Urban Habitat Planning for Beneficial Insects and Pollinators

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Photo: Xerces blue butterflies by Joel Sartore, https://www.altaonline.com/dispatches/a35588986/xerces-blue-butterfly-san-francisco/

The Xerces Society

for Invertebrate Conservation

A science-based nonprofit organization that protects wildlife through the conservation of invertebrates and their habitats

Conservation programs:

- Pollinators & Agricultural Biodiversity
- Endangered Species Conservation
- Reducing Pesticide Use
- Community Engagement

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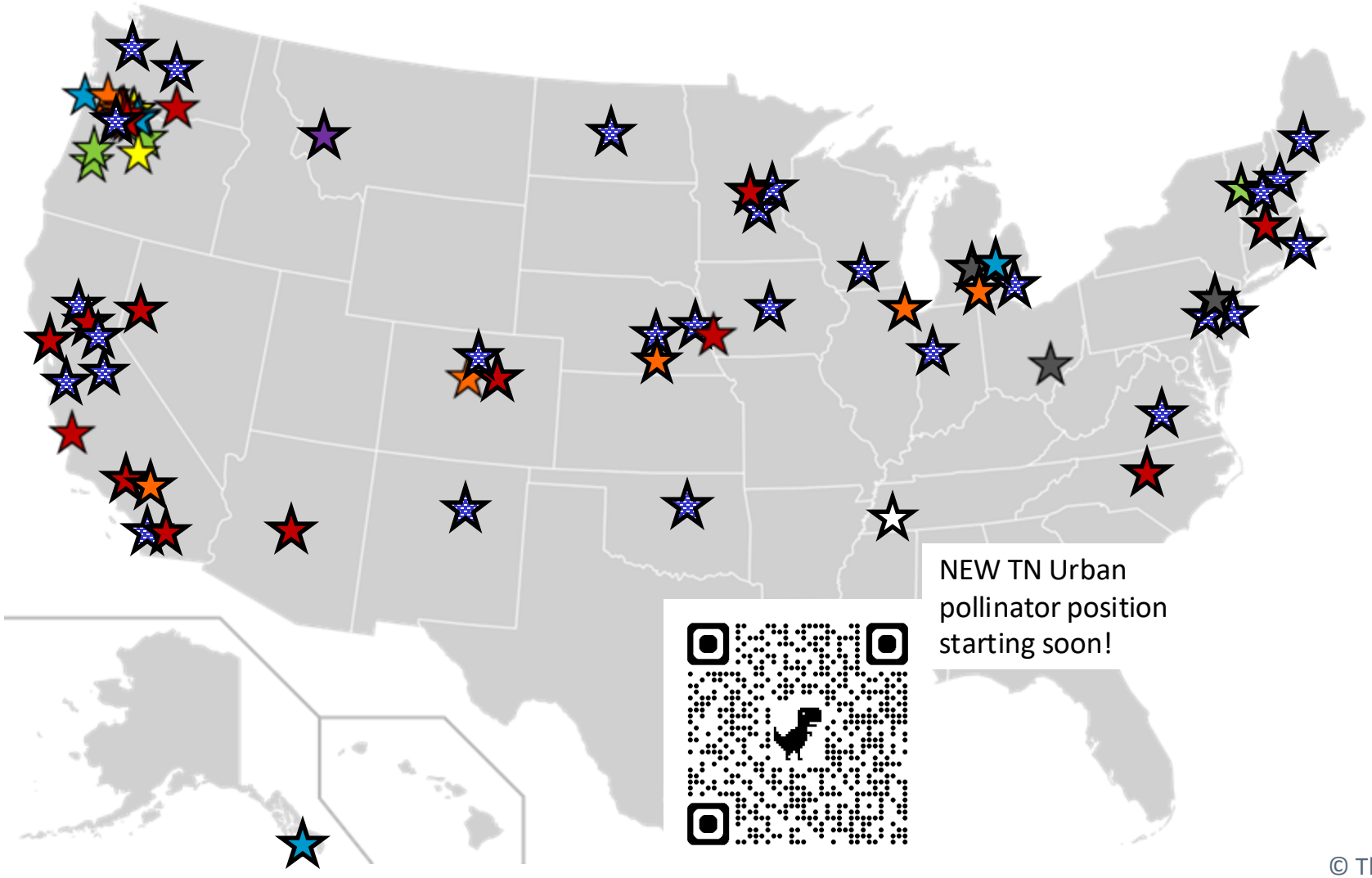
The Xerces Society: Program Structure



NEW TN Urban pollinator position starting soon!

- Pollinator Program
- Endangered Species Program
- Pesticide Program
- Outreach & Education

- Communications
- Membership
- Grants & Corporate Giving
- Finance & Operations

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Thank you to these Xerces Society supporters:

- Xerces Society members
- American Farmland Trust
- BAND Foundation
- Brand Addition
- Bureau of Land Management
- California Department of Fish and Wildlife
- California Department of Food and Agriculture
- California Wildlife Conservation Board
- Carroll Petrie Foundation
- Cascadian Farm
- Ceres Trust
- Chantecaille
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- Church and Dwight Philanthropic Foundation
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- Missouri Department of Conservation
- Monarch Joint Venture
- National Fish and Wildlife Foundation
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- Nature Valley
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- Pheasants Forever, Inc.
- Practical Farmers of Iowa
- RAEN Winery
- Regrid
- Samuel Freeman Charitable Trust
- San Diego Zoo Wildlife Alliance
- Sarah K. de Coizart Article TENTH Perpetual Charitable Trust
- The Betsy and Jesse Fink Family Foundation
- The Dudley Foundation
- The Edward Gorey Charitable Trust
- The Marion R. Weber Family Fund
- The New-Land Foundation
- The Taggart Saxon Schubert Fund
- District
- University of Northern Iowa
- Tito's Handmade Vodka
- Tualatin Soil and Water Conservation
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service's Office of Conservation Investment
- U.S. Fish and Wildlife Service's State Wildlife Grant Program
- U.S. Forest Service
- USDA Forest Service International Programs (USFS IP)
- USDA Natural Resources Conservation Service
- Western Sustainable Agriculture Research and Education
- White Pine Fund
- Whole Foods Market

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Photo: Karin Jokela / Xerces

Why focus on pollinator habitat?

the importance of pollinators

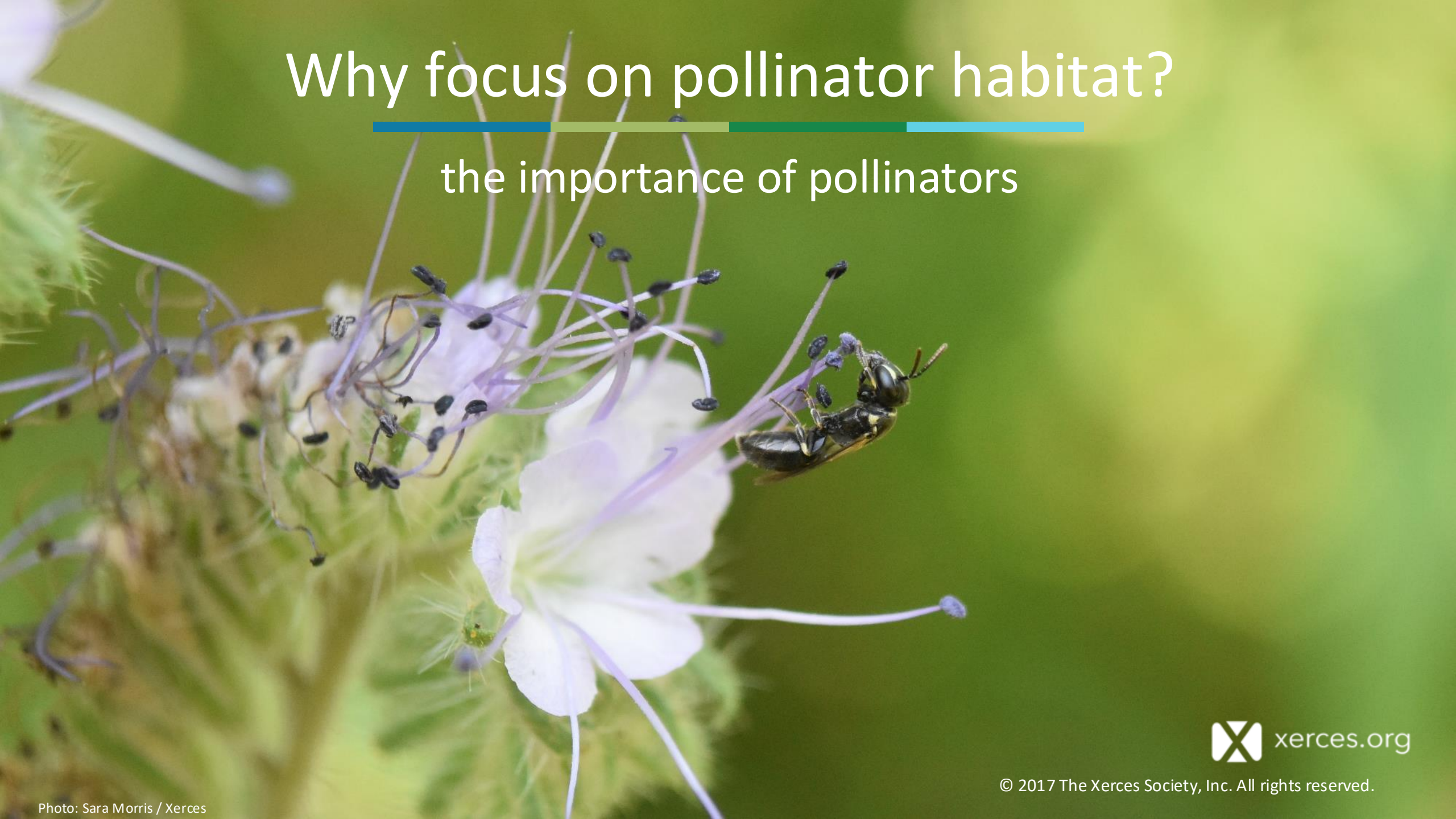

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Photo: Sara Morris / Xerces

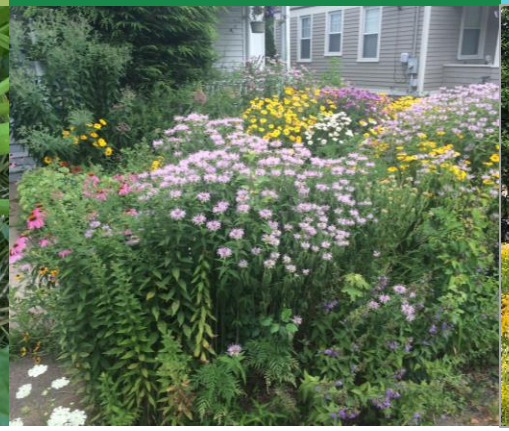
Why do we need habitat?

****Crops and wild plants require a diversity of pollinators for effective and sustainable pollination****

1. Widespread habitat loss -> insect decline

2. > 30% of crop production worldwide

3. > 80% of all flowering plants



4. Help reduce climate change effects

Photo: Kelly Gill / Xerces; Stefanie Steele / Xerces; Adam Varenhorst; Nick Dorian / Bee Campus Tufts University

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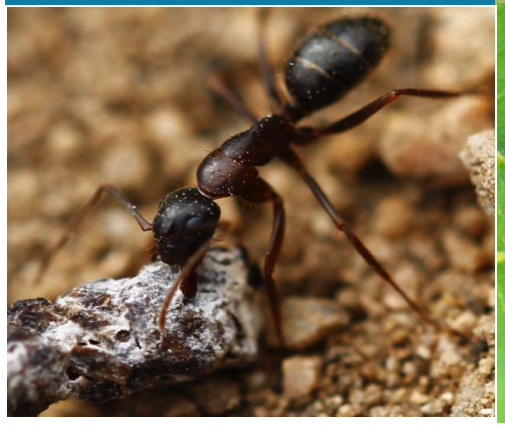
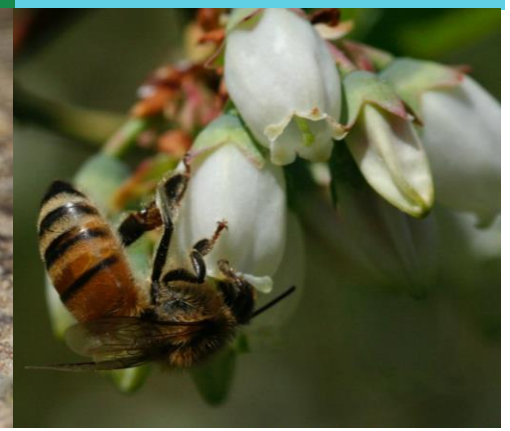
“The fate of the world’s insects is inseparable from our own”

Soil health, pest control, food for wildlife, crop pollination and higher yields…

Recycle nutrients throughout the ecosystem	Offer free natural pest control services	Food sources for other animals	Help plants reproduce
			

Photos: (left to right): Magnus Robinson; USDA ARS Scott Bauer; Marcel Holyoak via flickr; Emily May / Xerces Society
Quote from NYT Editorial Insect Armageddon October 29, 2017

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Native habitat for native bees

More than **3,600** species of native bees in the United States

Photos: Rollin Coville, Betsy Betros, Jason Gibbs, Emily May

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NOTE: European Honey Bees - not a typical bee

- **<u>Unusual Biology:</u>** Eusocial bees, division of labor (queen, workers, drones) + cooperative care, perennial colony - overwinters by feeding on honey stores
- **<u>Domesticated Livestock:</u>** Colonies managed for honey + hive products and **crop pollination**: often temporarily brought to farms to provide crop pollination
- **<u>Status:</u>** Non-native, not at risk of extinction, globally secure with localized problems

An agricultural/hobbyist pursuit, *<u>not</u>* a conservation strategy

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Photos: Stefanie Steele/ Xerces

Pollinator habitat = natural pest control

Conservation Biological Control (CBC)

- "Natural enemies" eat or parasitize pests
- Many natural enemies need pollen and nectar too

Photo: Assassin Bug (top left): John Flannery Flickr Creative Commons; Syrphid flies (lower left): Karin Jokela / Xerces Society; Lacewing (right): Sarah Foltz Jordan / Xerces Society

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Multi-Functional, Beautification, Education + Jobs, Food + Herbs

Photo: Stefanie Steele / Xerces, Anna Victoria / River City Garden; Stefanie Steele / Xerces

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Habitat & Planning Considerations

for a diversity of pollinators

Photo: Stefanie Steele / Xerces

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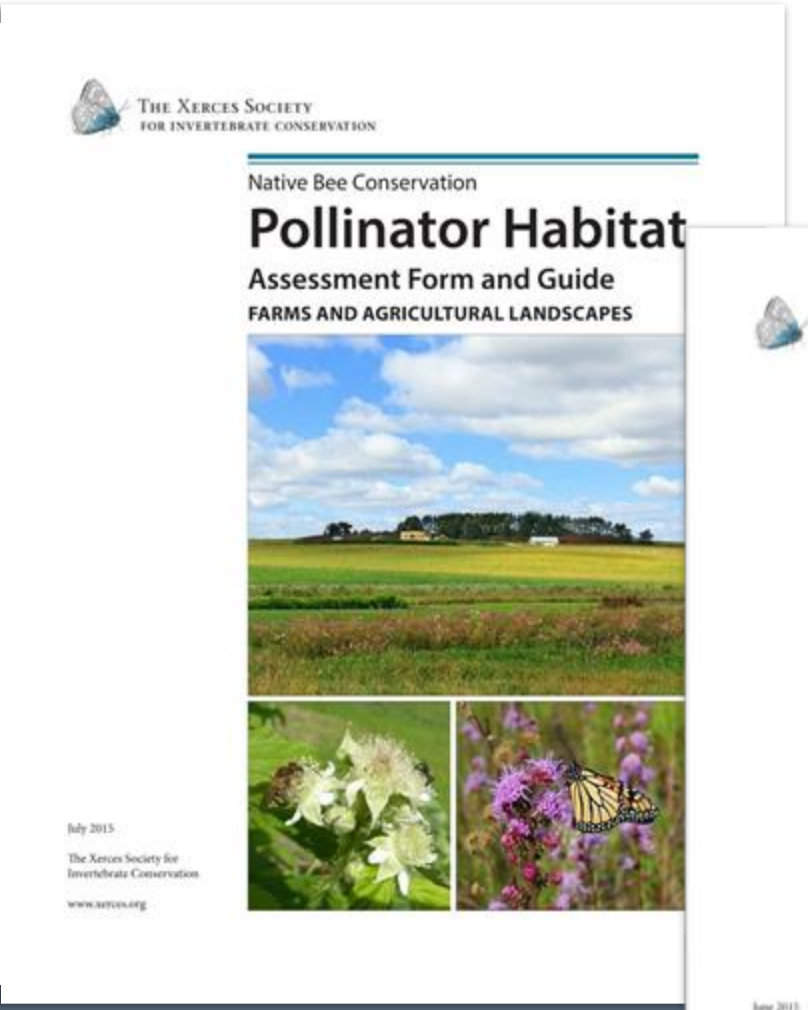
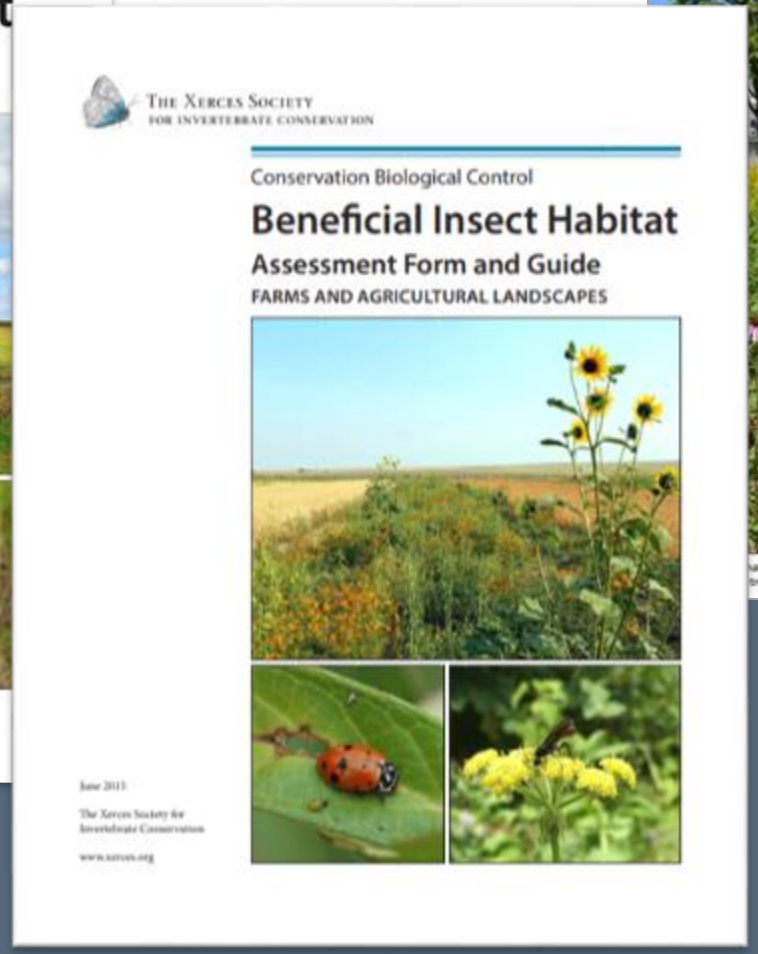
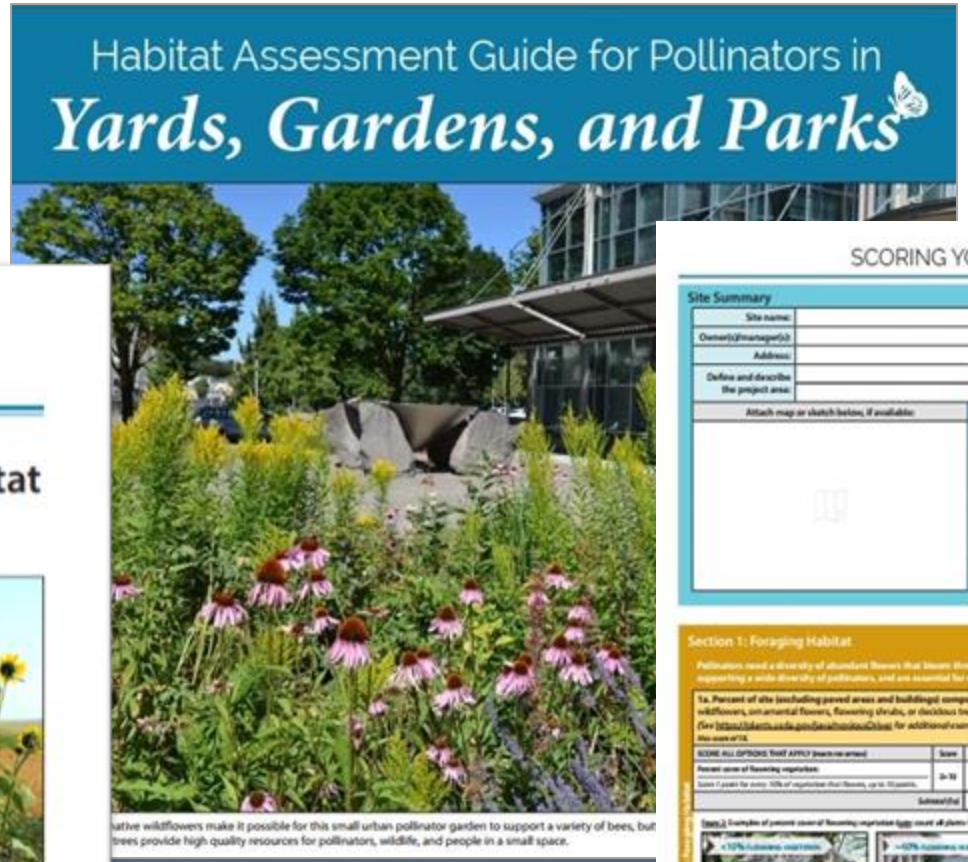
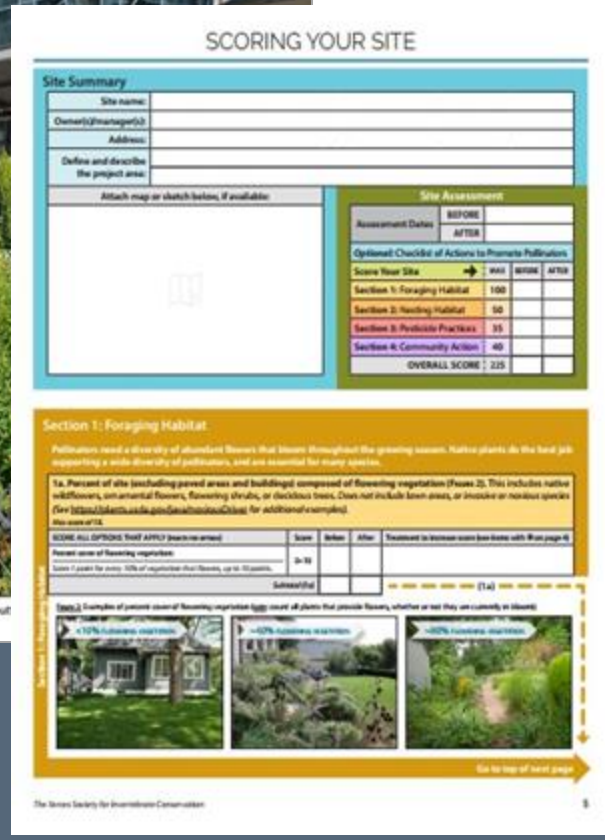
Where to start with creating habitat? – Assess!









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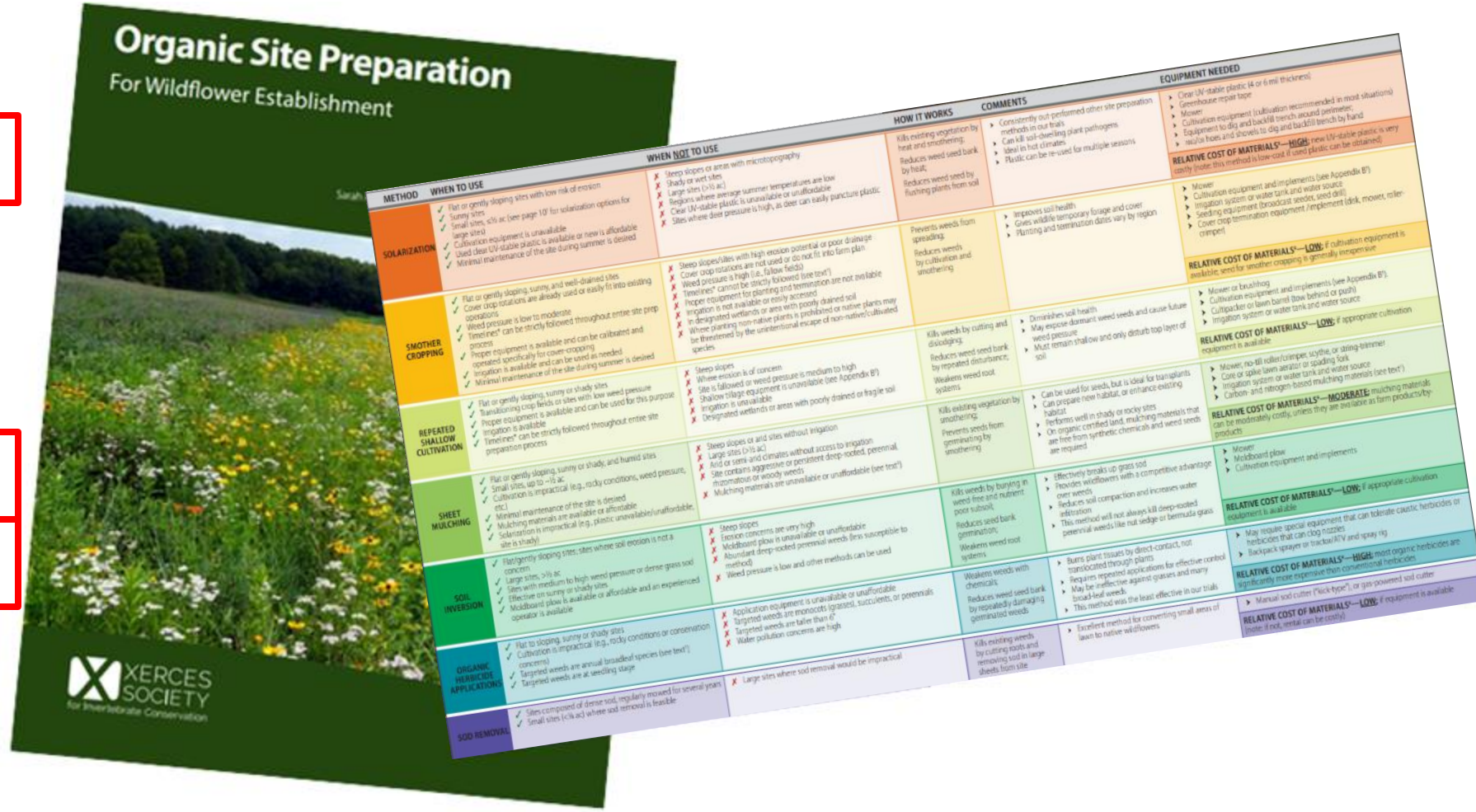
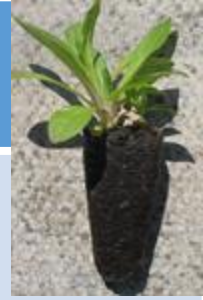
Organic Site Prep Methods

- ❑ Smother Cropping
- ❑ Solarization
- ❑ Repeat Cultivation
- ❑ Soil inversion
- ❑ Organic Herbicides
- ❑ Sheet Mulching
- ❑ Sod Removal
- ❑ Weed barriers
- ❑ Livestock Rooting
- ❑ Burning/Grazing

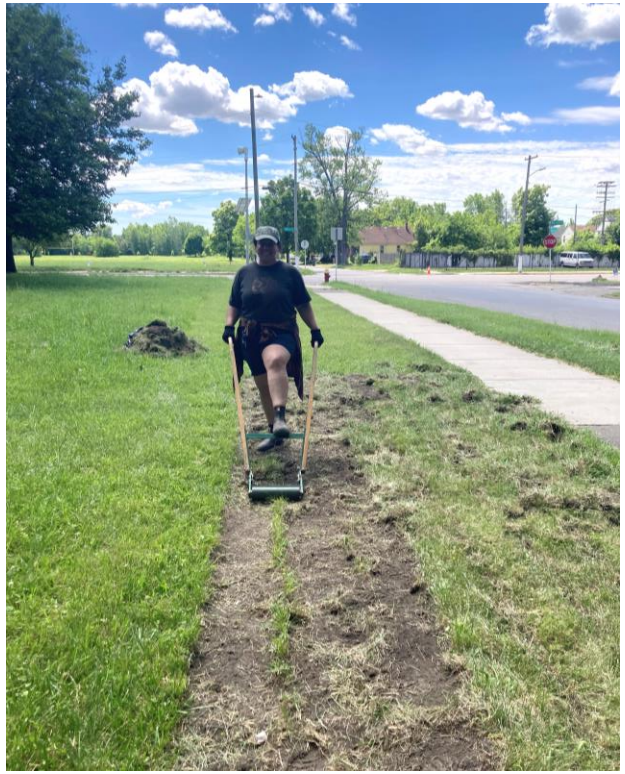


Starting Habitat from Seed	Starting from Transplants
Lower Cost	**Higher Cost**. Can bring cost down if you grow some yourself
More pre-planting weed control needed, since native seeds can easily get out competed by weeds	**Less weed control** needed, since native plants will have more of a competitive advantage
Requires high mowing for weed management during establishment	**No mowing needed**. Spot weeding as needed
Flowers usually not blooming/thriving until 3rd or 4th year of project (year 1: weed control, year 2: mowing….)	Blooming flowers can be realized the **1st year** of project, abundant blooms by second
Seed mix can be **highly diverse** (but not always realized in plant community)	Plantings are generally **lower diversity**
Less control (design is limited to seed mix)	**More control & design** (desired plants can be selected, clustered, evenly distributed, distributed by height, etc.)
Better for large areas	**Better for small areas** (1/10 acre / ~4356 sqft = ~2k to 4K plants or 600 sqft = ~ 260 to 600 plants at 1.5ft to 1ft spacing)
Irrigation only needed in dry climates	**May require irrigation** at time of transplant, during establishment, and dry periods



Small-Scale Site Prep & Planting

Passive smother tarps, sod removal, plant augers, community members!



Photos: Marty Post / Hillside Village; Loretta Powell / Detroit Little Community Garden; Micah Kloppenburg and Sarahrda / Xerces; Erma Leaphart / VOJ

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Three Requirements for Quality Habitat

1. **Food:** Nectar, pollen, host plants
2. **Shelter & Nesting:** Nest sites, overwintering sites, refuge
3. **Protection:** Protection from pesticide risk, habitat disturbance

Supporting pollinators throughout their life cycle is critical

Photo: Elizabeth Sellers / Flickr

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Where do native bees nest???

~70% Solitary Ground Nesting

~30% Solitary Stem/Wood Nesting

~1% Social Nesting (Bumble Bees)

Photos: Kent McFarland (Flickr-CC), Sara Morris and Nancy Lee Adamson (Xerces Society)

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Life Cycle of a Solitary Bee

Up to a year to develop before emerging to spend a few weeks as an adult.

Majority of native bees:
Most *adults* are active for
~ 1 month!

Mining bee

Majority of native bees:
vulnerable and *developing*
in the nest for
~ 11 months of their life.

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Pho ty / Mace Vaughan; Dennis Briggs (3); Robbin Thorp.

Ground Nest Sites: ~ 70% of Native Bees

- AVOID:

Permanent landscape plastic/fabric, heavy mulch, regular tillage or other ground disturbance

- ADD:

Pebbles/light rock mulch encourage nesting of some species

- Reminder:

Solitary and not aggressive = don't defend nests

Photos: Hillary Sardinas, Kelly Gill, Jennifer Hopwood (Xerces Scociety)

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Stem/Wood Nest Sites: ~ 30% of Native Bees

- AVOID:

Cutting + removing all plant stems & dead wood

- ADD:

Plants w/hollow or pithy stems, dead + rotting wood: logs, stumps, branches, snags, and stones to create crevices

- REIMNDER:

Cell partitions constructed with mud, leaf or petal pieces, resin, sawdust, pebbles, or plant hairs

Photos: Photos: Ruaa Brahran, Edward S. Ross. Darrin O'Brien, Clay Bolt, Sarah Foltz Jordan, Stefanie Steele

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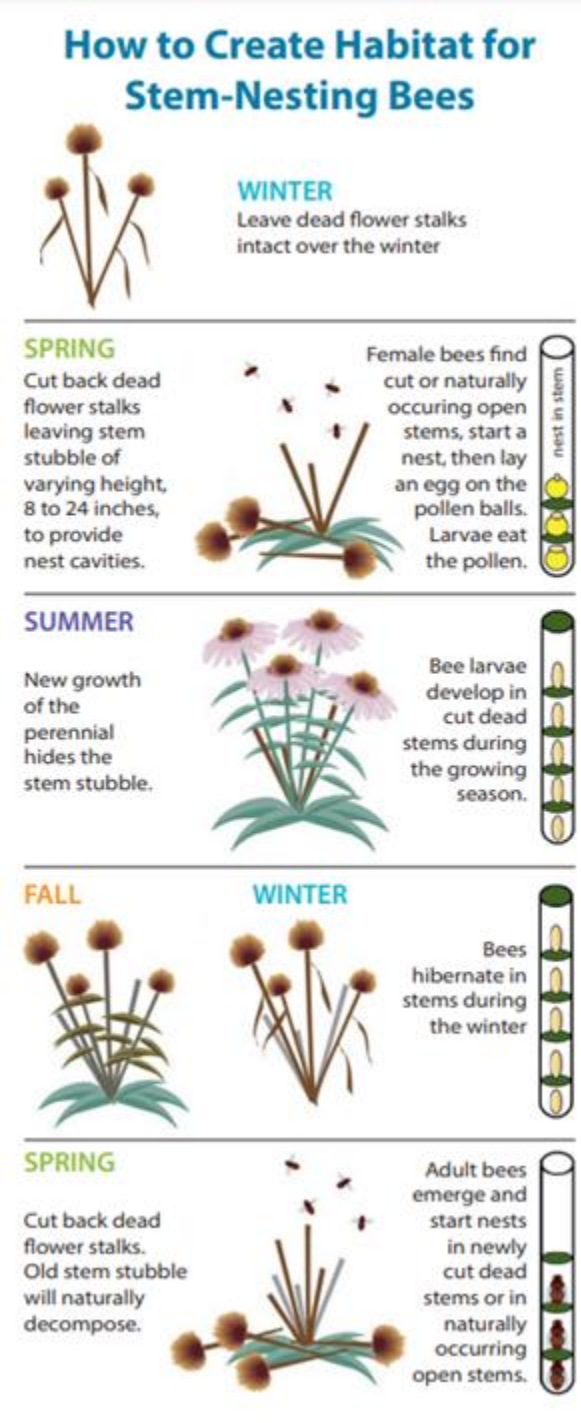

A few highly-used plants for stem-nesting bees

Photo: A Sarar Foltz Jordan/ Xerces, B Heather Holm

Common Name	Plant Genus
Hyssop	*Agastache*
Echinacea	*Echinacea*
Sunflowers	*Helianthus*
Blazing Star	*Liatris*
Bee balm	*Monarda*
Goldenrods	*Solidago*
Asters	*Symphyotrichum*
Raspberry & other brambles	*Rubus*
Sumac	*Rhus*
Elderberry	*Sambucus*

How to create habitat for stem-nesting bees, by Colleen Satyshur and Elaine Evans, with contributions from Sarah Foltz Jordan and Heather Holm. https://www.beelab.umn.edu/sites/beelab.umn.edu/files/stem-nesting-bee-handout-v5.pdf

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Plant Selection Overview: Perennials!

For regional plant lists visit
Xerces Pollinator Conservation Resource Center

Bloom		Common Name	Scientific Name	Flower Color	Max. Height (Feet)	Water Needs (Low, Medium, or High)	Notes
		Forbs					All species perennials, unless otherwise noted. Monarchs are present June through October in the Great Lakes Region.
Summer	1	Butterfly milkweed	*Asclepias tuberosa*	Orange	2	L	Host plant for monarch caterpillars and excellent nectar plant for adults. Very showy flowers. Prefers dry soils and full sun.
	2	Common milkweed	*Asclepias syriaca*	Pink	5	L/M/H	Host plant for monarch caterpillars and excellent nectar plant for adults. Fragrant flowers. Thrives in a wide range of soils.
	3	Culver's root	*Veronicastrum virginicum*	White	6	M	Excellent landscaping plant. Beautiful flowers attract butterflies, bumble bees, and other insects.
	4	Swamp milkweed	*Asclepias incarnata*	Pink	4	M/H	Excellent monarch caterpillar host plant and nectar plant. A great option for shorelines, rain gardens, and riparian buffers.
Summer to Fall	5	Black-eyed Susan	*Rudbeckia hirta*	Yellow	2	L	Biennial but can self-seed. Butterfly attractant. Also visited by longhorn bees, green sweat bees, and other pollinators.
	6	Common boneset	*Eupatorium perfoliatum*	White	6	M/H	Tolerates sandy or clay soils but needs constant moisture. Also attracts bees and an amazing assortment of beneficial wasps.
	7	Eastern purple coneflower	*Echinacea purpurea*	Pink/purple	5	L/M	Attracts a number of butterflies, native bees, and hummingbirds. Native range includes most of the region apart from MN.
	8	Field thistle	*Cirsium discolor*	Pink/purple	7	L	Not to be confused with exotic thistles, this non-aggressive native thistle is exceptional for pollinators and songbirds. Biennial.
	9	Marsh blazing star	*Liatris spicata*	Purple	5	M/H	Highly adaptable and easy to grow. Attracts many butterflies, bees, and hummingbirds. A great *Liatris* for wet soils.
	10	Meadow blazing star	*Liatris ligulistylis*	Purple	5	M	The ultimate monarch magnet, even compared to other *Liatris*. Native range stretches east only as far as WI. Medium soils.
	11	Ontario blazing star	*Liatris cylindracea*	Purple	2	L	Shorter than other *Liatris* species and tends to bloom later in the year. Requires dry soils.
	12	Rough blazing star	*Liatris aspera*	Purple	4	L	Another incredibly attractive *Liatris* for monarchs as well as many other insects. Drought tolerant.
	13	Sawtooth sunflower	*Helianthus grosseserratus*	Yellow	10	M	Tolerates many soil types. Can be quite large in the garden. Continues blooming late into the fall. Rhizomatous.
	14	Showy goldenrod	*Solidago speciosa*	Yellow	5	L	An excellent monarch nectar plant; also visited by beneficial solitary wasps, pollen-eating soldier beetles, and more.
	15	Smooth oxeye	*Heliopsis helianthoides*	Yellow	5	L/M	Also known as early sunflower, this plant has a long bloom period from July to October. Tolerates clay and moist soils.
	16	Spotted beebalm	*Monarda punctata*	White/pink/yellow	3	L	Prolific blooms are highly attractive to beneficial wasps and bees. Prefers dry, sandy soils. A beautiful, unique flower.
	17	Spotted joe pye weed	*Eutrochium maculatum*	Pink	6	H	Prefers moist soils. Attracts numerous butterflies and bees, including the very rare rusty patched bumble bee.
	18	Stiff goldenrod	*Oligoneuron rigidum*	Yellow	5	L/M	This plant offers abundant and accessible pollen and nectar—a utopia for insects! Flat-top flower is unusual for a goldenrod.
	19	Swamp thistle	*Cirsium muticum*	Pink/purple	7	H	This lovely native thistle attracts numerous butterflies and bees. Host plant for the swamp metalmark butterfly. Wet soils. Biennial.
	20	Whorled milkweed	*Asclepias verticillata*	White	3	L	Monarch caterpillar host plant and exceptional nectar plant. This small milkweed plant is great for landscaping. Dry soils.
	21	Wild bergamot	*Monarda fistulosa*	Purple	5	L/M	A superb bumble bee plant, also known as bee balm. Also attracts hawk moths and hummingbirds. Aromatic foliage.
Fall	22	Aromatic aster	*Symphyotrichum oblongifolium*	Purple	2	L	Very late blooming aster with fragrant foliage. Stiff stems branch out to create a bush-like appearance. Full sun and dry soils.
	23	Maximilian sunflower	*Helianthus maximiliani*	Yellow	8	L	Very showy and vigorous plant. Caterpillar host plant for the silvery checkerspot and bordered patch butterflies.
	24	New England aster	*Symphyotrichum novae-angliae*	Pink/purple	6	M	One of the latest fall-blooming plants. Butterfly magnet and important food resource for pre-hibernation bumble bee queens.

- Focus on native perennial plants: herbaceous flowers + bunch grasses / sedges and flowering woody species
- Locally adapted, matched to site conditions
- Succession of bloom periods – at least 3 species per period, diversity of families, flower shape, and color
- Species with high pollinator value (nectar, pollen, nesting, free of pesticides)
- Butterfly host plants
- Harvestable products
- Culturally significant plants
- Availability and cost

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What does urban pollinator habitat look like??

Photos: Alina Harris, Stefanie Steele, Laura Rost, Kelly Gill

Examples from MI + WI Habitat Kit Programs

In-row Pollinator Strip

High Tunnel Insectary

Farm Outbuilding Planting

Prairie Pocket Planting

Photos: Rue de Bungaloo Farm/Hannah Frank, Boerson Farm/Matt Boerson, Xerces/Stefanie Steele @ Green Boots Veteran Community Marketplace, Xerces/Laura Rost @ Detroit Hives

Need: FOOD all growing season

Photos: Sarah Foltz Jordan, Stefanie Steele, Matthew Shepherd, Kathryn Prince, Nancy Adamson, Justin Wheeler Jim Eckberg, Jennifer Hopwood

Need: SHELTER/NESTING - always








Photos: Stefanie Steele, Micah Kloppenburg, Laura Rost, Sara Morris, Mace Vaughan / Xerces;

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Need: PROTECTION - always

PROTECTING POLLINATORS FROM PESTICIDES

Buying Bee-Safe Plants

Plants grown for sale in retail nurseries, even those marketed as "pollinator-friendly," are commonly treated with pesticides. Learning more about your local nursery's pest management practices and ensuring the flowering plants you purchase are free from harmful pesticides are important steps in protecting pollinators.

Pollinator gardening has skyrocketed in popularity. Increasingly, garden centers and nurseries are labeling plants as "pollinator-friendly," or adding bee or butterfly images to plant tags to denote their ability to attract these wonderful insects to the landscape.

Consumers may make the assumption that these images and phrases mean that these plants are safe for bees and that pesticides harmful to bees and butterflies were not applied during production. While this may be the case for some growers, don't assume it's so. Currently there is no legal or nursery industry standard definition or set of practices mandated for the use of terms such as "pollinator-friendly" or "bee-friendly."

Plants that attract pollinators should be free from harmful pesticide residues

surprise that researchers are finding toxic levels of insecticides in nursery plants. So, remember that the bee and butterfly pictures on the plant tags only tell half the story—whether a plant is attractive to pollinators. You will still need to figure out whether a plant is free of harmful pesticides, a task that takes some time and effort.

In this factsheet, we provide tips on why and how to talk with nurseries about pollinator-friendly practices.

Consumer Requests Are Powerful and Can Transform Practices

While it may feel awkward to start the conversation with your retailer or nursery, consumer requests can transform nursery production practices and the purchasing behavior of retail plant buyers. By respectfully asking the questions outlined here, you will signal that customers are informed and care

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Tools: Communicate Intention – “cues to care”

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Photos: Marilyn Griffin, Stefanie Steele, Kailee Slusser, Laura Rost, Kelly Gill / Xerces, Pat Mclamore

Who are the pollinators

and beneficial insects

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Who are the pollinators? Insects primarly...

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Photos: Stephanie McKnight/Xerces; Sarah Foltz Jordan/Xerces; Stephanie McKnight/Xerces; Mary Keim/Flickr; Debbie Roos/NCSU CES; Sara Morris

POLLEN—KEY CHARACTERISTICS:

- Does the bee have **pollen** on its body?
- If so, **where?**
- Does the pollen look **moist and packed**, or **dry and loose**?

Photograph courtesy of Tom Koerner.

Photograph by Sara Morris.

Photograph courtesy of Debbie Roos

Photograph by Mace Vaughan.

Photograph by Sara Morris.

Photograph courtesy of Anne Reeves.

BEES = Most important and efficient group of pollinators:

1. Actively collect and transport pollen
2. Exhibit flower constancy
3. Forage near nest

Reminder: Male bees do not have pollen carrying structures!

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WHAT SIZE IS THE BEE?

Photograph by Sarah Foltz Jordan.

Photograph by Mace Vaughan.

Many bees = size of a **grain of rice**

Photos: Xerces Upper Midw
Community Science Pollinator
Monitoring Guide, Stefanie Steele

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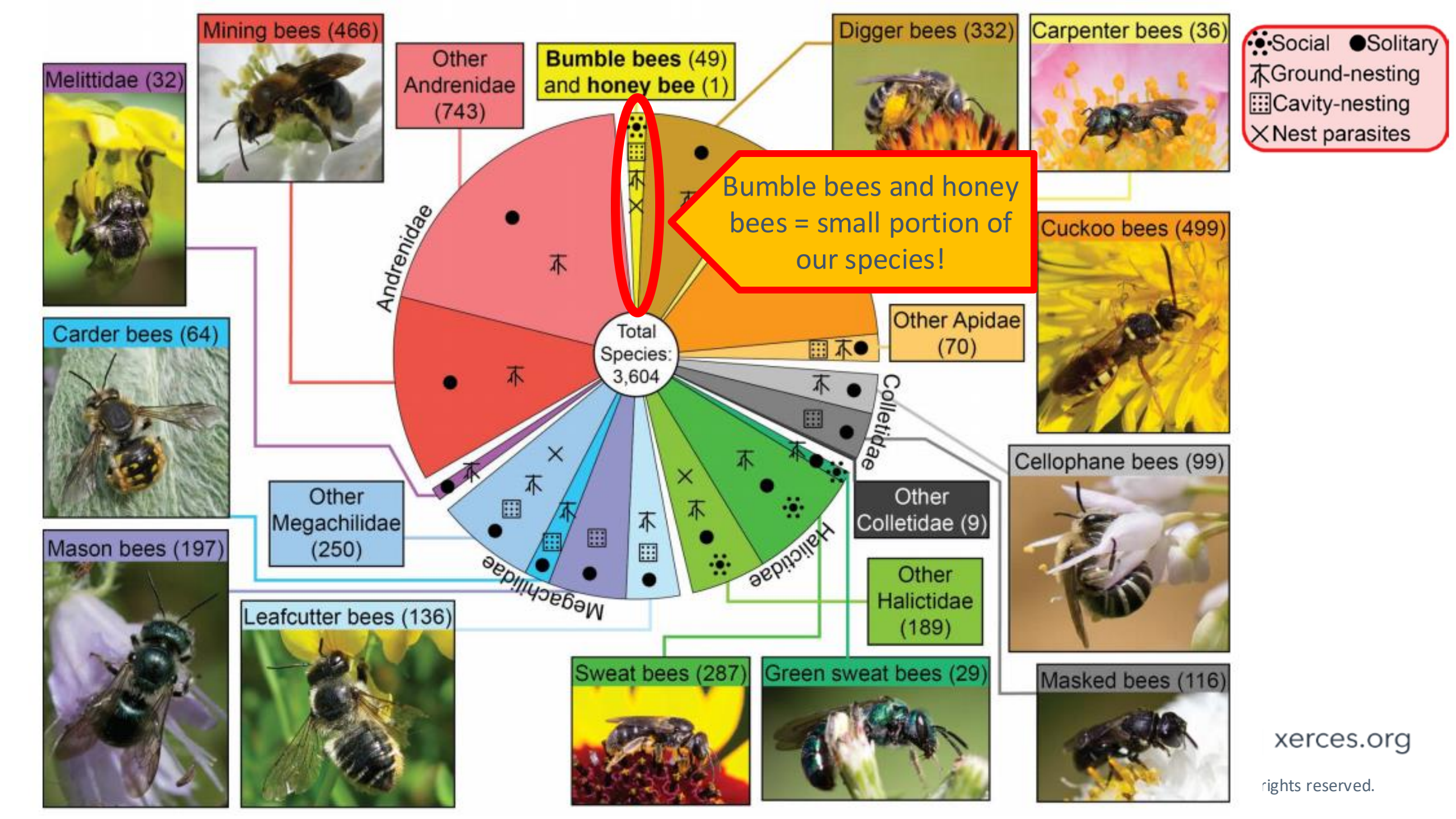
Mining bees (466)
Other Andrenidae (743)
Bumble bees (49) and honey bee (1)
Digger bees (332)
Carpenter bees (36)
Social
Solitary
Ground-nesting
Cavity-nesting
Nest parasites
Melittidae (32)
Bumble bees and honey bees = small portion of our species!
Andrenidae
Total Species: 3,604
Other Apidae (70)
Cuckoo bees (499)
Carder bees (64)
Colletidae
Cellophane bees (99)
Other Megachilidae (250)
Other Colletidae (9)
Halictidae
Megachilidae
Mason bees (197)
Other Halictidae (189)
Leafcutter bees (136)
Sweat bees (287)
Green sweat bees (29)
Masked bees (116)
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rights reserved.

Some bees need certain flowers

Photo: Nancy Lee Adamson

Learn more about specialist bees!

Flowers that host pollen specialist bees include:

- Sunflowers (*Helianthus*)
- False goldenaster (*Heterotheca*)
- Ironweed (*Vernonia*)
- Native thistles (*Cirsium*)
- Asters (*Symphyotrichum)*
- Willows (*Salix*)
- Primroses (*Oenothera*)
- Globemallow (*Sphaeralcea*)
- Squash (*Cucurbita*)
- And many more

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Photo: Lacewing larva consuming aphid by Alex Wild

Common Beneficial Insect Groups

- Insect Predators
- Insect Parasitoids
- Some are also pollinators:
  - Flies, wasps, beetles
- Some also play a role in soil health

- Non-insects:
  - Spiders, harvestmen, centipedes, mites, pseudoscorpions

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Predators: Flower Flies/Hover Flies

- Predaceous larvae, adults feed on pollen and nectar
- Overwinter in leaf litter or soil

Photos: Mace Vaughan, Xerces Society; Mario Ambrosino

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Predators: Soldier Beetles

- Predatory as larvae, some as adults
- Adults will feed on nectar and pollen
- Overwinter in leaf litter or loose soil

Photos: Adult soldier beetles mating, by Debbie Roos; larva by Karen Loughrey Richard

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Predators: Predatory Wasps

- Larvae consume prey, adults feed on flower nectar
- Nest underground or in tunnel cavities
- Many are solitary species, but social paper wasps also beneficial


Great golden digger wasp


Mason wasp


Paper wasp

Photo: Sarah Foltz Jordan

Parasitoid Wasps

- Most parasitoids are specialists
- Persist in environments with low-levels of prey
- Overwinter within host
- Adults are nectar-feeding
- Recognizing their activity may be easier than seeing the wasp itself
  - Aphid mummies
  - Emergence holes in eggs
  - Pupae on caterpillars

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Resources to Learn More:

Beneficial Insects Scouting Tools

TECHNICAL NOTE

BENEFICIAL INSECT SCOUTING GUIDE

FIGURE 1: *Floral monitoring outside a high-tunnel greenhouse (left), sweep-netting meadow habitat (center), and a parasitized colony of aphids (right).*

BENEFICIAL INSECTS FOR NATURAL PEST CONTROL:

Flower Scouting

PURPOSE

Beneficial insects like flower flies, soldier beetles and predatory wasps can provide important natural pest control in a farm or garden setting. This guide and worksheet is designed to help you assess the presence of beneficial insects visiting flowers in a farmscape. Many predatory and parasitoid insects use flowers for food. With this guide, you will be able to count these flower-visiting beneficial insects in habitat adjacent to crops. Use this guide along with our foliage and soil scouting guides to gain a better understanding of the beneficial insect community on your farm.

WHAT YOU NEED	• Clipboard, worksheet copy, and pen/pencil • Timer • Measuring tape (100-ft. preferred, shorter ok) • Thermometer (or means to collect weather info) • Flags or stakes (to mark transect lines) • Hand lens (optional)
WHERE TO USE	Flowering habitats adjacent to crops (e.g. field borders, hedgerows) or within crops (e.g. cover crops, beetle banks, insectary strips). Scouted habitat areas should be located in full sun and protected from pesticide applications.
WHEN TO USE	Twice per year , May – August • Visits separated by at least 2 to 3 weeks • Visits between 10:00 AM and 3:00 PM Warm, sunny, and calm conditions • Temperatures >60 °F (15.5 °C) • Skies sunny to partly cloudy or bright but overcast

HOW TO SCOUT

You will be conducting visual observations of insects on flowers along two 100 ft.-length transect lines (scouting paths) for 7.5 minutes per transect line. A transect line may be divided into shorter lengths for small habitat areas (see worksheet for more info). Before scouting, assess habitat area(s) to ensure that flowers are present to scout.

- Lay out measuring tape to define your transect lines. Use flags to mark them if needed.
- Set your timer for 7.5 minutes and ready your clipboard and worksheet.
- Begin your timer and slowly walk the designated transect line, observing and recording foraging flower visitors. Focus on benefical insects listed (see photos to right). Record only those beneficial insects observed within a 3 ft. distance from the transect line.
- Walk slowly while scouting for insects. Avoid sudden movements and visual interference from your shadow that may scare off insects.
- Pace all transect walks to end simultaneous with the timer. If timer ends before you complete the entire transect distance, quickly assess the remaining length.
- *Consistency is key for good scouting!* When scouting between transects and scouting dates, try to use the same methods as much as possible.

Acknowledgments: Guide created by Thelma Heidel-Baker, Sarah Foltz Jordan, Jarrod Fowler, and Eric Lee-Mader of The Xerces Society. Photos by Sarah Foltz Jordan (1, 2, 4) and Thelma Heidel-Baker (3, 5).

Adapted from: Ward, K., D. Cariveau, E. May, M. Roswell, M. Vaughan, N. Williams, R. Winfree, R. Isaacs, and K. Gill. 2014. Streamlined bee monitoring protocol for assessing pollinator habitat. 16 pp. Portland, OR: The Xerces Society.

XERCES SOCIETY for Invertebrate Conservation

BENEFICIAL INSECTS FOR NATURAL PEST CONTROL:

Foliage Scouting

PURPOSE

Beneficial insects like lady beetles, damsel bugs, and lacewing larvae can provide important natural pest control in a farm or garden setting. This guide and worksheet is designed to help you assess the beneficial insects present - though not always readily visible - in plant vegetation. Many beneficial insects hunt and rest in plant vegetation. Using a simple tool called a beat sheet, you will be able to count the foliage-dwelling predatory insects in habitat adjacent to crops. Use this guide along with our flower and soil scouting guides to gain a better understanding of the beneficial insect community on your farm.

WHAT YOU NEED	• Beat sheet (blank sheet of paper) • Clipboard (for beat sheet and worksheet) and pen/pencil • Timer • Measuring tape (100-ft. preferred, shorter ok) • Flags or stakes (to mark transect lines) • Thermometer (or means to collect weather info) • Hand lens (optional)
WHERE TO USE	Undisturbed habitats adjacent to crops (e.g. field borders, hedgerows, woodland edges) or within crops (e.g. cover crops, beetle banks, insectary strips). Scouted habitat areas should be located in full sun and protected from pesticide applications.
WHEN TO USE	Twice per year, June-September • Visits separated by at least 2 to 3 weeks • Visits between 10:00 AM and 3:00 PM Warm and calm conditions • Temperatures >60 °F (15.5 °C) • Skies sunny to partly cloudy or bright but overcast

HOW TO SCOUT

You will use an insect beat sheet (see image, right) to observe beneficial insects on plant foliage along two 100 ft.-length transect lines (scouting paths). Observations will occur for 7.5 minutes along each 100 ft. transect. Smaller habitat areas may require a transect line to be divided into shorter lengths.

- Select the habitat area(s) you want to monitor, and lay out the measuring tape to define your transect lines. Use flags to mark the transects if needed.
- Set your timer for 7.5 minutes and ready your beat sheet and worksheet. Begin your timer and slowly move along the transect line, using the beat sheat as you go.
- To use the beat sheet, choose a handful of stems near the top of herbaceous plants or ends of branches on woody plants then carefully bend the plant material over the insect beat sheet. Smartly tap the plant material onto the beat sheet several times to shake insects out of the vegetation.
- Quickly and briefly observe insects on the sheet. Record observations of beneficial insects onto the worksheet. Use images to the right as a starting point for common beneficial insects you may observe.
- Only plants within 3 ft. of the transect line should be sampled.
- Try to pace all transect walks to end simultaneous with the timer. If timer ends before you complete a transect, quickly assess the remaining transect left.

Acknowledgments: Guide created by Thelma Heidel-Baker, Sarah Foltz Jordan, Jarrod Fowler, and Eric Lee-Mader of The Xerces Society. All photos taken by Thelma Heidel-Baker.

XERCES SOCIETY for Invertebrate Conservation

BENEFICIAL INSECTS FOR NATURAL PEST CONTROL:

Soil Scouting

PURPOSE

Beneficial insects like predatory ground beetles and spiders can provide important natural pest control in a farm or garden setting. This guide and worksheet is designed to help you assess the presence of predatory organisms that hunt and rest on soils. Using catch-and-release pitfall traps, you will be able to easily detect and count these soil-surface predators. Use this guide along with our flower and foliage scouting guides to gain a better understanding of the beneficial insect community on your farm.

WHAT YOU NEED	• Clipboard , worksheet copy, and pen/pencil • Small spade or trowel • Containers for pitfall traps (e.g., plastic drinking cups or large yogurt containers, ideally with lids) • Flags or stakes (to mark trap locations)
WHERE TO USE	Undisturbed habitats adjacent to crops (e.g. field borders, hedgerows, woodland edges) or within crops (e.g. cover crops, beetle banks, insectary strips). Scouted habitat areas should be located in full sun and protected from pesticide applications.
WHEN TO USE	Twice per year, July-September • Visits separated by at least 1 month • Deploy pitfall traps in early evening • Empty traps as soon as possible the next morning Warm conditions with daytime temperatures >60 °F (15.5 °C) Avoid sampling in rainy conditions that may flood traps

HOW TO SCOUT

You will be setting out catch-and-release pitfall traps (see photo, right) to observe and record soil-surface predators. The number of traps you will set out is dependent on the number of habitat areas you are interested in monitoring. We recommend one or two pitfall traps per habitat feature of interest, placed at least 50 ft. apart (further apart in larger habitat areas).

- **Select habitat area(s) you want to monitor.**
- **Deploy traps in late afternoon or early evening.** Dig an appropriate-sized hole in each location you wish to survey. Place container (lidded if possible) inside the hole so that its rim is level with the soil surface. (Using lid prevents dirt from spilling into bottom of the trap, and a dirt-free container makes trap evaluation easier the next morning.) Once the container is well-positioned, fill dirt in around the container and carefully remove the lid.
- **Use flags or stakes to mark trap locations.** Mark trap locations to ensure you can find traps again the next morning.
- **Revisit traps the following morning.** Use provided worksheet to record any predators in traps. Use photos at right for guidance on commonly caught predators.
- **Remove trap, or place lid on the trap (if reusing).** The stake/flagging should be left in place for the next survey date. Traps can be left in place, but must be covered to prevent further captures during the interim period. If farm practices (like mowing) prevent use of physical markers in some habitat areas, then a detailed description of trap locations is needed.

Acknowledgments: Guide created by Thelma Heidel-Baker, Sarah Foltz Jordan, Jarrod Fowler, and Eric Lee-Mader of The Xerces Society. All photos taken by Sarah Foltz Jordan.

XERCES SOCIETY for Invertebrate Conservation

Downloadable resources at xerces.org: Beneficial Insects

Downloadable resources at xerces.org: Monarch and Pollinator Habitat

New-ish Regional Pollinator and Beneficial Insect Plant Lists!

SCIENTIFIC NAME	COMMON NAME	BLOOM	LIFE	FORM	SUN	SOIL	ADDITIONAL DETAILS ⓘ
Agastache scrophulariifolia	Purple giant hyssop	Jul–Sep	P	Forb	Full sun, Partial sun, Full shade	D–M	Attracts beneficial insects; Bumble bee plant
Amelanchier laevis ★	Allegheny serviceberry	Mar–May	P	Tree, Shrub	Full sun, Partial sun, Full shade	D–M	Larval host (butterfly, moth); Attracts beneficial insects
Asclepias incarnata	Swamp milkweed	Jun–Aug	P	Forb	Full sun, Partial sun	M–W	Larval host (butterfly, moth); Attracts beneficial insects; Bumble bee plant; Nest site; Deer resistant
Asclepias syriaca	Common milkweed	Jun–Aug	P	Forb	Full sun, Partial sun	D–M	Larval host (butterfly, moth); Attracts beneficial insects; Bumble bee plant; Nest site; Deer resistant
Asclepias tuberosa ★	Butterfly milkweed	Jun–Aug	P	Forb	Full sun, Partial sun	D	Larval host (butterfly, moth); Attracts beneficial insects; Bumble bee plant; Nest site; Deer resistant
Carex bebbii	Bebb's sedge	May–Jun	P	Sedge	Full sun, Partial sun, Full shade	W	
Carex cristatella	Crested sedge	May–Jun	P	Sedge	Full sun, Partial sun, Full shade	M–W	Larval host (butterfly, moth)
Carex scoparia	Broom sedge	May–Jun	P	Sedge	Full sun, Partial sun, Full shade	M–W	
Carex vulpinoidea	Fox sedge	Apr–May	P	Sedge	Full sun, Partial sun	M–W	Deer resistant
Ceanothus americanus	New Jersey tea	Jun–Jul	P	Shrub	Full sun, Partial sun	D–M	Larval host (butterfly, moth); Supports specialist bee; Attracts beneficial insects; Bumble bee plant
Cirsium discolor	Field thistle	Aug–Oct	B / P	Forb	Full sun	M	Larval host (butterfly, moth); Supports specialist bee; Attracts beneficial insects; Bumble bee plant; Nest site; Nest materials; Deer resistant
Coreopsis lanceolata	Lanceleaf tickseed	Apr–Jun	P	Forb	Full sun	D–M	Supports specialist bee; Attracts beneficial insects; Bumble bee plant; Deer resistant

KEY

Life: Annual, Biennial, Perennial
Soil: Dry, Moist, Wet
★ *Staff favorite*
Form: Forb, Cactus, Grass, Sedge, Shrub, Tree, Vine
Sun: Full sun, Partial sun, Full shade
Add'l. Details: Larval host (butterfly, moth), Supports specialist bee, Attracts beneficial insects, Bumble bee plant, Nest site, Nest materials, Nest thatch, Deer resistant

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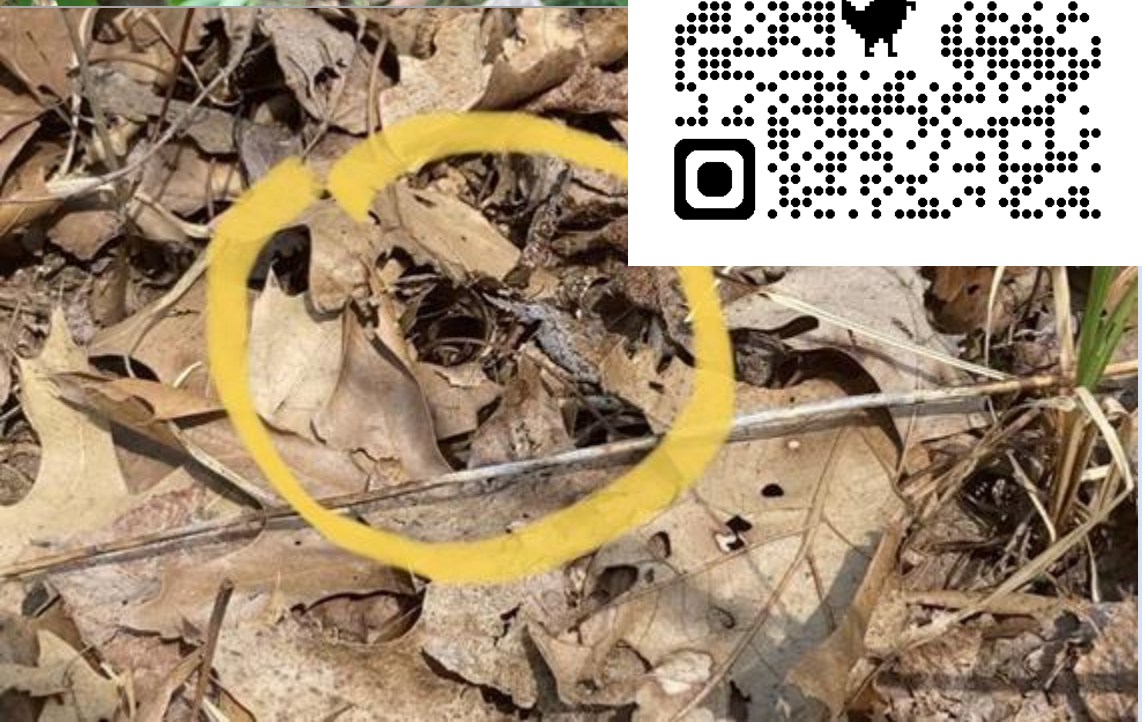
Downloadable resources at xerces.org: Pesticide Guidance



Get Involved: Community Science

1. iNaturalist:
   - *Megachile* bee leaf cuts (leafcutter bees)
   - Project GNBees (ground nesting bees)
2. Monarch Butterflies:
   - Xerces Monarch Nectar Plant Database
   - Journey North: Monarch Nectar & Plant Watch
   - International Monarch Blitz
3. Xerces Atlas Programs:
   - Firefly Atlas
   - Bumble Bee Atlas & Watch
4. Xerces Insect Scouting & Monitoring Guides
   - Beneficial Insect
   - Native Bee
   - Soil Inverts

Photos: Xerces / Stefanie Steele

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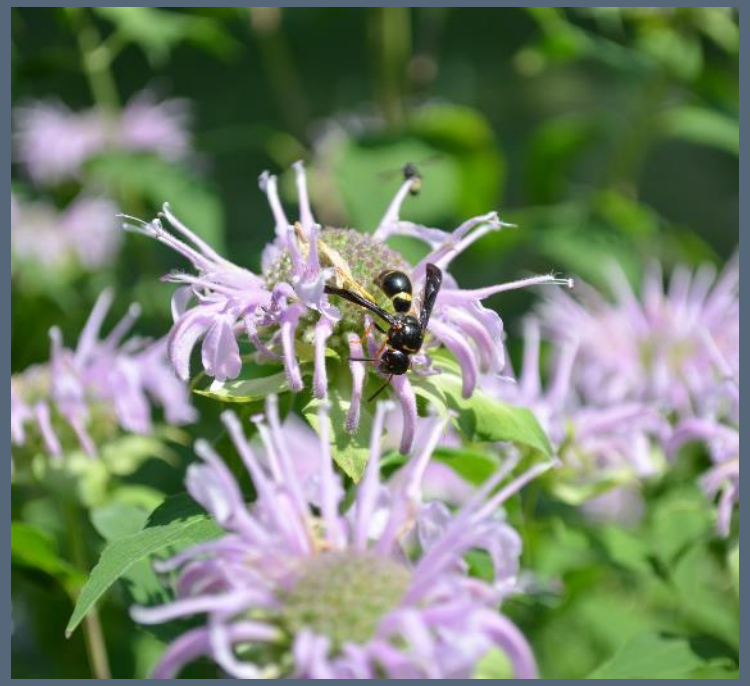
Thank You



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for Invertebrate Conservation

Feel free to follow up with us!

https://xerces.org/

pollinators@xerces.org

stefanie.steele@xerces.org

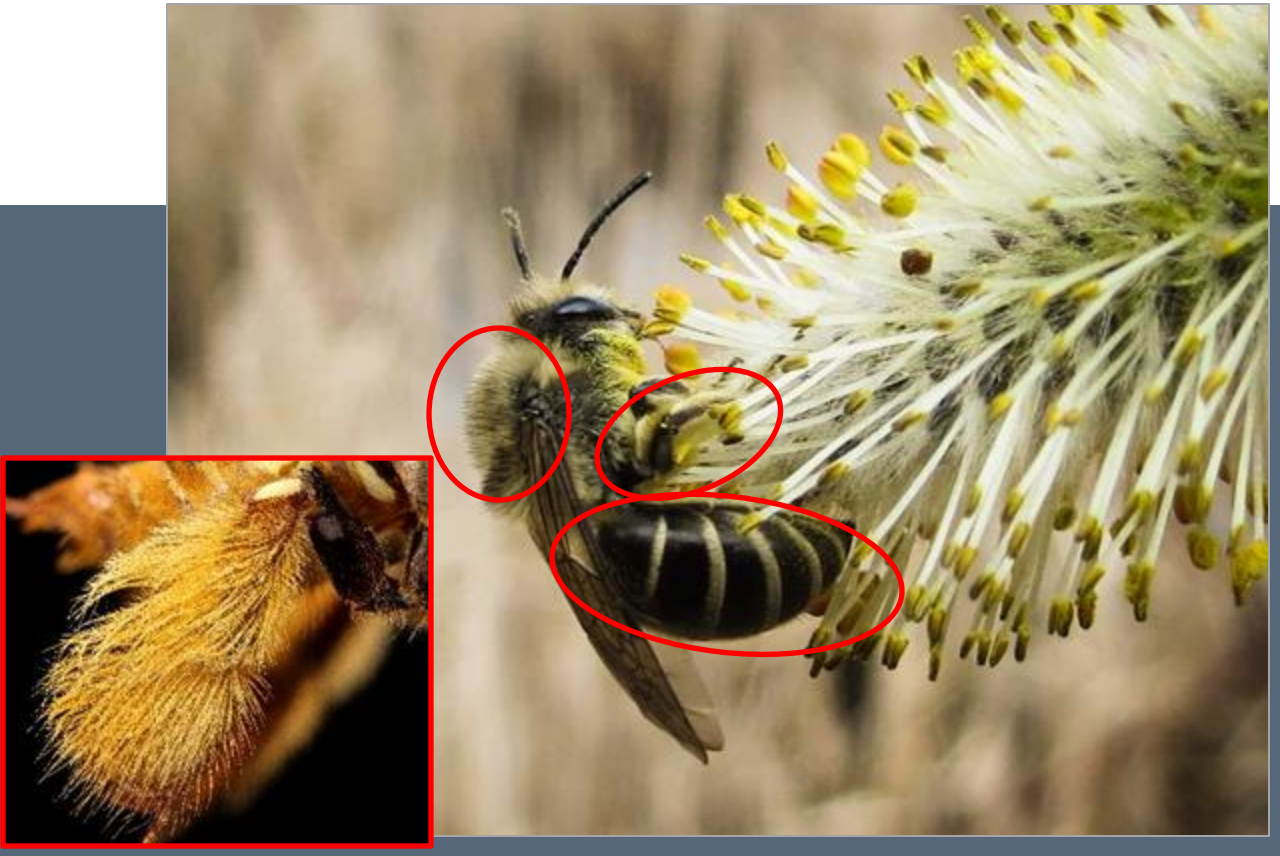
Photos: Scott Seigfried

Thank You

ADDITIONAL SLIDES

Bee (“vegetarian wasps“) vs. Wasp

Bees: hairier; pollen carrying structure, thicker body



Wasps: few hairs; no pollen carrying structure – spiny legs; wings may fold lengthways; thin waist

Photos: Cole Cheng, Flickr; Jason King, Flickr; Whitney Cranshaw, CSU, Bugwood.org

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Bee vs. Fly

Bee: long, elbowed antennae; eyes on side of head; pollen carrying structure; two pairs of wings, hairy

Fly: tiny antenna; large eyes; no pollen carrying structure; one pair of wings, slender legs

Photos: Bryan E. Reynolds; Sean McCann

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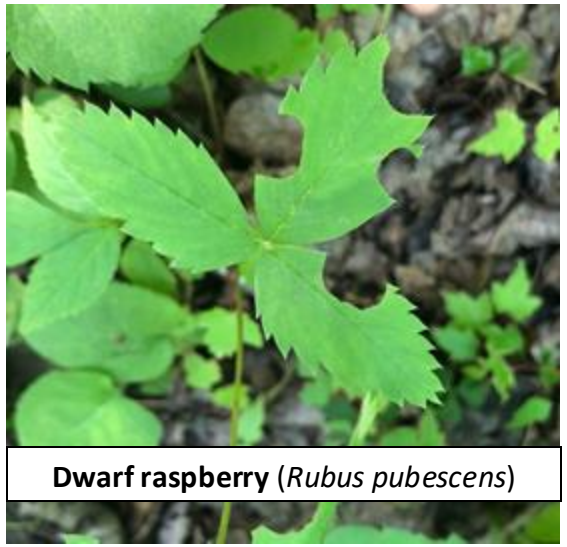
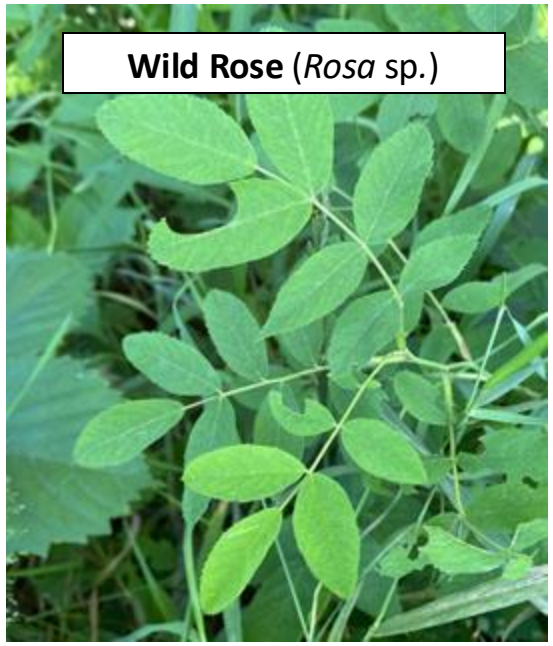
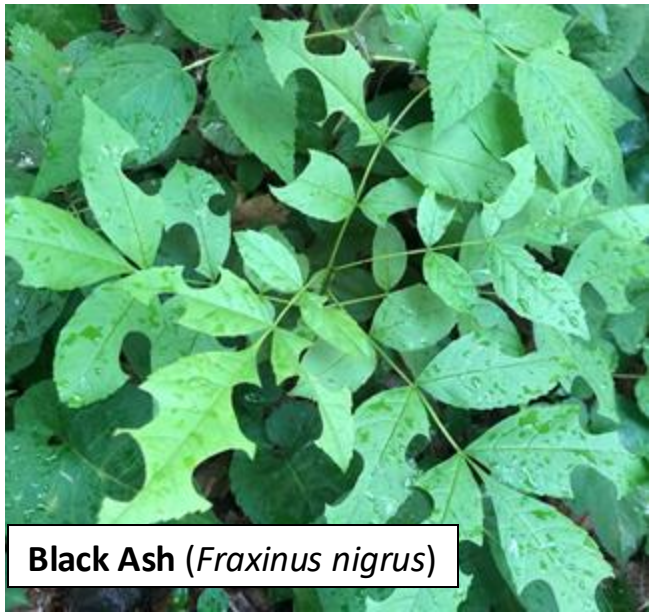
Bee Nests: Plants used by leaf cutter bees (*Megachile*) for cell partitioning



Dwarf raspberry (*Rubus pubescens*)



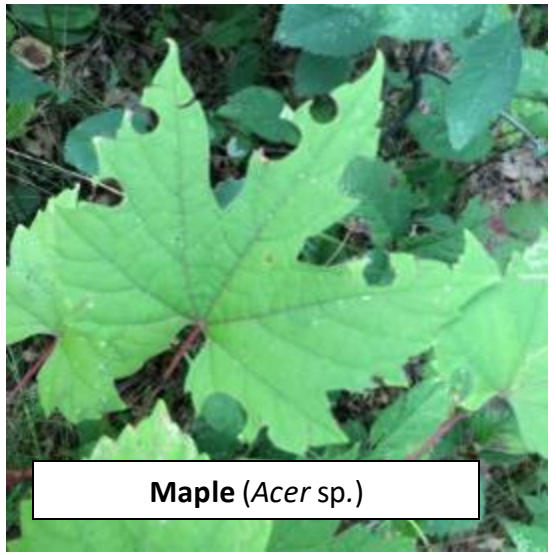
Wild Rose (*Rosa* sp.)



Black Ash (*Fraxinus nigrus*)

Juneberry (*Amelanchier* sp.)

Native honeysuckle (*Lonicera canadensis*)

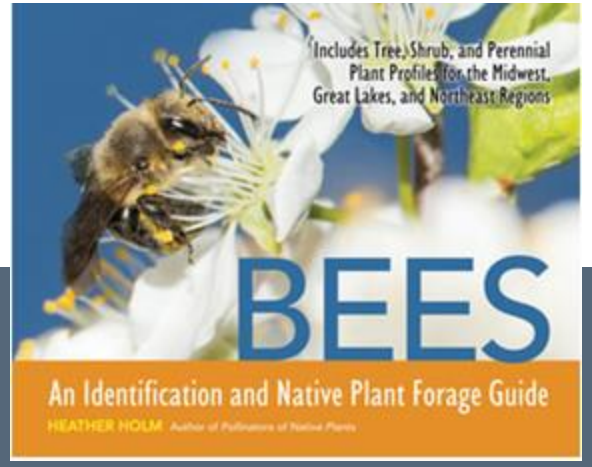


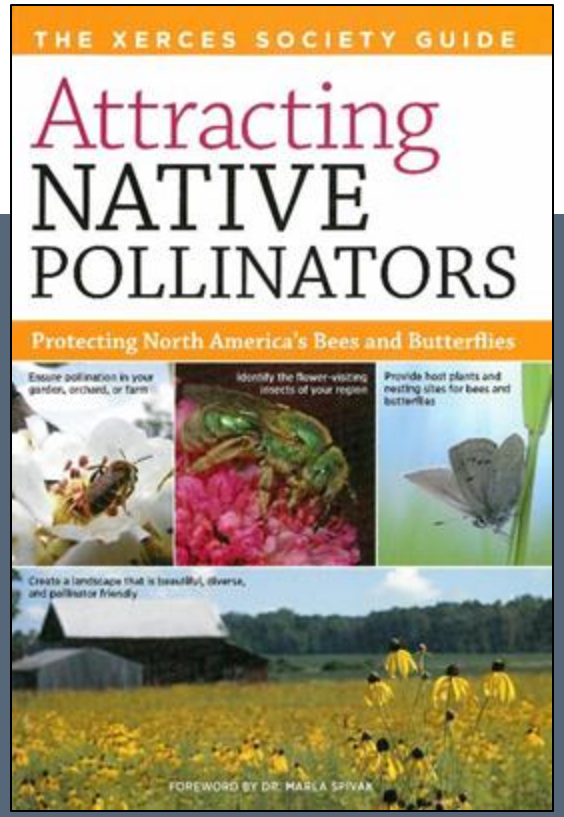
Maple (*Acer* sp.)

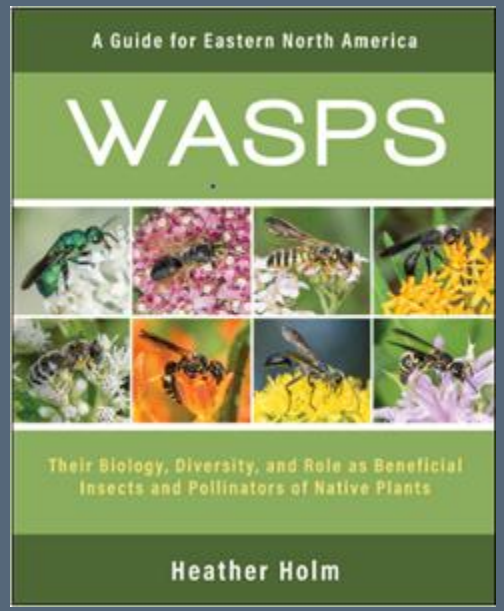
Photos: Sarah Foltz Jordan, Xerces Society

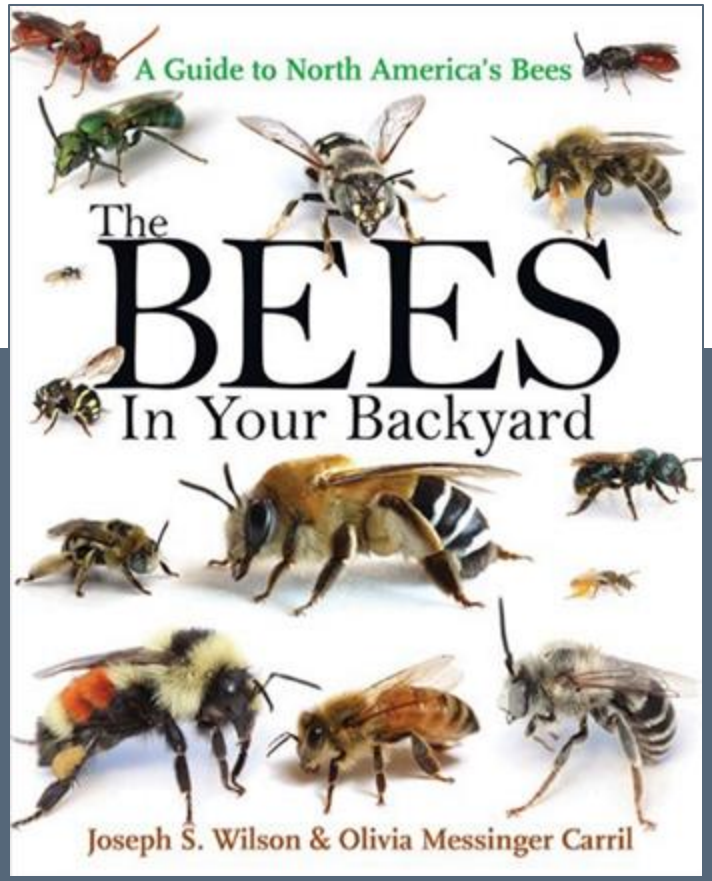
- **Ash (*Fraxinus* spp.)**
- **Juneberry (Amelanchier spp.)**
- **Native honeysuckle (*Lonicera canadensis*)**
- **Basswood (*Tilia americana*)**
- **Maples (*Acer* spp.)**
- **Canada ticktrefoil (*Desmodium canadense*)**
- **Evening primrose (*Oenothera biennis*)**
- **Dogwood (*Cornus* spp.)**
- **Roses (*Rosa* spp.)**
- **Brambles (*Rubus* spp.)**
- **Wild Strawberry (*Fragaria*)**
- **Sumac (*Rhus* spp.)**

Books to Help You Understand Bees









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Other Resources to Help ID Bees

Michigan Pollinator Initiative: Native Bee Habitat

https://pollinators.msu.edu/resources/pollinator-planting/native-bee-habitat/

Bumble Bee Watch

https://www.bumblebeewatch.org/

iNaturalist

https://www.inaturalist.org/

Discover Life

https://www.discoverlife.org/mp/20q?search=Apoidea

BugGuide

https://bugguide.net/node/view/59

Exotic Bee ID

http://idtools.org/id/bees/exotic/

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Discussion Questions

1. What challenges/roadblocks do you face establishing habitat?
2. For those who have established habitat, what did you wish you knew at the beginning or would have done differently?
3. What resources do you use to create pollinator habitat? How could resources improve to better help you?
4. How has your community responded to your pollinator habitats? How do you educate them about the habitat?
5. What about your habitat brings you the most joy or benefits to your farm/garden/community?

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Urban Soil Management

Edwin Muñiz – Soil Scientist

FARM PRODUCTION AND CONSERVATION
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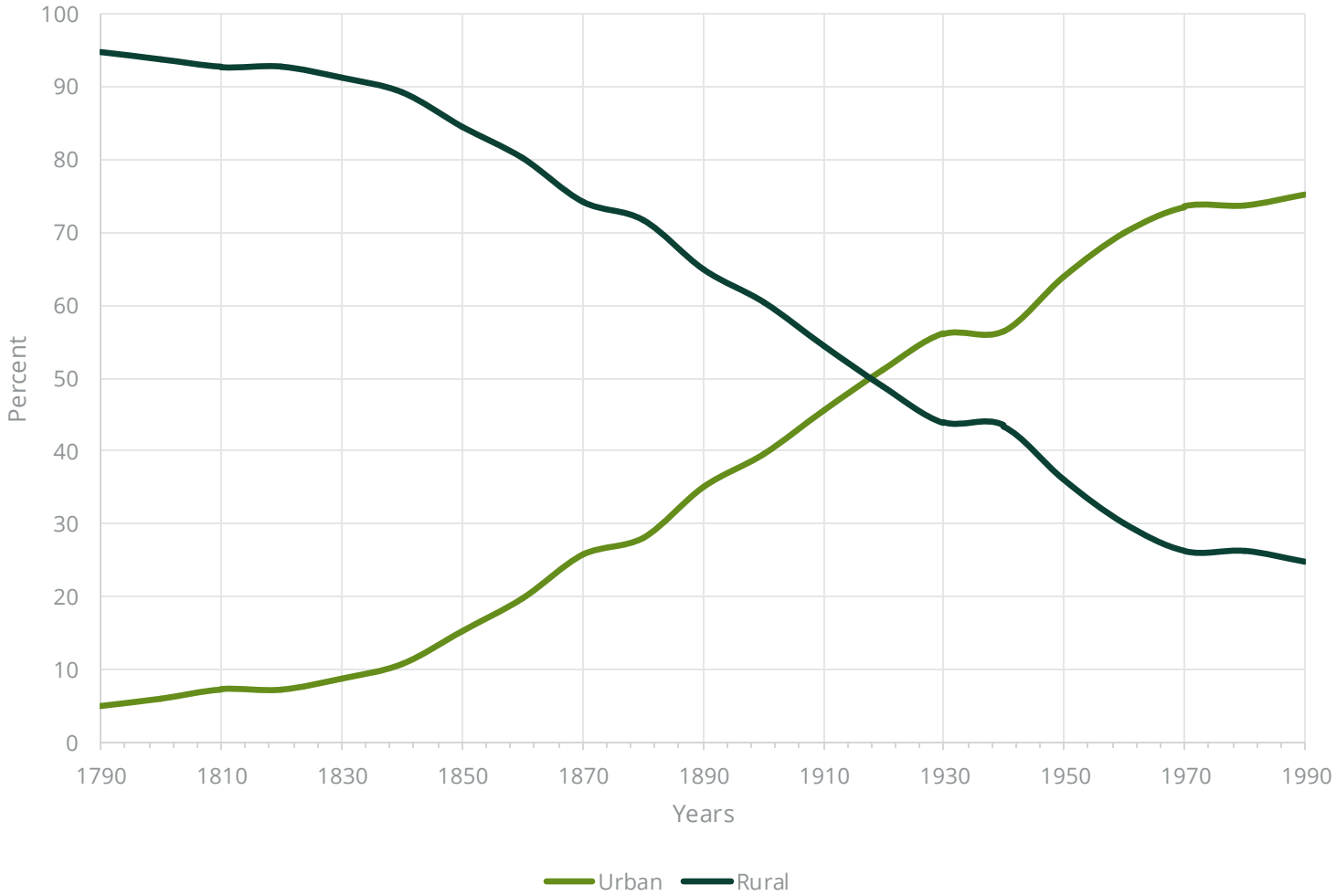
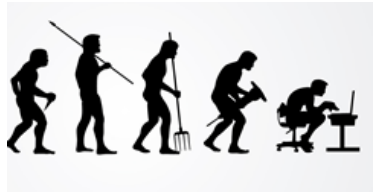
Transformation United States Rural to Urban Population

Years	Percent Urban	Rural
1990	75.2	24.8
1980	73.7	26.3
1970	73.6	26.3
1960	69.9	30.1
1950	64.0	36.0
1940	56.5	43.5
1930	56.1	43.9
1920	51.2	48.8
1910	45.6	54.4
1900	39.6	60.4
1890	35.1	64.9
1880	28.2	71.8
1870	25.7	74.3
1860	19.8	80.2
1850	15.4	84.6
1840	10.8	89.2
1830	8.8	91.2
1820	7.2	92.8
1810	7.3	92.7
1800	6.1	93.9
1790	5.1	94.9

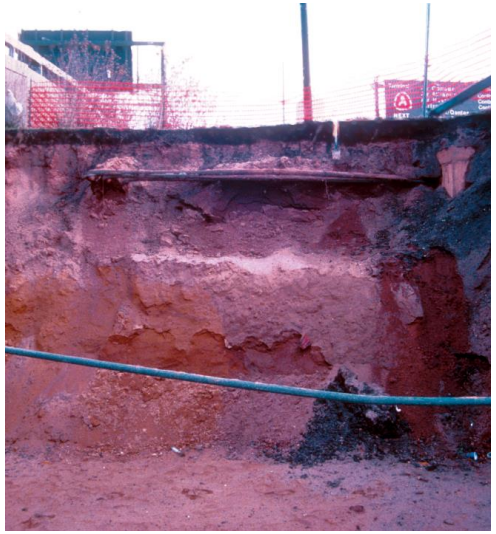




About, 84 % of the population of the U.S.A. lives in urban areas (University of Michigan, 2019)

What are Urban Soils?

- Soil material formed from human-altered or human-transported material
- Contain
  - Natural coarse fragments
  - Construction debris
  - Metal
  - Glass
  - Other
- Activities not associated with agriculture



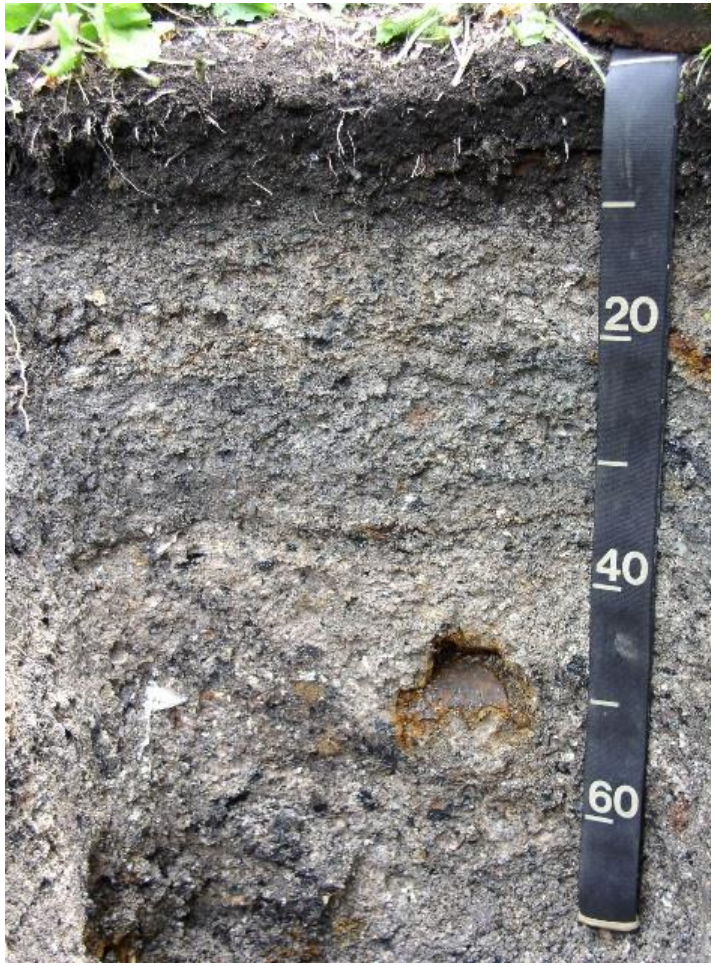
Type Soil Material - Artifactic

Laguardia

Secaucus

- Soil material consisting of
  - Natural coarse fragment
  - Concrete
  - Bricks
  - Metal
  - Glass
  - Asphalt

Type Soil Material - Combustic

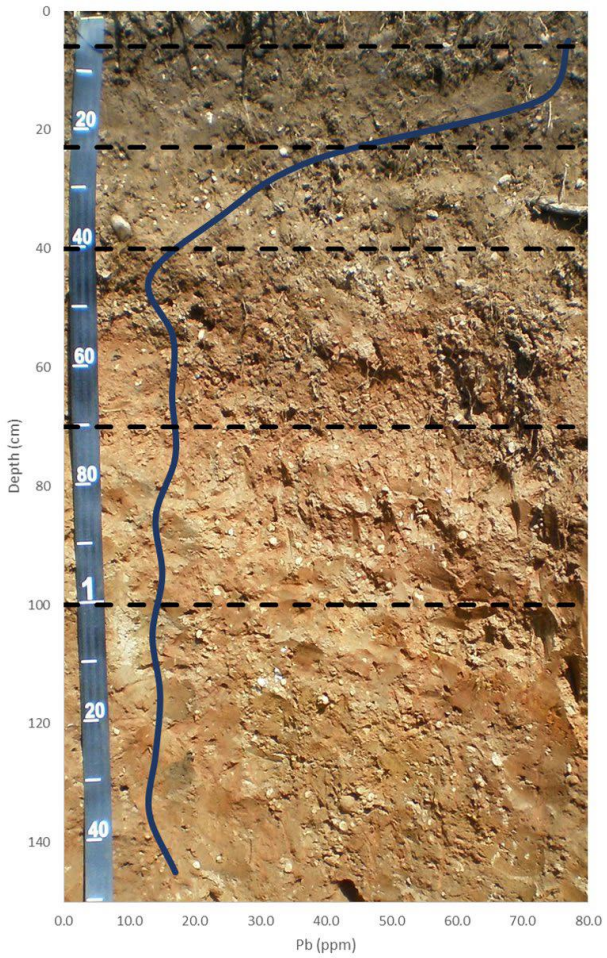


Mosholu

Rikers

- Soil material consisting of
  - Coal slag
  - Coal ash
  - Fly ash

Atmospheric deposition and Dredgic



Bigapple

Sediment material from dredging are used as fill in low-lying urban areas. Depending on the dredge material salt may be moved onto a site. Other problem with dredge material may include compaction of a subsurface layer.

Scheyer, J.M., and K.W. Hipple. 2005. Urban Soil Primer. United States Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center, Lincoln, Nebraska (http://soils.usda.gov/use).

USDA Natural Resources Conservation Service
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Resources Concern with Urban Soils

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Urban Soils Resources Concern

- Soil erosion
  - Soil transport by rainfall, melting snow, irrigation and wind.
- Subsidence
  - Loss of volume and depth of organic soils due to oxidation caused by above normal microbial.
- Organic matter depletion
  - Management-induced depletion of any or all pools of soil organic matter resulting in limited soil function and processes that support plant productivity, biological activity and water and nutrient cycling.

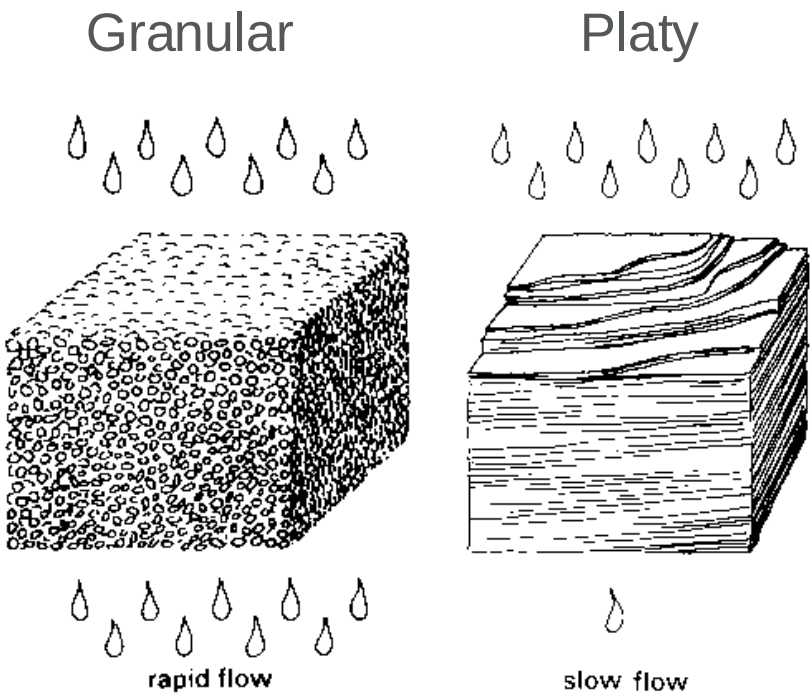
Urban Soils Resources Concern

- Soil organism habitat loss or degradation
  - Quantity, quality, diversity or connectivity of food, cover, space, shelter and/or water is inadequate to meet requirements of beneficial soil organisms.

- Compaction
  - Management-induced soil compaction at any level throughout the soil profile resulting in reduced plant productivity, biological activity, infiltration and aeration.

Urban Soils Resources Concern

- Aggregate instability
  - Management-induced degradation of water stable soil aggregates resulting in destabilized soil carbon; surface crusting; reduced water infiltration, water holding capacity, and aeration; depressed resilience to extreme weather; increased ponding and flooding; increased soil erosion and plant stress; and reduced habitat and soil biological activity.

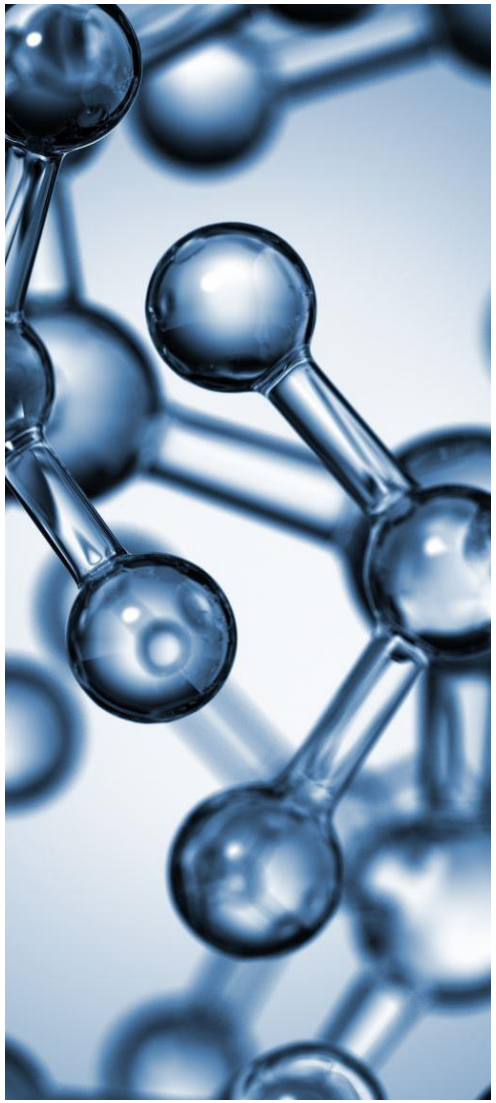


Urban Soils Resources Concern

- Seasonal high-water table
  - Water table levels can change depending on a number of factors including precipitation rates, soil permeability, drainage patterns, and more.
- Plant productivity and health
  - Improper fertility, management or plants not adapted to site negatively impact plant productivity, vigor and/or quality
- Concentrated salts or other chemicals
  - Concentration of salts or concentrations of other chemicals impacting productivity, populations of beneficial organisms or limiting desired use.

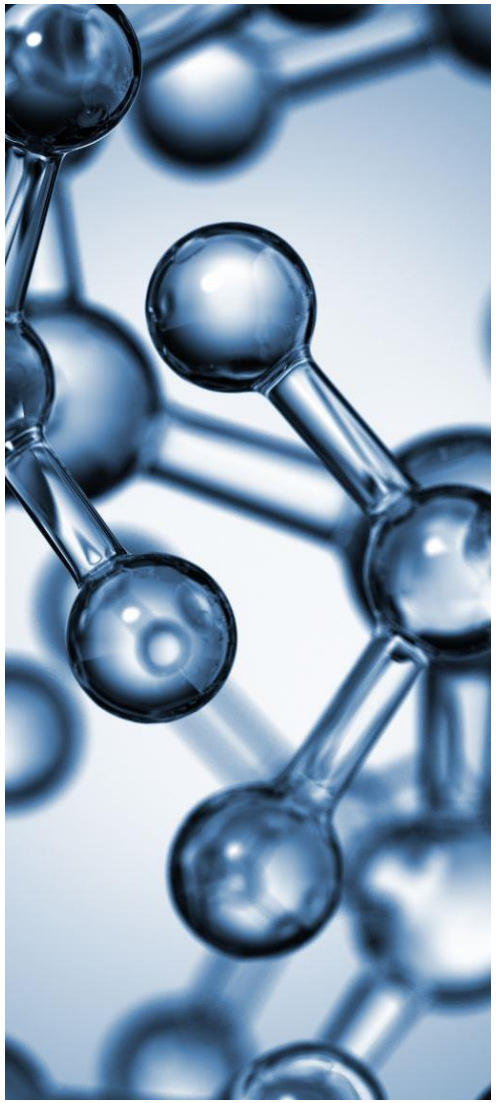
Sources of trace elements in soil

- Natural source (parent material) – low concentrations most of the times
- Mining
- Manufacturing and synthetic products
  - Pesticides
  - Fertilizers
  - Paints
  - Batteries
  - Industrial waste
  - Leaded gasoline



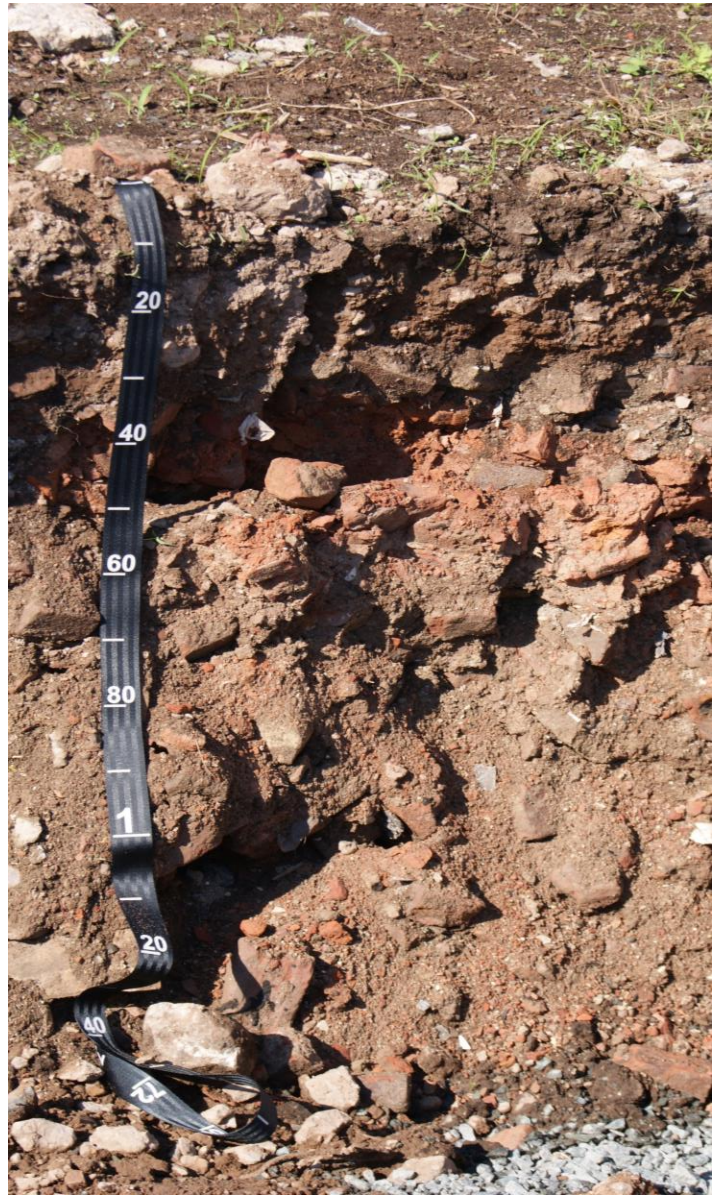
Sources of trace elements in soil

- Land application
  - Industrial or domestic sludge
  - Animal manure
- Coal combustion
- Atmospheric deposition



Resource concerns example

- Organic matter depletion
- Concentration of salts or other chemicals
- Soil organism habitat or degradation
- Aggregate instability
- Moisture management
- Surface water depletion
- Emission of particulate matter
- Plant productivity and health



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Soil Management and Best Management Practices in Urban Agriculture

FARM PRODUCTION AND CONSERVATION
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Urban Soil Management

- Increasing the soil pH to 6.5 or higher.
  - Raising pH reduce lead (cation, positive charge) availability but at the same time increases arsenic (anion, negative charge) availability.

- Reduce soil saturation
  - Improves soil aeration and will allow metals to oxidize, making them less soluble.

Urban Soil Management

- Applying phosphate
  - Heavy phosphate applications reduce the availability of cationic elements like lead but have the opposite effect on anionic elements like arsenic.

- Plant selection
  - Plants could translocate larger quantities of metals to their leaves than to their fruits or seeds. The greatest risk of food chain contamination is in leafy vegetables like lettuce or spinach.

Best management practices (UCONN Factsheet)

- Gardens should be located away from older, painted structures and heavily traveled roads.
- Give planting preference to fruiting crops like tomatoes, squash and peppers on soils with elevated lead levels.
- Remove outside leaves of green leafy vegetables, peel root crops, and wash all vegetables thoroughly to remove soil particles.

Best management practices (UCONN Factsheet)

- Maintain the soil pH at 6.5 to 7.0 by applying limestone at recommended rates to reduce the availability of lead uptake by plants.

- Maintain soil organic matter levels between 5 and 10 percent. Organic particles will bind with lead making it less available for plant uptake.

- Maintain soil phosphorus levels by applying the recommended amounts of fertilizer to garden plots.

Best management practices (UCONN Factsheet)

- Phosphorus can reduce lead uptake by plants.

- Minimize dust and exposure to bare soil through use of mulches.

Example conservation practices Urban Ag

- Cover crop
- Mulching
- Low tunnel

Example conservation practices Urban Ag

- Solar energy
- Composting facility

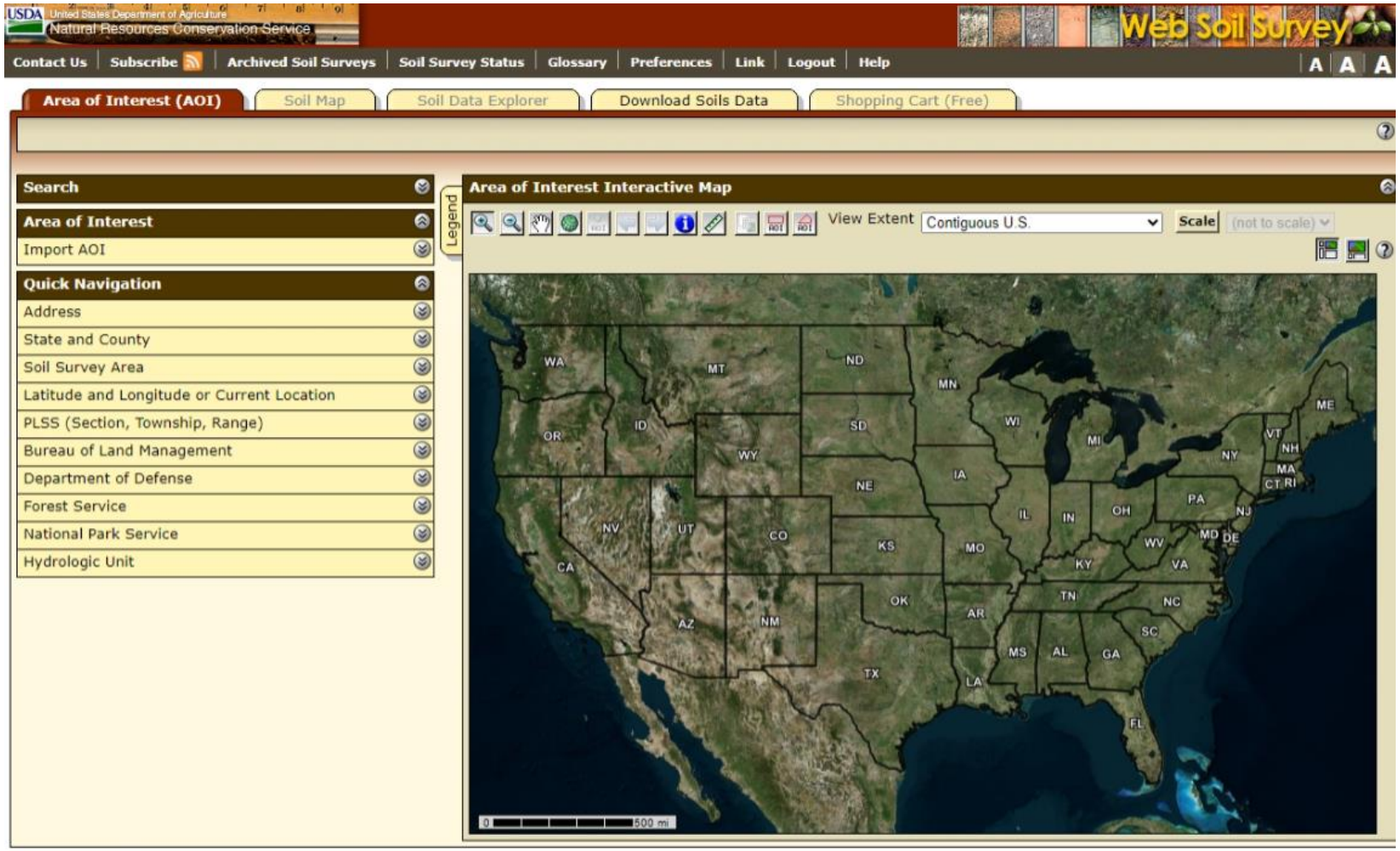
USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

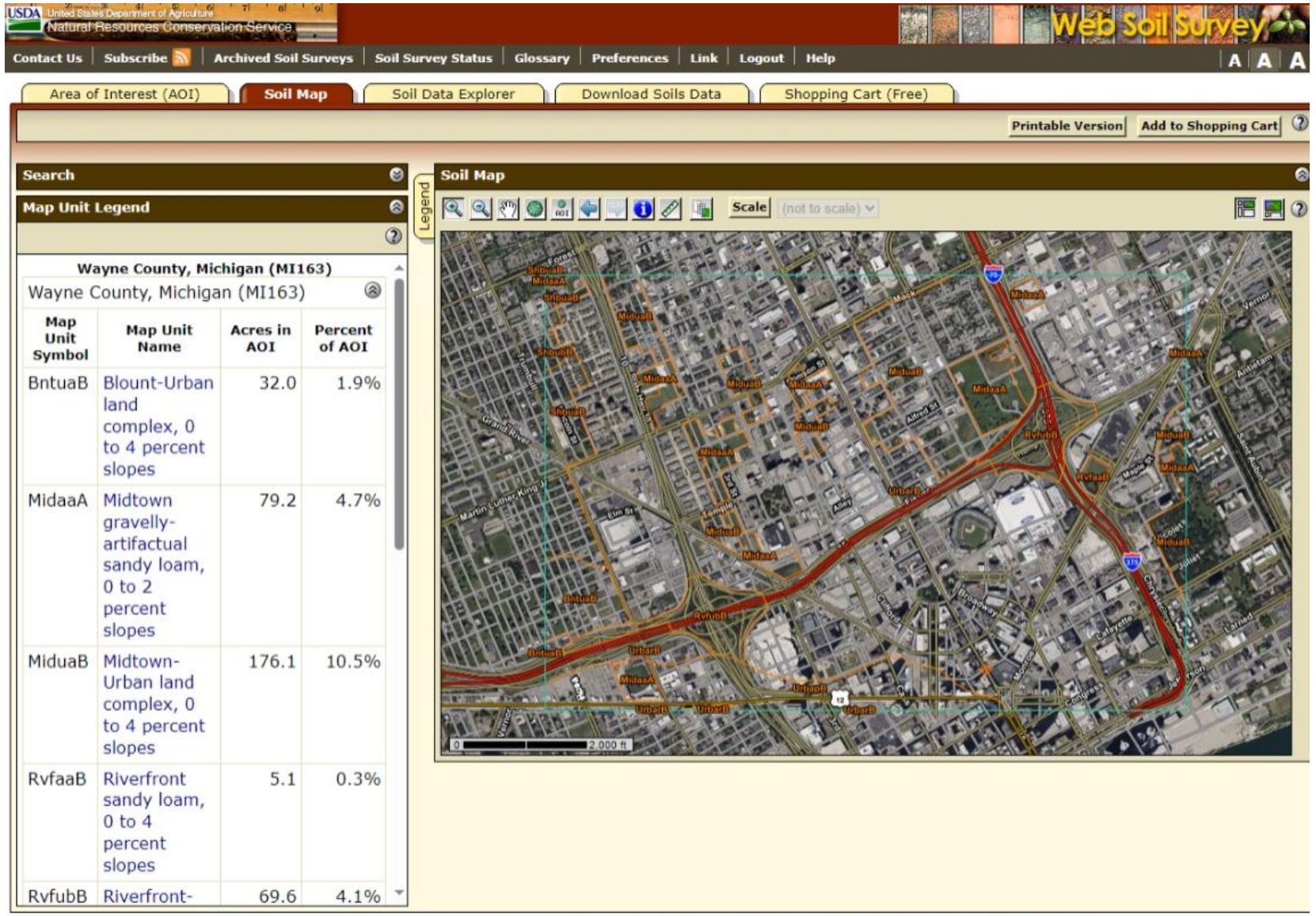
Source of Soils Information

Web Soil Survey

FARM PRODUCTION AND CONSERVATION
FSA | NRCS | RMA | Business Center

Web Soil Survey Urban Areas

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Soil Map
Scale (not to scale)
Wayne County, Michigan (MI163)
Wayne County, Michigan (MI163)
Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI
BntuaB | Blount-Urban land complex, 0 to 4 percent slopes | 32.0 | 1.9%
MidaaA | Midtown gravelly-artifactual sandy loam, 0 to 2 percent slopes | 79.2 | 4.7%
MiduaB | Midtown-Urban land complex, 0 to 4 percent slopes | 176.1 | 10.5%
RvfaaB | Riverfront sandy loam, 0 to 4 percent slopes | 5.1 | 0.3%
RvfubB | Riverfront- | 69.6 | 4.1%
0
2,000 ft
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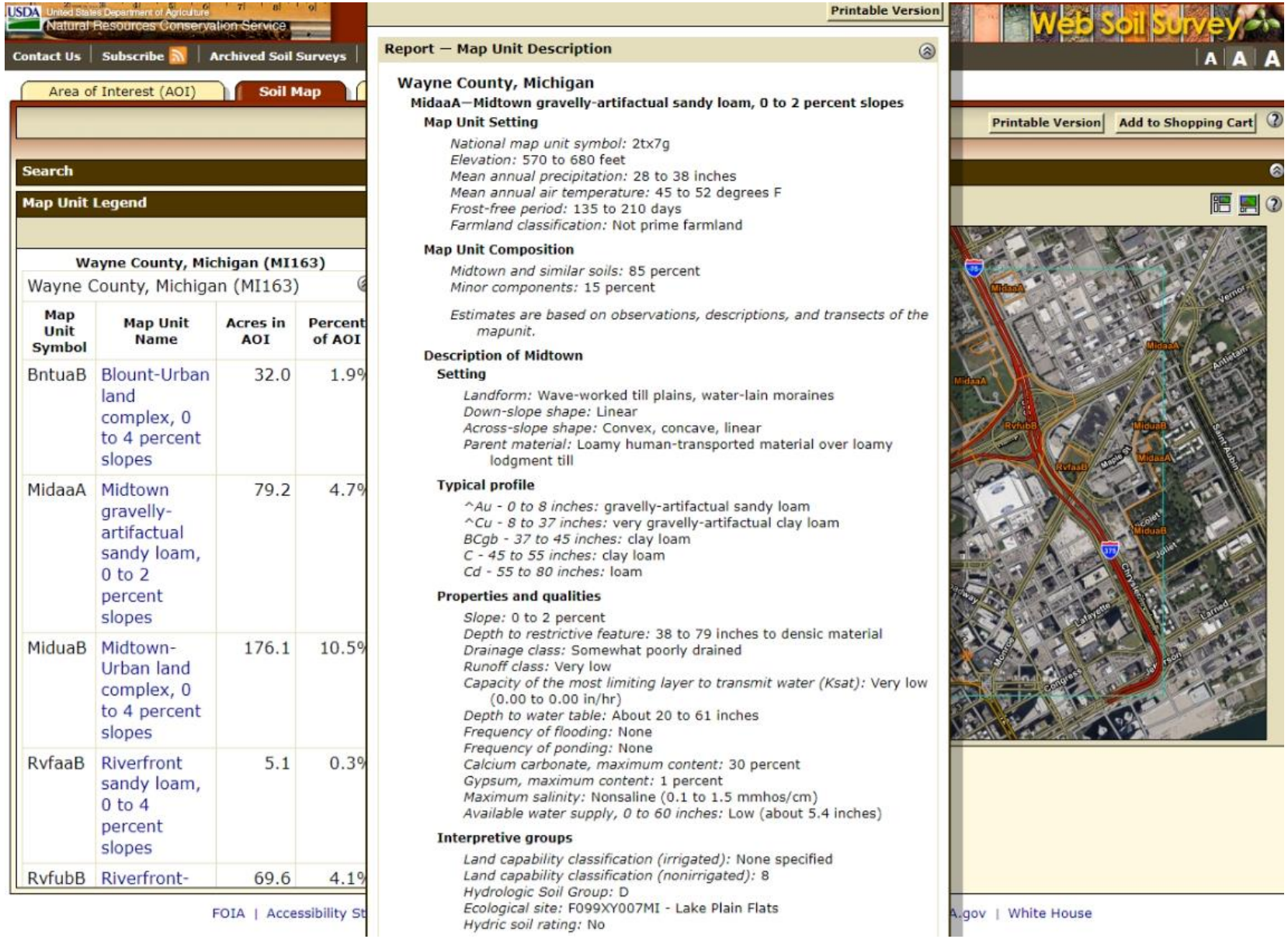
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Map Unit Legend
Wayne County, Michigan (MI163)
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RvfubB | Riverfront- | 69.6 | 4.1%
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Report — Map Unit Description
Wayne County, Michigan
MidaaA—Midtown gravelly-artifactual sandy loam, 0 to 2 percent slopes
Map Unit Setting
National map unit symbol: 2tx7g
Elevation: 570 to 680 feet
Mean annual precipitation: 28 to 38 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 210 days
Farmland classification: Not prime farmland
Map Unit Composition
Midtown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Midtown
Setting
Landform: Wave-worked till plains, water-lain moraines
Down-slope shape: Linear
Across-slope shape: Convex, concave, linear
Parent material: Loamy human-transported material over loamy lodgment till
Typical profile
^Au - 0 to 8 inches: gravelly-artifactual sandy loam
^Cu - 8 to 37 inches: very gravelly-artifactual clay loam
BCgb - 37 to 45 inches: clay loam
C - 45 to 55 inches: clay loam
Cd - 55 to 80 inches: loam
Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 38 to 79 inches to densic material
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: About 20 to 61 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.1 to 1.5 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)
Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Ecological site: F099XY007MI - Lake Plain Flats
Hydric soil rating: No
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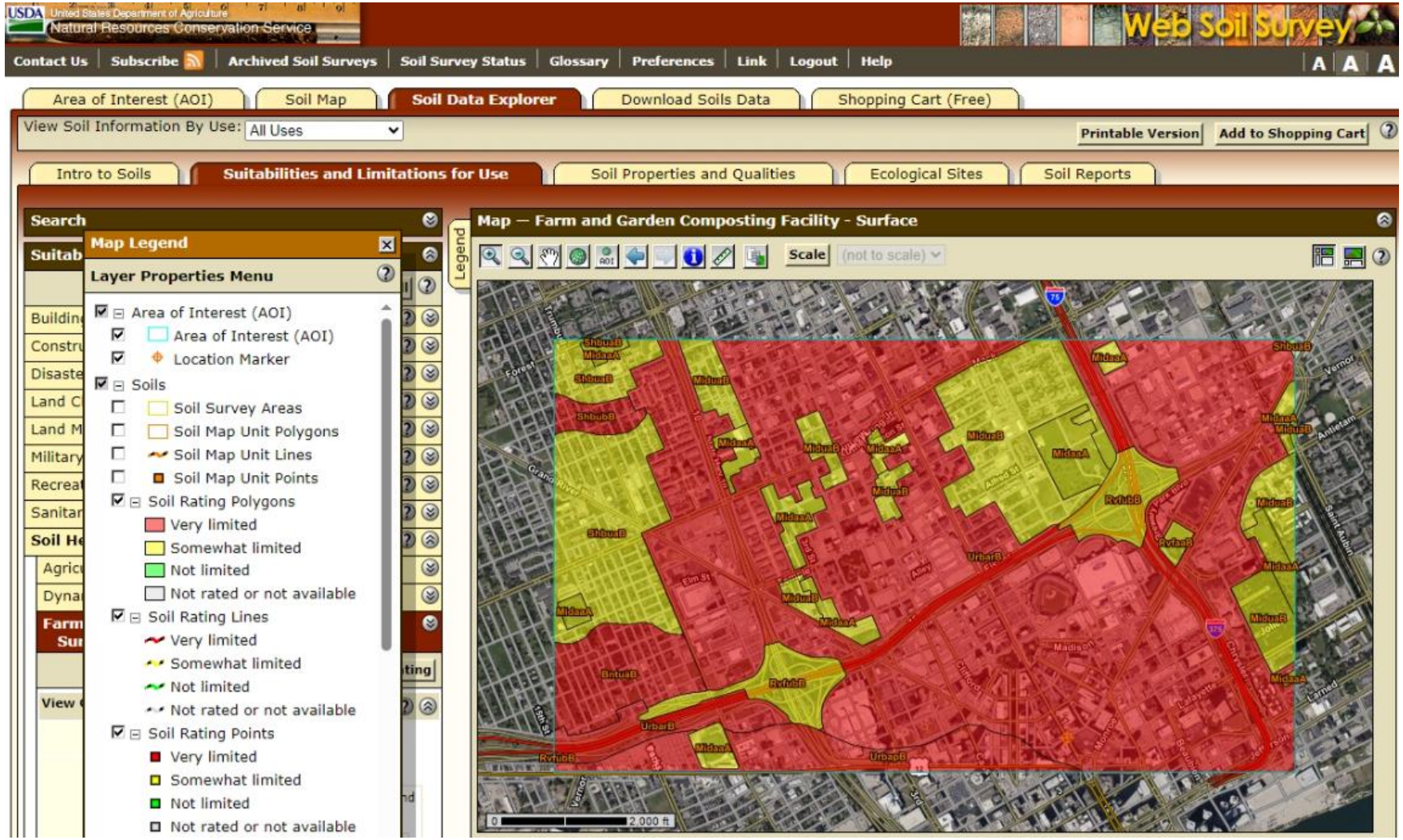
Farm and Garden Composting Facility

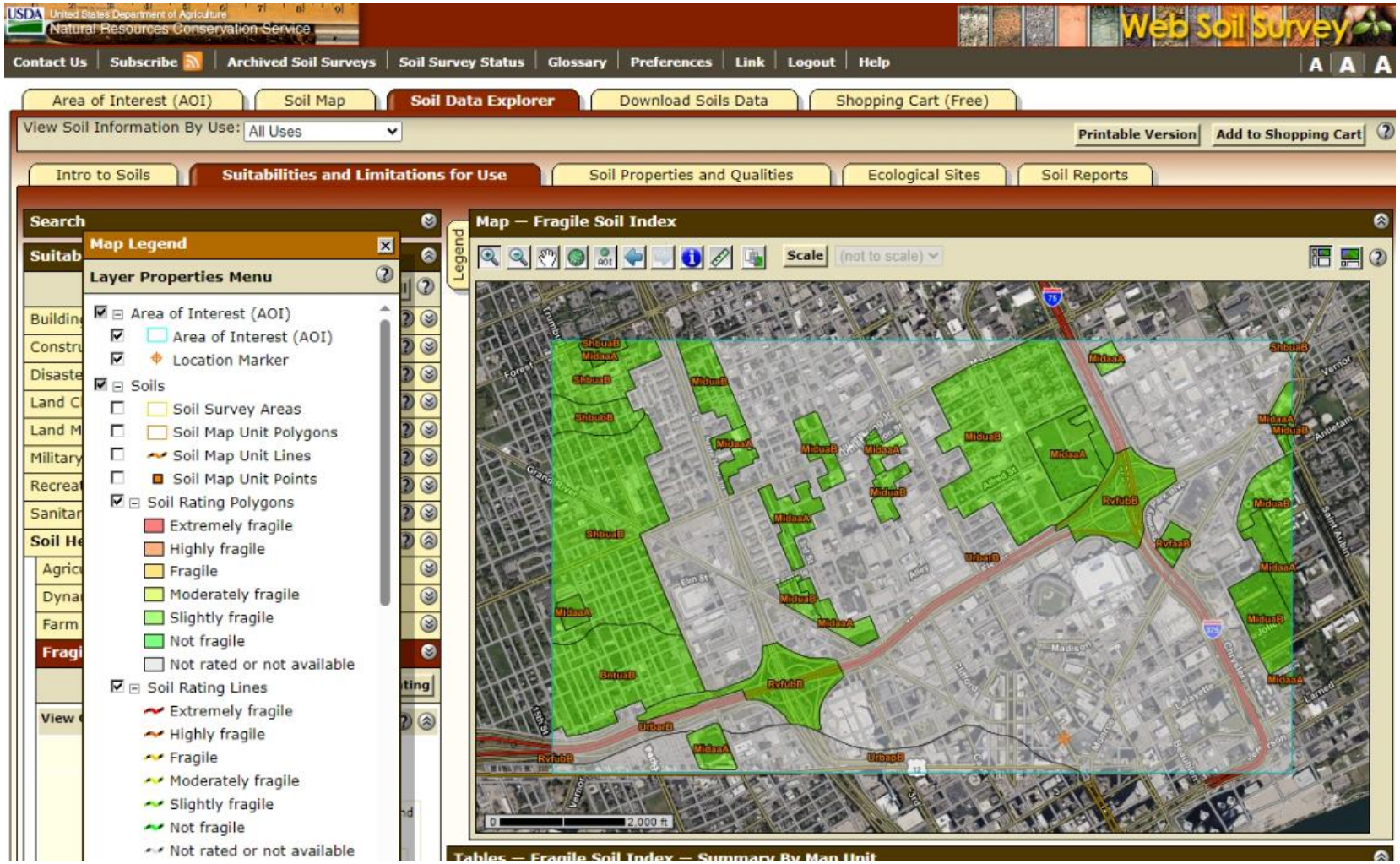
The ratings are based on the soil properties that affect trafficability; decomposition and microorganisms; construction and maintenance of the site; and public health.



Fragile Soil Index

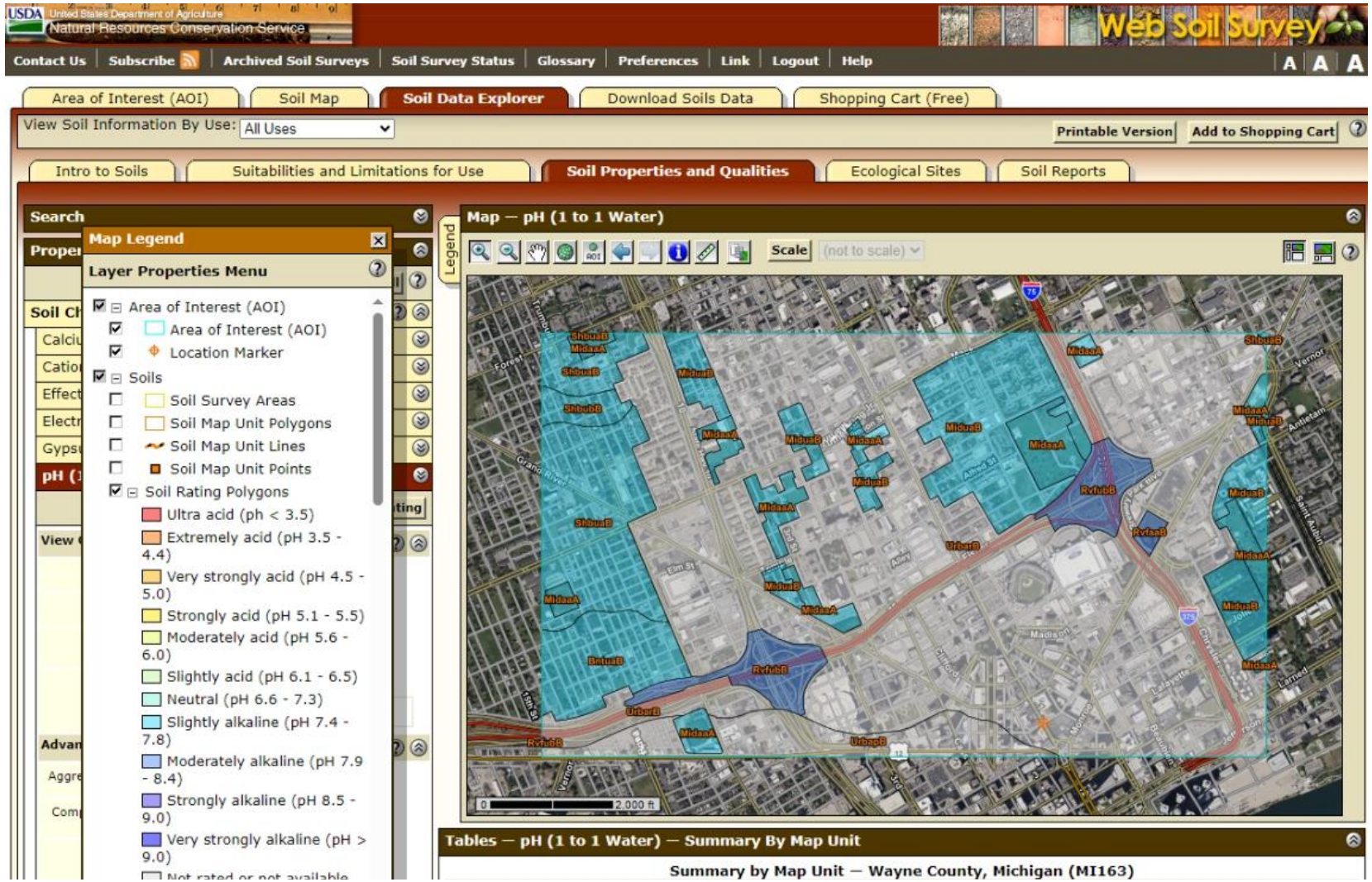
Soils can be rated based on their susceptibility to degradation in the "Fragile Soil Index" interpretation. Fragile soils are those that are most vulnerable to degradation.

Slightly Fragile: These soils have a high potential to resist degradation and be resilient.

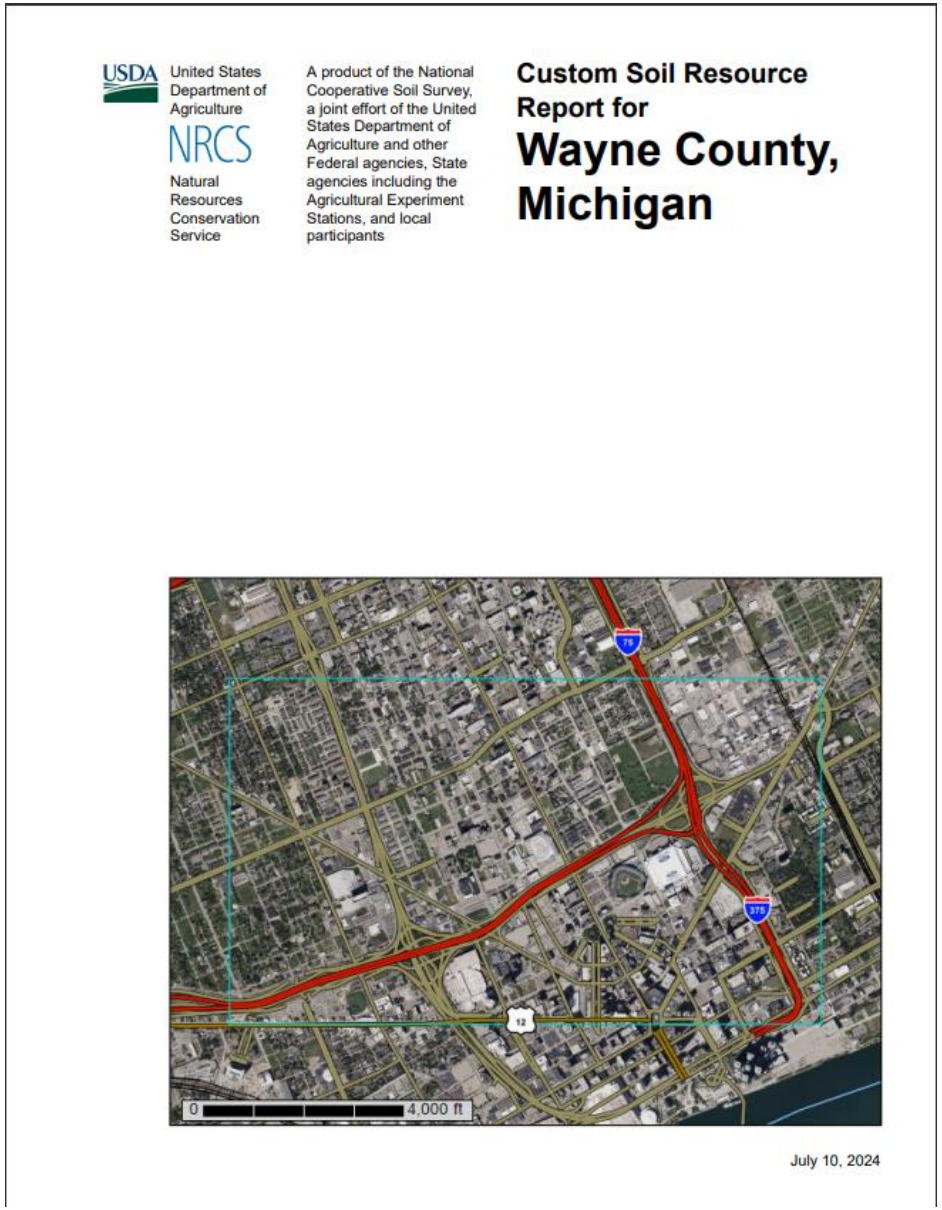


Soil Chemistry pH Soil Surface

It is important in selecting crops and other plants, in evaluating soil amendments for fertility.



Custom Soil Survey Report



United States Department of Agriculture
NRCS
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Wayne County, Michigan

July 10, 2024

Questions

Connect with us!

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- Check out our YouTube channel @nrcssoilandplantscience

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