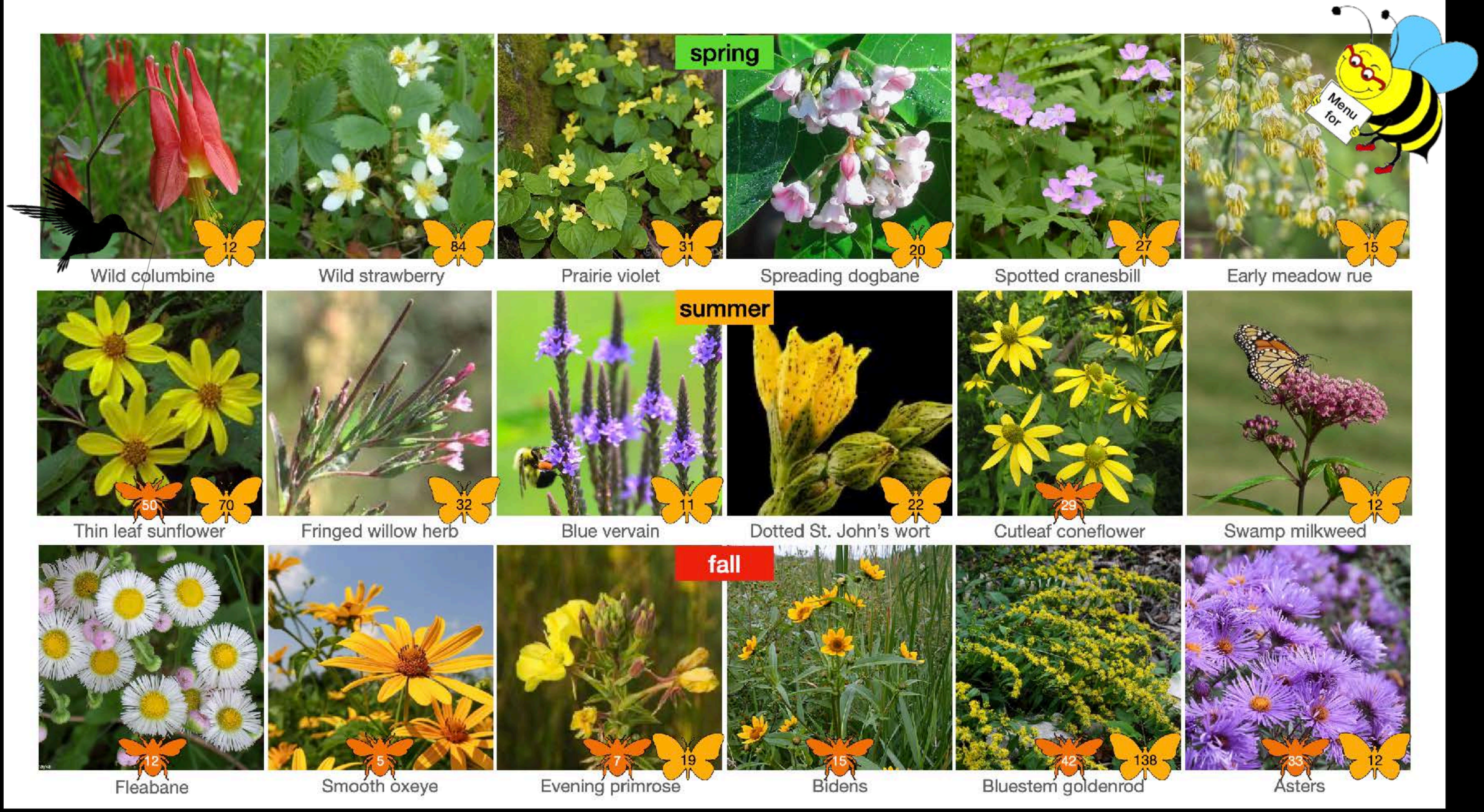
S. patula

S. ptarmicoides

S. rugosa

S. squarrosa

S. uliginosa



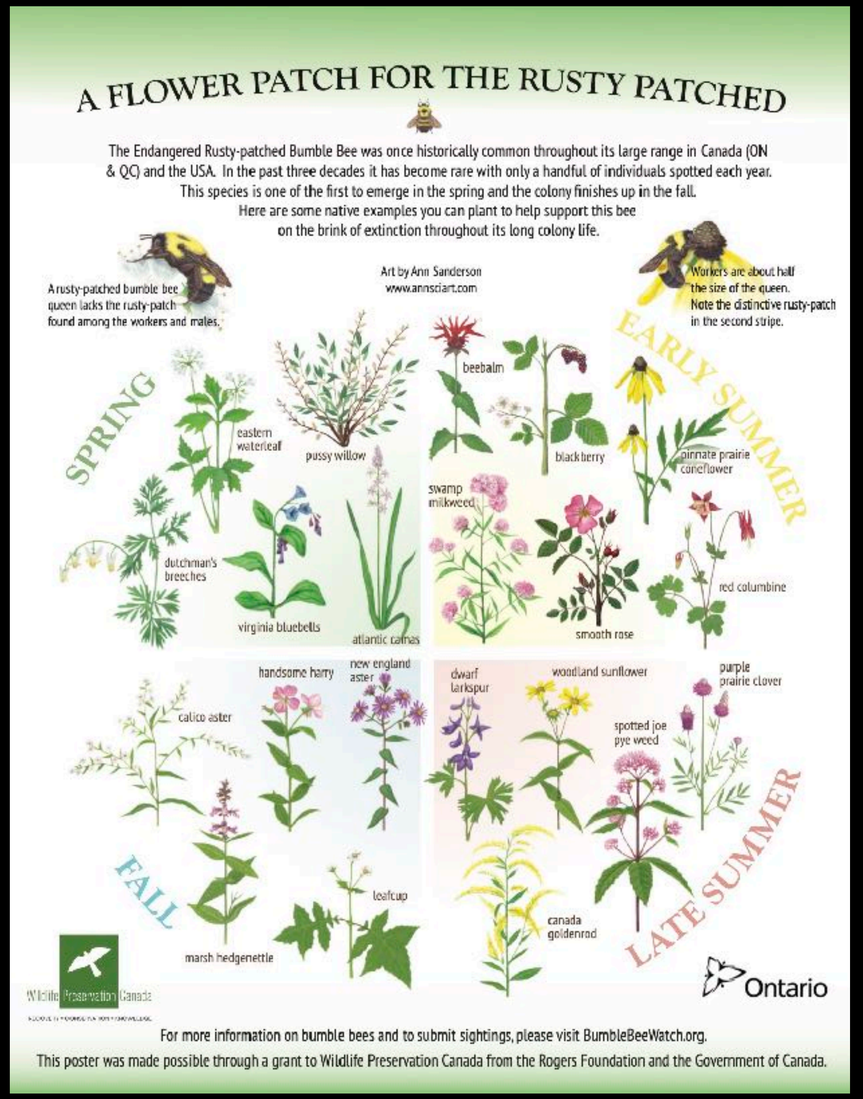
National Wildlife Foundation Plant Finder https://www.nwf.org/nativeplantfinder/

Bombus affinis

There are “pre-made” garden suggestions.

The Rusty-patched Bumble Bee is endangered. This species is one of the first to emerge in the spring and lives throughout the summer until the fall.

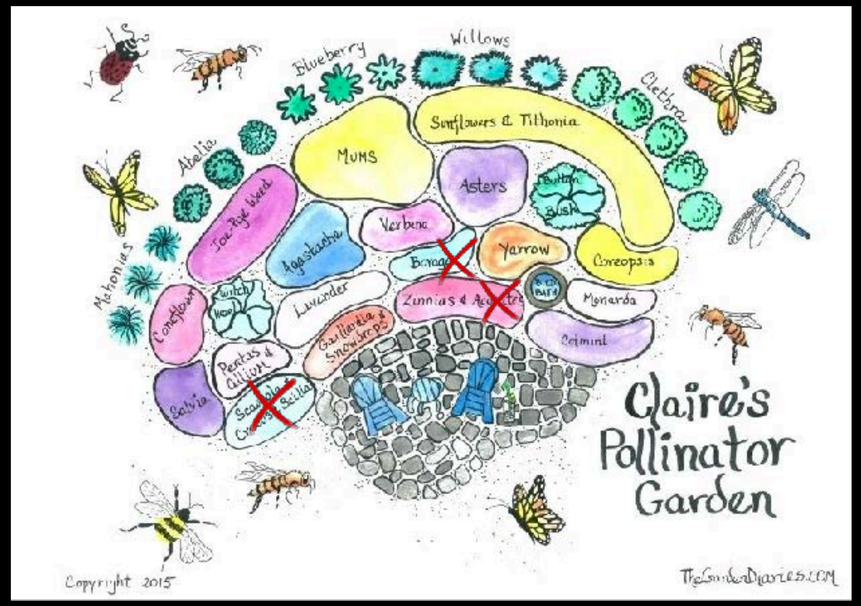
Plant a native garden to help support this bee on the brink of extinction.



https://wildlifepreservation.ca/a-flower-patch-for-the-rusty-patched/

Many lists and designs online … may not be regionally appropriate

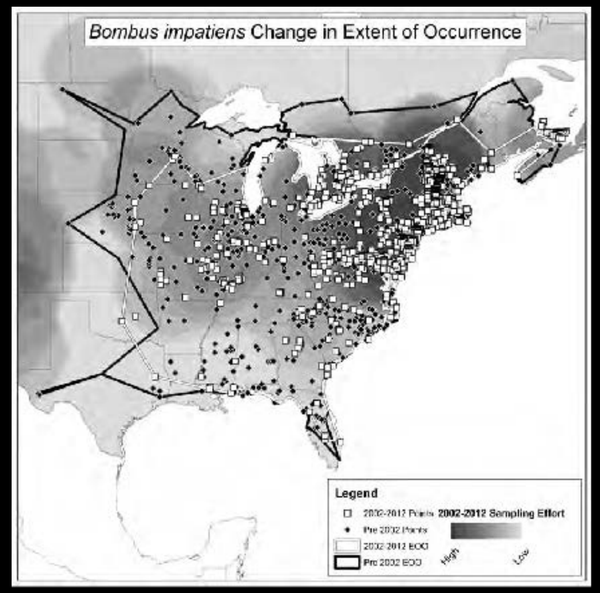
Early	Mid-season	Late
Blueberry	Blackberry	Aster
Crabapple	Catnip	Borage
Cranberry	Chives	Coneflower
Crocus	Dahlia	Cornflower
Foxglove ✗	Hyssop	Cosmos
Heliotrope	Lavender	Goldenrod
Hazelnut	Raspberry	Pumpkin
Heather	Sunflower	Sedum ✗
Primrose	Yarrow	Squash
Willow	David Suzuki Foundation Butterfly Garden for Canada	



Many non-native species. HUM… and some invasive!

Some species cover a large range

- These pollinators are more adaptable to southern species



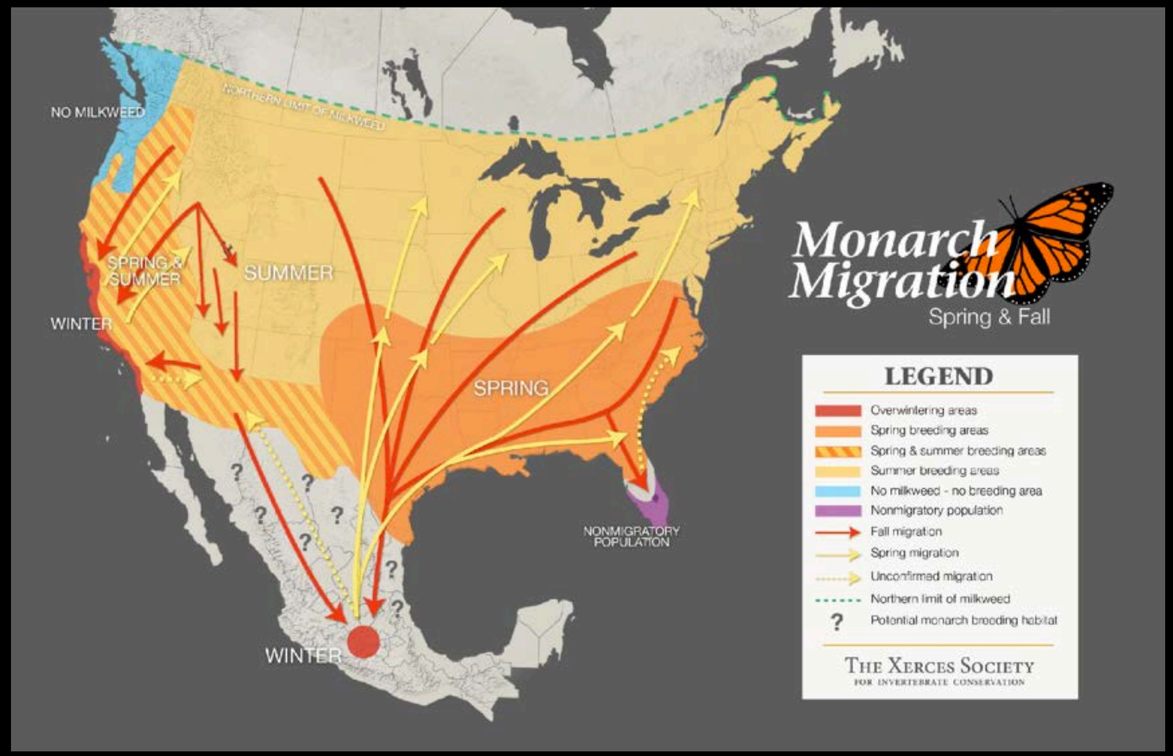
Hatfield, Rich & Colla, Sheila & Jepsen, Sarina & Richardson, Leif & Thorp, Robbin & Foltz, Sarah. (2014). IUCN Assessments for North American Bombus spp. for the North American IUCN Bumble Bee Specialist Group.

Common Eastern Bumble Bee (*Bombus impatiens*)

Photo: Ryan Hodne wikimedia

Tithonia - Mexican sunflower

The Painted Lady, Common Buckeye, American Lady, Red Admiral, Cloudless Sulphur, Skipper, Sachem, Question Mark, Clouded Skipper, Fiery Skipper and Mourning Cloak are all butterflies that migrate as well.



Native and Exotic

Native

Nativar

Exotic

Invasive

Rosaceae Rosa palustris
Photo: Kevin C. Nixon

Rosa palustris var. scandens
Photo: Fine Gardening

Rosa ‘WEKosomit’ Mellow YellowTM
Photo: Alice Rose

Rosa multiflora
Photo: Phil Lucas

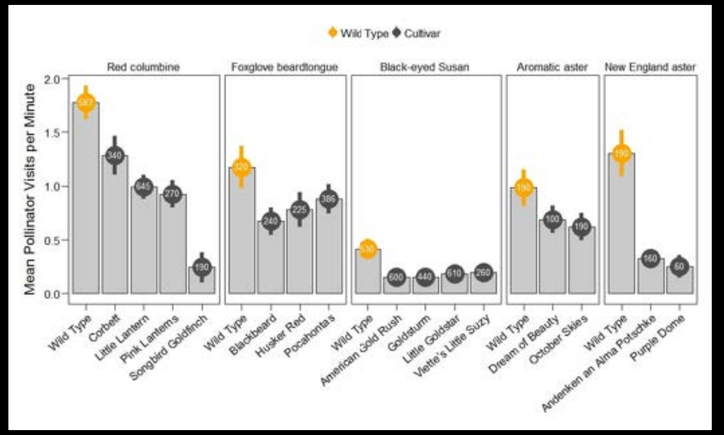
Hey! Where’s the pollen?

Nativars

Some are better than others

- These can be a part of your garden
- Some offer disease resistance
- Longer flowering
- More rigid form
- But… they reduce gene pools, are less likely to support native pollinators, and may introduce invasive genes.

Nativars research project in the Midwest. From top to bottom: red columbine (*Aquilegia canadensis*), black-eyed Susan (*Rudbeckia fulgida*), New England aster (*Symphyotrichum novae-angliae*).



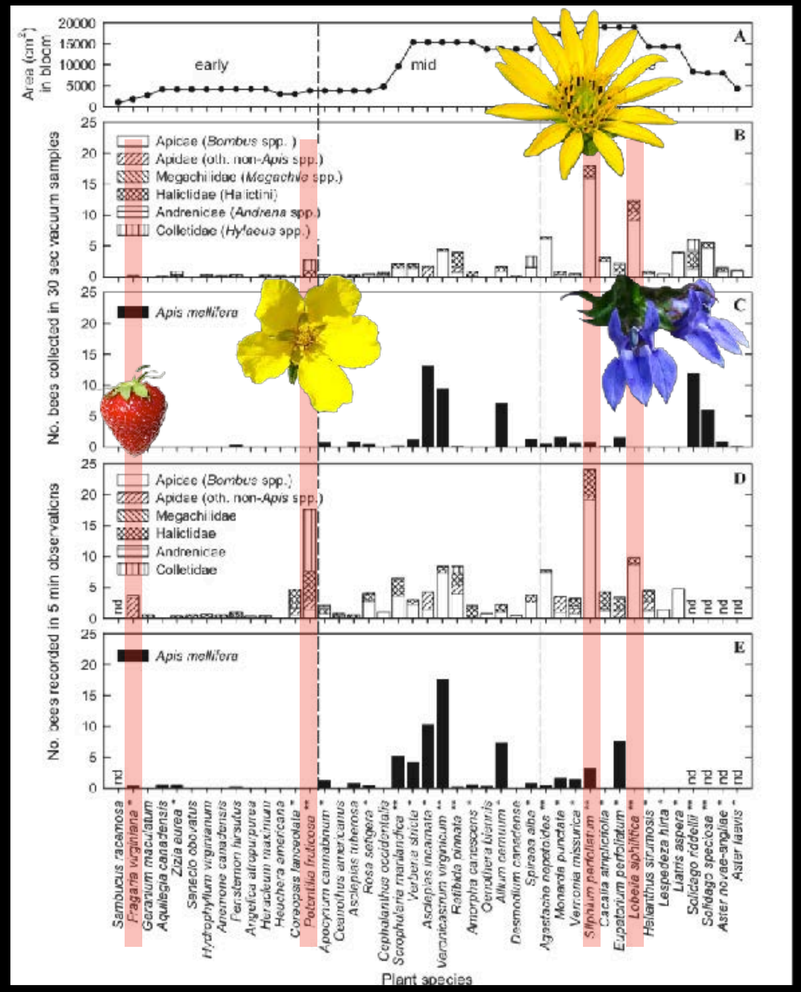
Budburst Nativars Research Project in
www.ecolandscaping.org/07/designing-ecological-landscapes/native-plants/citizen-scientists-help-parse-the-native-nativar-debate/

Phlox paniculata ‘Jeana’

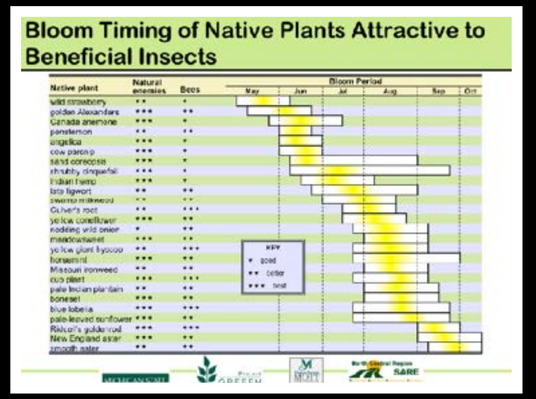
- Attracted 14 times the abundance and twice the diversity of visitors compared to the species
- Long bloom time beginning two weeks earlier than the species
- Flowers are narrow and nectar is concentrated in the centre making it easier for butterflies

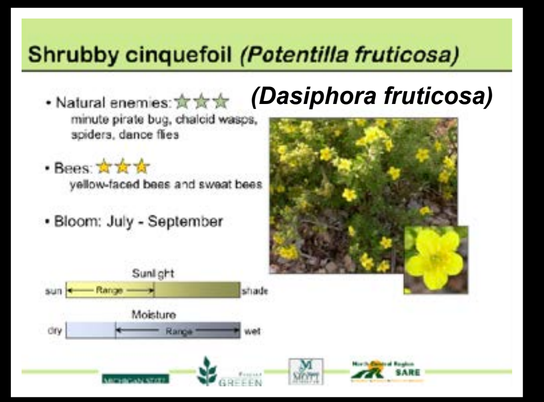
Nevison, Keith A.. 2016 The Role of Native Cultivars in the Ecological Landscape: Evaluating Insect Preferences and Nectar Quality in Phlox and Its Cultivars. University of Delaware, ProQuest Dissertations Publishing

We need more studies



Tuell J.K., Fiedler A.K., Landis D. & Isaacs R. (2008) Visitation by wild and managed bees (Hymenoptera: Apoidea) to eastern US native plants for use in conservation programs. Environmental Entomology, 37, 707-718





Michigan State Department of Entomology Native Plants and Ecosystem Services

Michigan State http://www.canr.msu.edu/nativeplants/resources/teaching_tools

Native grasses

Grasses are wind-pollinated but the provide shelter and seeds and leaves are food …

Switch grass *Panicum virgatum*
Warren Gretz, DOE/NREL - National Renewable Energy Laboratory

- Big bluestem *Andropogon gerardii*
- Reed Grass *Calamagrostis stricta*
- Bottle brush *Elymus hystrix*
- Wood Millet *Milium effusum*
- Switch grass *Panicum virgatum*
- Little bluestem *Schizachyrium scoparium*
- Indian grass *Sorghastrum nutans*

Sedges

- Carex albicans, part shade to full
- C. bromoides, part sun to shade (moist)
- C. crinata, full sun to part shade (moist)
- C. eburnea, sun to shade
- C. grayii, part sun to part shade, (moist)
- C. grisea, sun to shade (moist)
- C. pensylvanica, full sun to shade (moist)
- C. plantaginea, part sun to shade
- C. sprengelii, part sun or shade (moist)
- C. vulpinoidea, full sun

Tickseed, Ironweed, Blanket flower, Coneflower are not native, but are good choices for pollinators

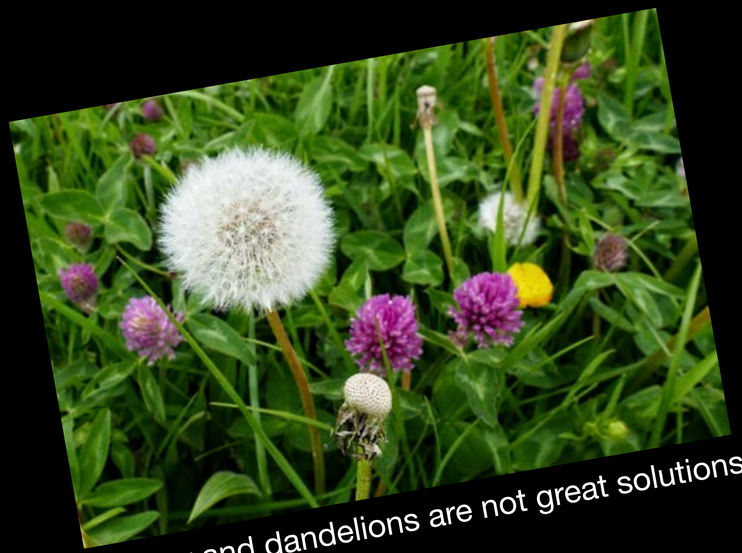
"Plant a variety of plants, biased towards native and near-native species with a selection of exotics to extend the flowering season …"

Salisbury, A., et al. (2015), EDITOR'S CHOICE: Enhancing gardens as habitats for flower-visiting aerial insects (pollinators): should we plant native or exotic species?. J Appl Ecol, 52: 1156–1164.

Milkweed (*Asclepias syriacus*) with hairstreaks in July

Rethink lawns

- Diversify ground covers and consider alternatives
- No mow sedges ..



Clover and dandelions are not great solutions

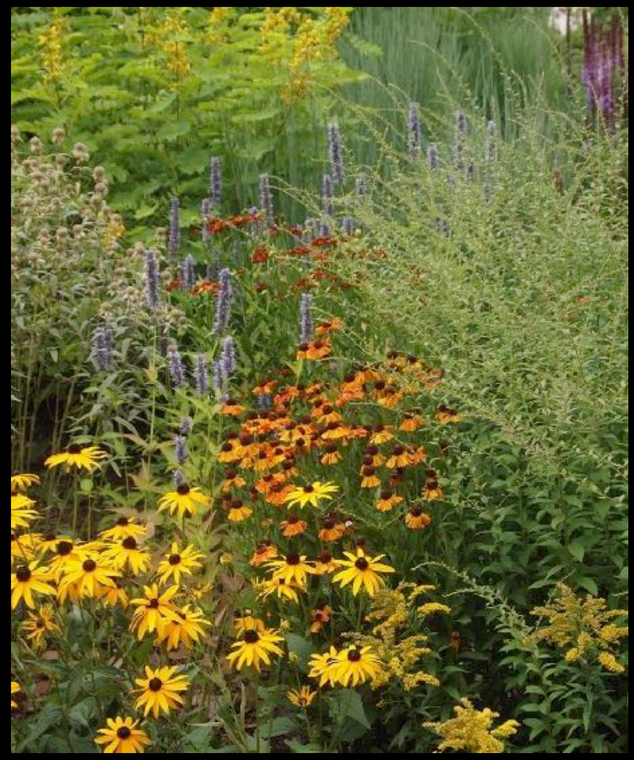
courtesy Justin Lewis - Burlington Ontario

A hummingbird and bees sharing a water fountain.
Photo: Toshiyasu Morita.

Water

we all need it

Harris' Checkerspots sipping on damp sand
photo: Bob Yukich

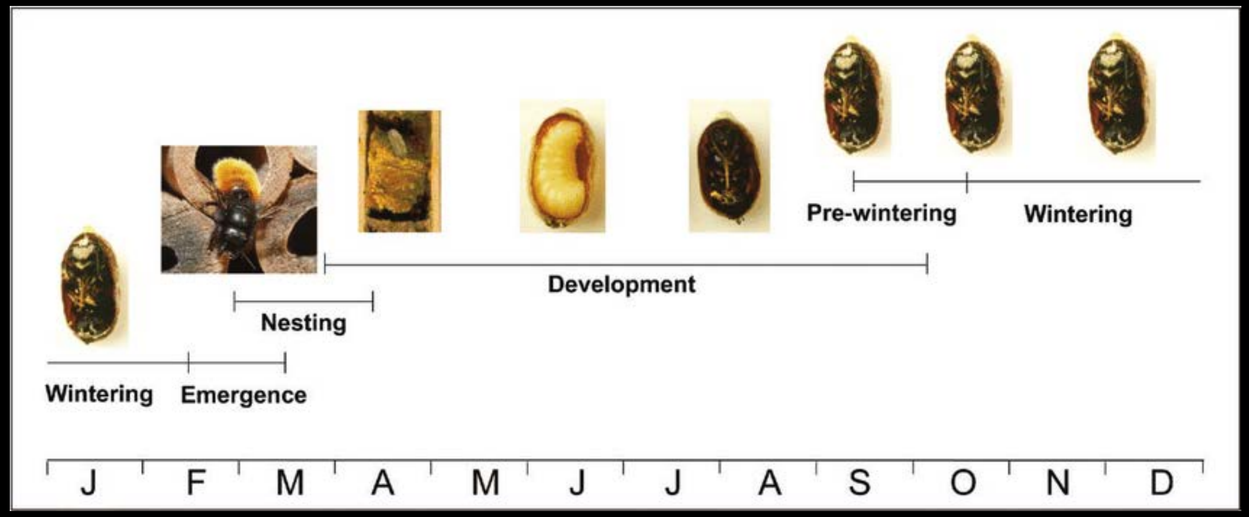


How you care for your garden through the seasons is important.

What happens if you cut down the stems?

Cavity nesting bees need old stems to raise their babies.

The genus Ceratina. Photo by Heather Holm.



Life cycle of Osmia spp. Photo credits: egg (USDA), prepupa (USDA), pupa (USDA), cocooned adult (USDA), emerged adult (Serena Magagnoli).

Don’t aggressively cut back or clean up these plants and consider leaving dead branches alone.

Life cycles are tied to plant cycles

- Specialist bees are becoming increasingly rare
- Lack of plants
- Fragmented populations
- Our desire to “clean up”
- Tilling and mulching soils
- etc.

Pollen Specialist Bees of the Eastern United States
Jarrod Fowler & Sam Droege (2020) **(Excerpt)**

Family: Subfamily: Tribe: Subtribe	*Genus (Subgenus) species*	J	F	M	A	M	J	J	A	S	O	N	D	Host plant Family: Tribe: *Genera*
Andrenidae: Andreninae	*Andrena (Callandrena) accepta*	.	.	.	.	.	.	.	X	X	X	.	.	Asteraceae: *Grindelia* Willd., *Helianthus* L.
	Andrena (Callandrena s.l.) aliciae	.	.	.	.	.	.	X	X	X	.	.	.	Asteraceae: *Bidens* L., *Helianthus* L., *Rudbeckia* L., *Silphium* L., *Solidago* L., *Symphyotrichum* Nees
	Andrena (Perandrena) andrenoides	.	.	.	X	X	.	.	.	.	.	.	.	*Salix* L.
	Andrena (Scaphandrena) arabis	.	.	X	X	X	.	.	.	.	.	.	.	*Arabis* L., *Cardamine* L.
	Andrena (Callandrena s.l.) asteris	.	.	.	.	.	.	.	X	X	.	.	.	*Eurybia* (Cass.) Cass., *Solidago* L., *Symphyotrichum* Nees
	Andrena (Callandrena s.l.) asteroides	.	.	.	.	.	.	.	.	X	X	X	.	*Symphyotrichum* Nees
	Andrena (Thysandrena) bisalicis	.	.	X	X	X	X	X	.	.	.	.	.	*Salix* L.
	Andrena (Callandrena s.l.) bruccata	.	.	.	.	.	.	.	X	X	X	.	.	*Euthamia* Nutt. ex Cass., *Solidago* L.
	Andrena (Conandrena) bradleyi	.	.	X	X	X	X	.	.	.	.	.	.	Ericaceae: *Chamaedaphne* Moench, *Kalmia* L., *Vaccinium* L.
	Andrena (Cnemidandrena) canadensis	.	.	.	.	.	.	.	X	X	.	.	.	Asteraceae: *Eurybia* (Cass.) Cass., *Grindelia* Willd., *Solidago* L., *Symphyotrichum* Nees
	Andrena (Andrena) carolina	.	.	.	X	X	X	X	.	.	.	.	.	Ericaceae: *Gaylussacia* Kunth, *Vaccinium* L.
	Andrena (Cnemidandrena) chromotricha	.	.	.	.	.	.	X	X	X	.	.	.	Asteraceae: *Grindelia* Willd., *Helianthus* L., *Solidago* L., *Symphyotrichum* Nees
	Andrena (Andrena) clarkella	.	.	.	X	X	X	X	.	.	.	.	.	*Salix* L.
	Andrena (Andrena) cornelli	.	.	.	.	X	X	X	.	.	.	.	.	*Rhododendron* L.
	Andrena (Ptilandrena) distans	.	.	.	X	X	X	.	.	.	.	.	.	*Geranium* L.
	Andrena (Callandrena) duplicata	.	.	.	.	.	.	.	X	X	X	.	.	Asteraceae: *Bidens* L.
	Andrena (Ptilandrena) erigeniae	.	.	X	X	X	.	.	.	.	.	.	.	*Claytonia* L.
	Andrena (Tylandrena) erythrogaster	.	.	.	X	X	X	X	.	.	.	.	.	*Salix* L.
	Andrena (Leucandrena) erythronii	.	.	.	X	X	X	.	.	.	.	.	.	*Erythronium* L.
	Andrena (Gonandrena) fragilis	.	.	.	.	X	X	X	.	.	.	.	.	*Cornus* (Swida) L.
	Andrena (Andrena) frigida	.	.	X	X	X	X	.	.	.	.	.	.	*Salix* L.

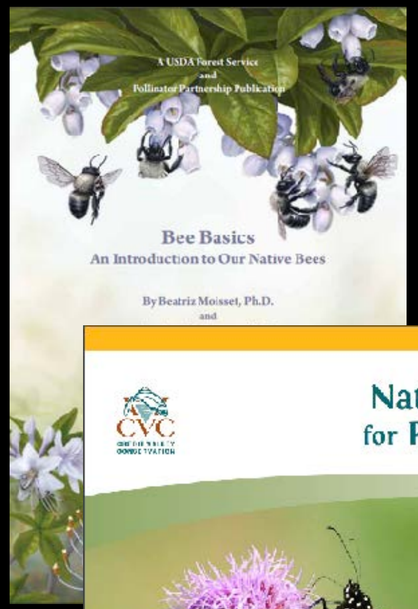
https://jarrodfowler.com/specialist_bees.html

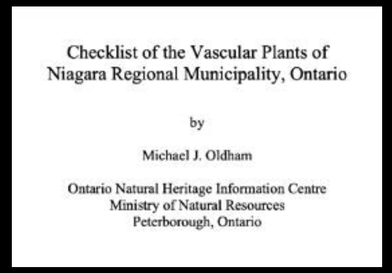
Funded by a grant from Wild Ones Minnesota. ©2021 Heather Holm and Neighborhood Greening.
Developed in consultation with Desiree Narango, Ph.D.; artwork by Elsa Cousins.
* For more on creating soft landings under trees, visit: www.PollinatorsNativePlants.com/softlandings.html

Rethink garden “cleanup”

nature isn’t dirty

- Leave leaf litter, duff and plant debris under trees and plants
- Chop and drop plant material, only when you really must.

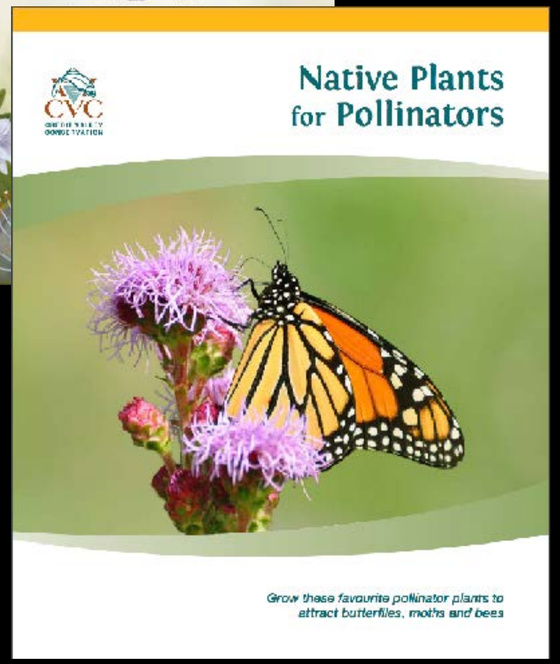


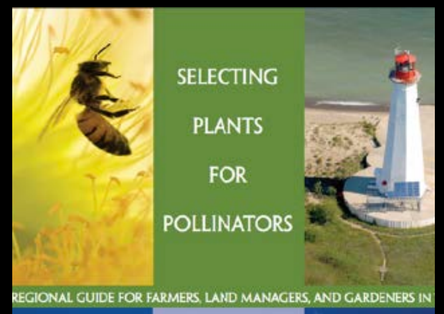

Checklist of the Vascular Plants of
Niagara Regional Municipality, Ontario

by

Michael J. Oldham

Ontario Natural Heritage Information Centre
Ministry of Natural Resources
Peterborough, Ontario

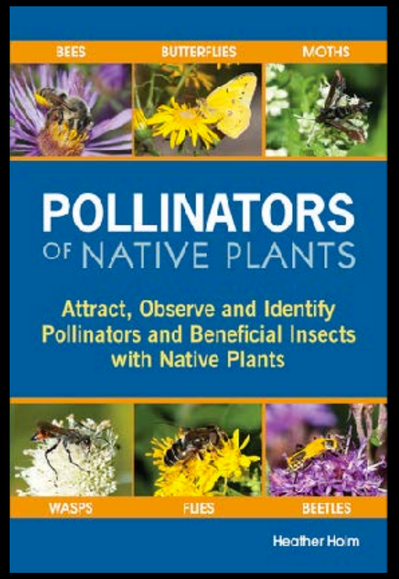


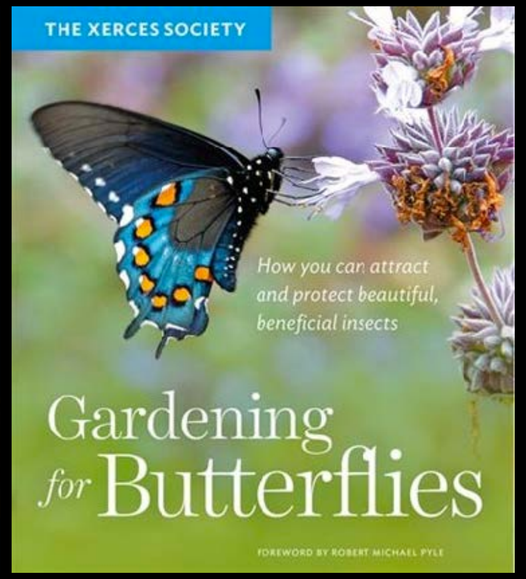


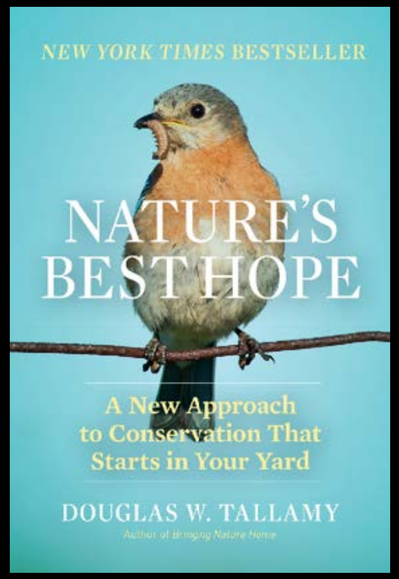
There are many online resources

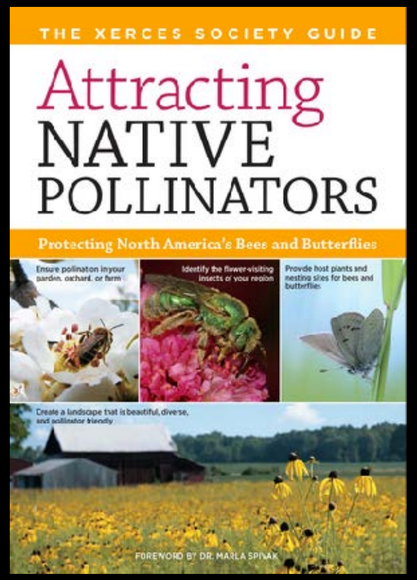
pollinator.org
xerces.org
pollinationguelph.ca

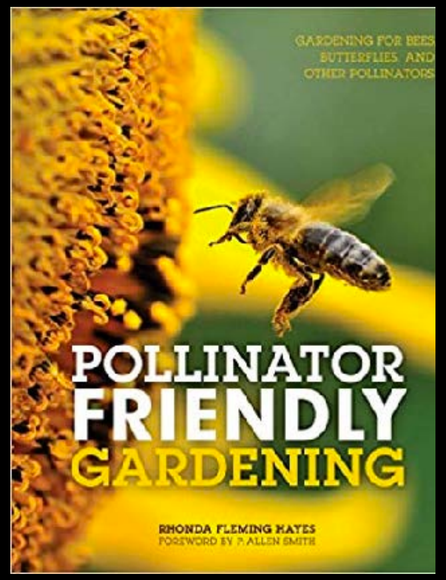
Many Great Reads

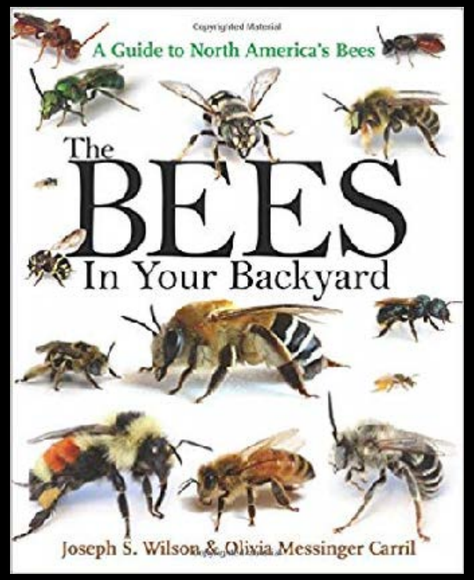


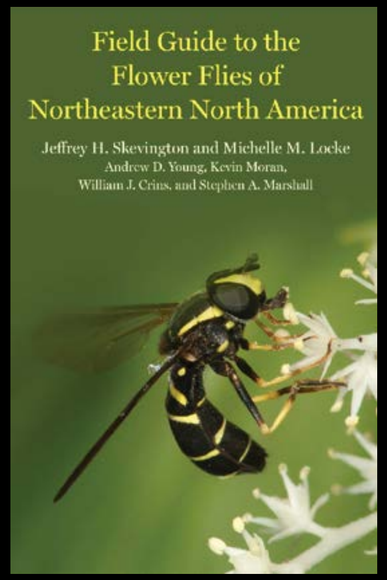












Webinars and videos

- Audubon Rockies *-Creating a Year Round Habitat for Pollinators* www.youtube.com/watch?v=eDAC636WvfA

Together we can make a difference for future generations

- Shrink lawns
- Choose native plants
  - Focus on **Keystone** species
  - Make native trees a priority
- Reject invasive plants
- Reduce light pollution
- Rethink the rules!
  - Don’t clean up your garden in the fall

Thank you

Questions?

contact me:

c.kavassalis@gmail.com

Female ruby-throated hummingbird on columbine
Gustav Verderber www.sojournsinnature.com