On-Farm Habitat Restoration Using Transplants

Practical Farmers of Iowa

Jan 17-19, 2019

Jon Judson
Diversity Farms

Sarah Foltz Jordan
Xerces Society

Photo: Sarah Foltz Jordan

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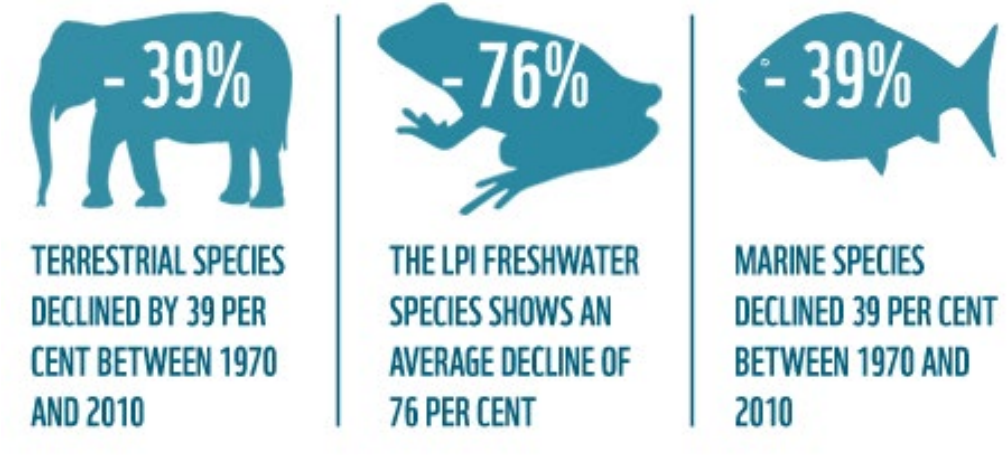
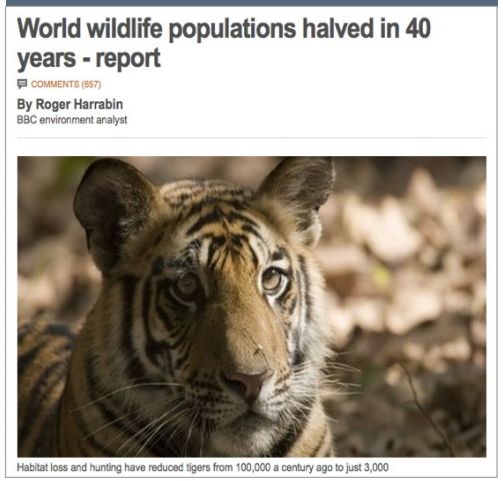
Living Planet Index - Meta Analysis

Earth has lost >50% of its wild animal populations in the past 40 years



Ecosystems are degrading at a rate unprecedented in human history

Largest global analysis of thousands of animal species (birds, mammals, fish, reptiles, etc.)



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Insect populations are plummeting, even in natural areas

New Research: Published October 2017

Between 1986 and 2016, insect biomass declined by 76% in German nature reserves

Hallmann, et al. 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLoSOne.https://doi.org/10.1371/journal.pone.0185809.

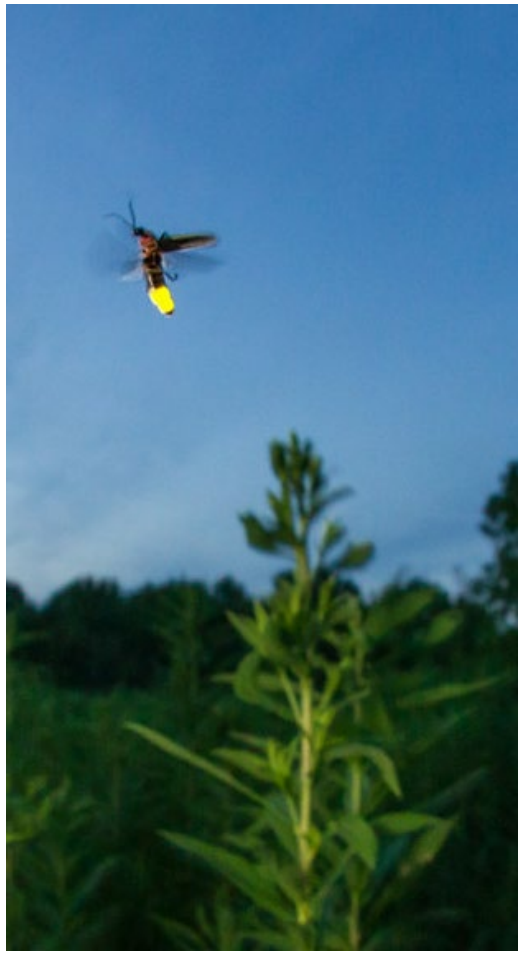

Photo: Alex Wild

The Washington Post

'This is very alarming!': Flying insects vanish from nature preserves

By Ben Guarino October 18

The white tent of a malaise trap in a nature reserve abutting farmland. (Verein Krefeld, entomologist)

Not long ago, a lengthy drive on a hot day wouldn't be complete without scraping bug guts off a windshield. But splattered insects have gone the way of the Chevy Nova — you just don't see them on the road like you

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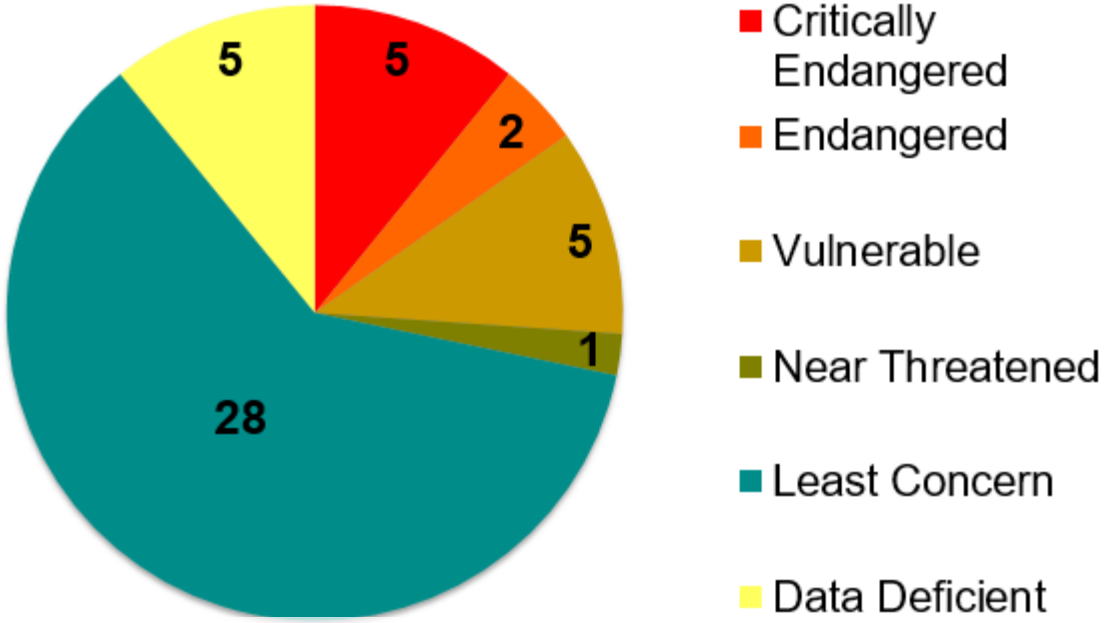
Bumble Bees

25% of North American Bumble Bee Species At-Risk of Extinction

- Including 6+ species in the Upper Midwest
- Among the most important wild pollinators of crops and native plants



Hatfield et al. 2014 Xerces Society-IUCN status review

Evans, E.,R. Thorp, S. Jepsen, and S. Hoffman Black, 2009. Status Review of Three Formerly Common Species of Bumble Bee in the Subgenus *Bombus*. Xerces Society.

Cameron et al. 2011. Patterns of widespread decline in North American bumble bees. PNAS

Photos: John Anderson, Johanna James-Heinz

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Butterflies are also in serious decline

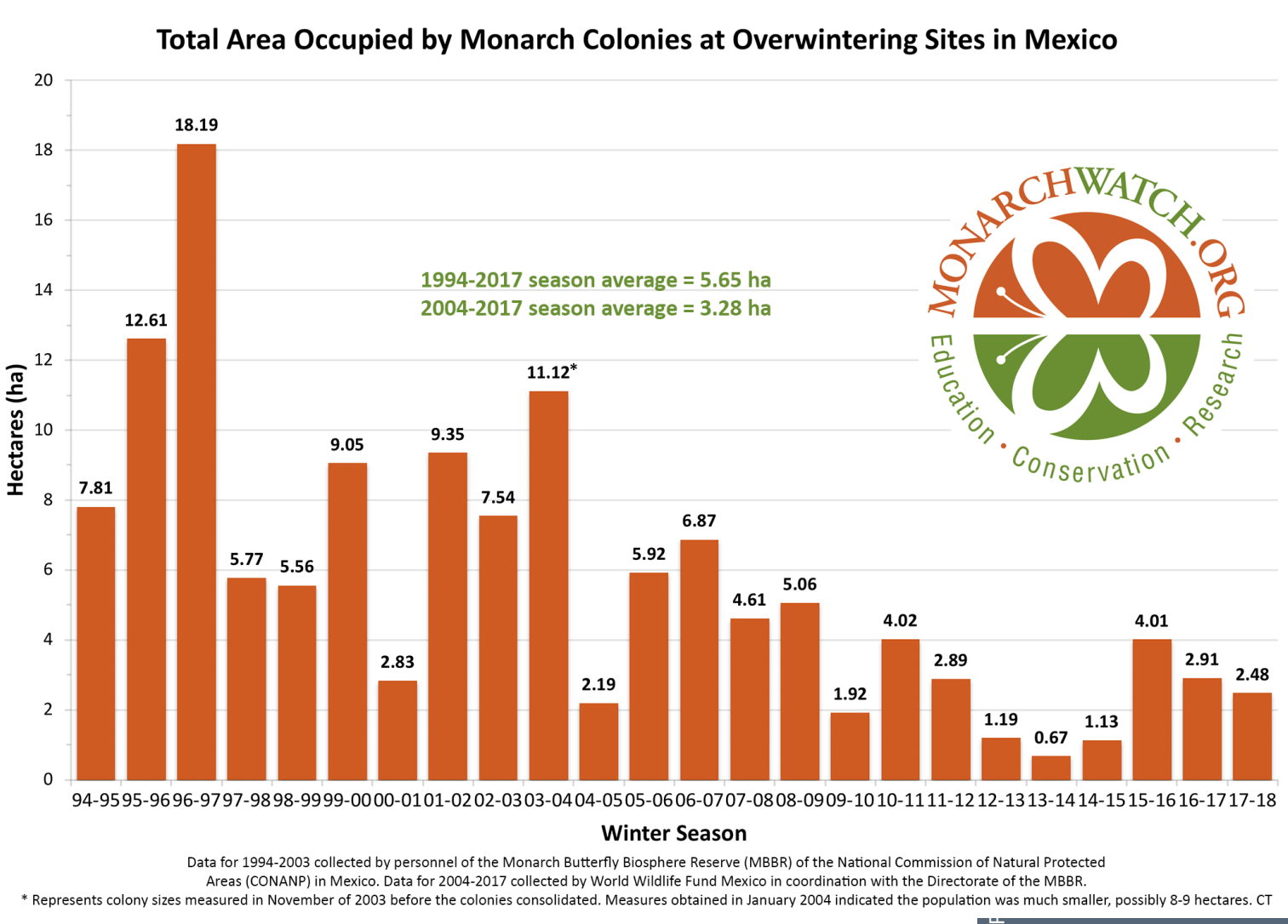
- According to NatureServe, **at least 141 N. American butterfly species are considered at risk of extinction (18%)**
- Historically rare, specialist butterflies are at risk but we are also seeing **declines in many once wide ranging and common butterflies.**

Photo: Cale Nordmeyer, MN Zoo

Monarch Status

Monarch Butterflies Decline >80% Since 1990s

1990s: **400 million** monarchs
2016-17: ~60 million monarchs



Data for 1994-2003 collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Natural Protected Areas (CONANP) in Mexico. Data for 2004-2017 collected by World Wildlife Fund Mexico in coordination with the Directorate of the MBBR.

* Represents colony sizes measured in November of 2003 before the colonies consolidated. Measures obtained in January 2004 indicated the population was much smaller, possibly 8-9 hectares. CT

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What's at stake?

Pollinators are critical to our economy… and our diets!

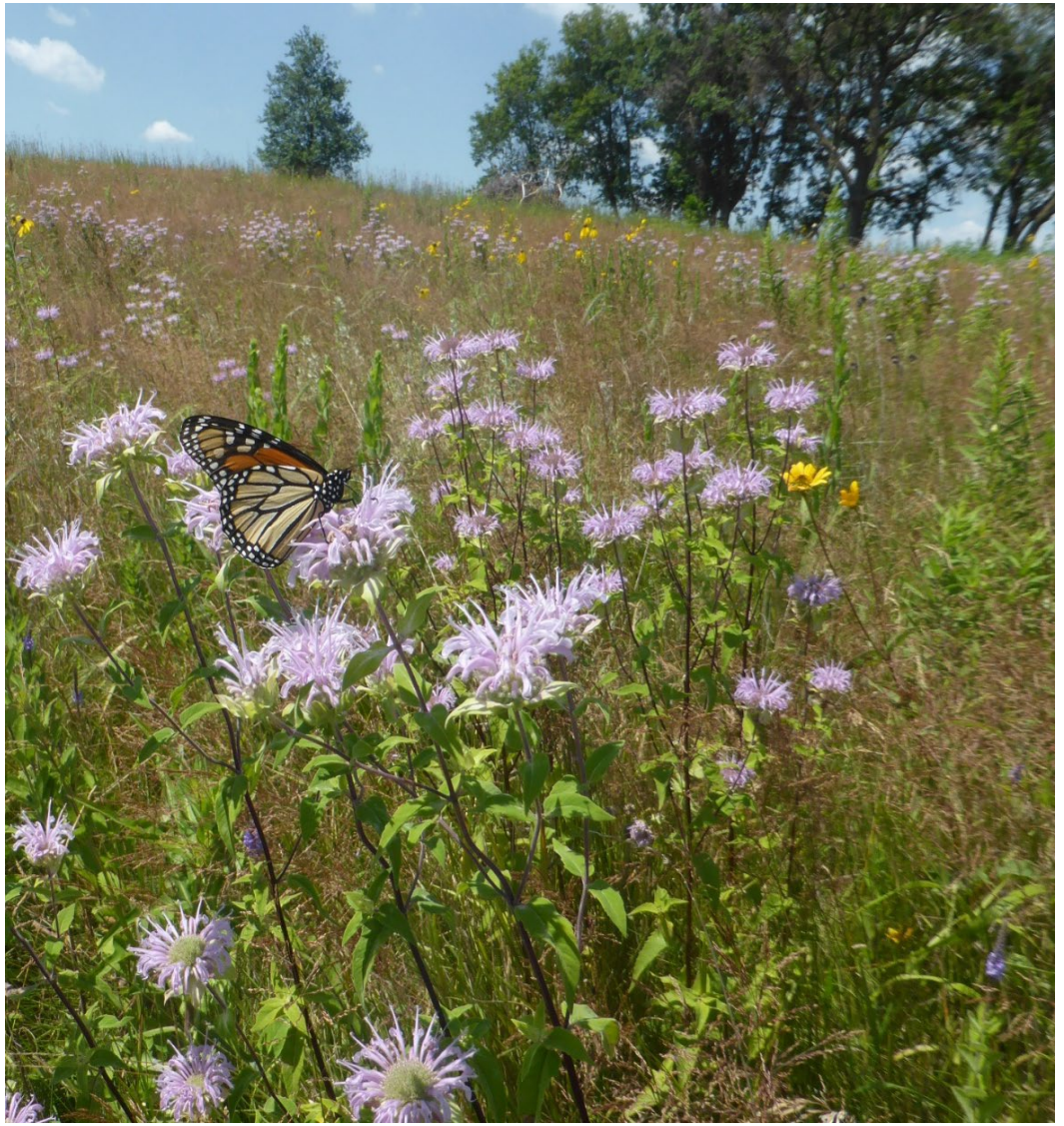
- 2/3 of crop plants (worldwide)
- 35% of crop production (worldwide)
- Many of our necessary vitamins and minerals come from insect-pollinated plants
- Over $18 to $27 billion value of crops in U.S. ($217 billion worldwide)

Morse and Calderone 2000; Klein et al. 2007; Eilers et al. 2011

Photo: USDA-ARS/Peggy Greb

Pollinators are Critical to Ecosystem Health

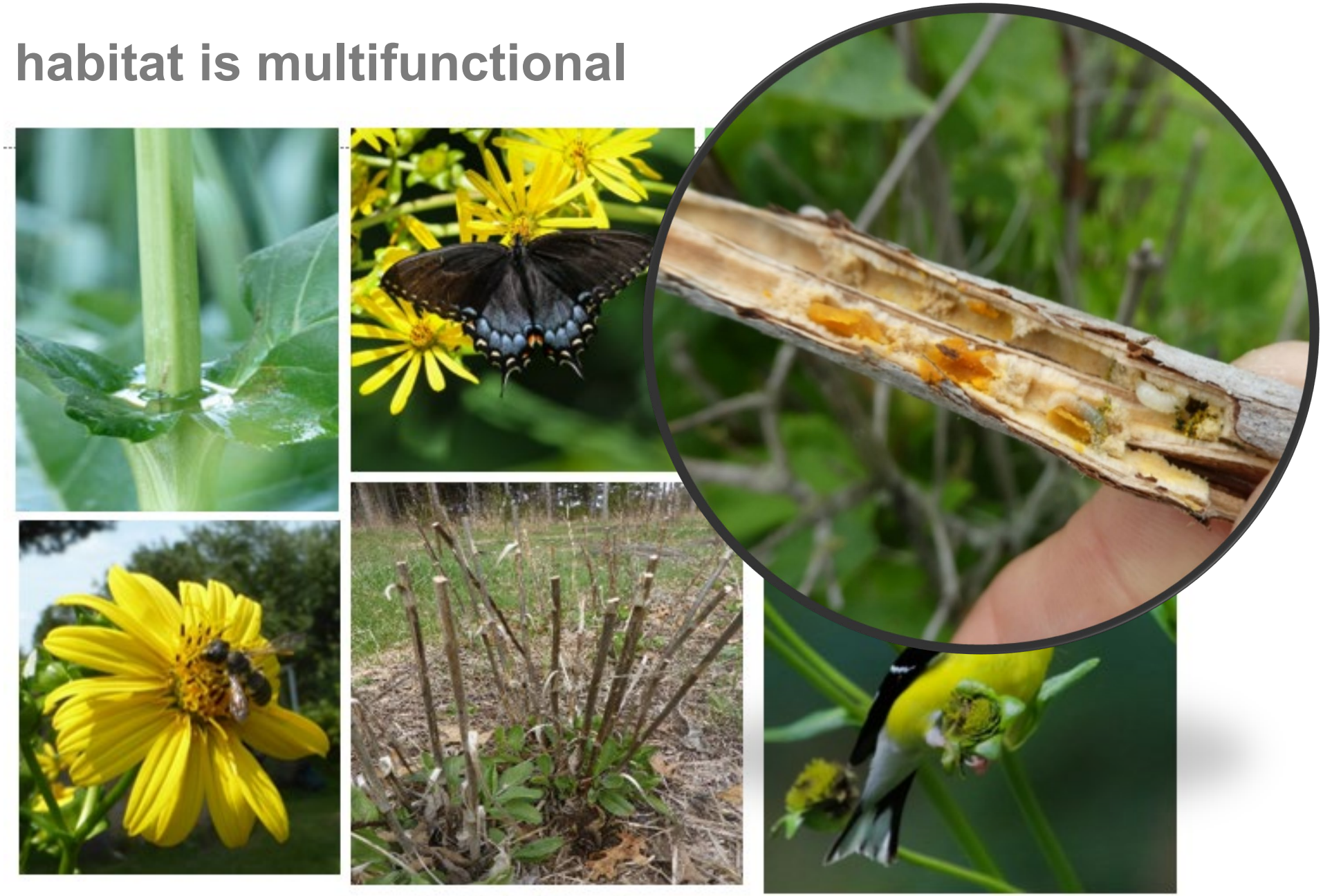
- More than 85% (~240,000 spp.) of flowering plants require an animal, mostly insects, to move pollen
- Diversity and longevity of our wild plant communities depends on pollination



Ollerton et al. 2011. How many flowering plants are pollinated by animals? Oikos 120: 321-326.
Burkle, L.A., Marlin, J.C., and T.M. Knight. 2013. Plant-Pollinator Interactions over 120 Years: Loss of Species, Co-Occurrence, and Function. Science 339: 6127 pp. 1611-1615.

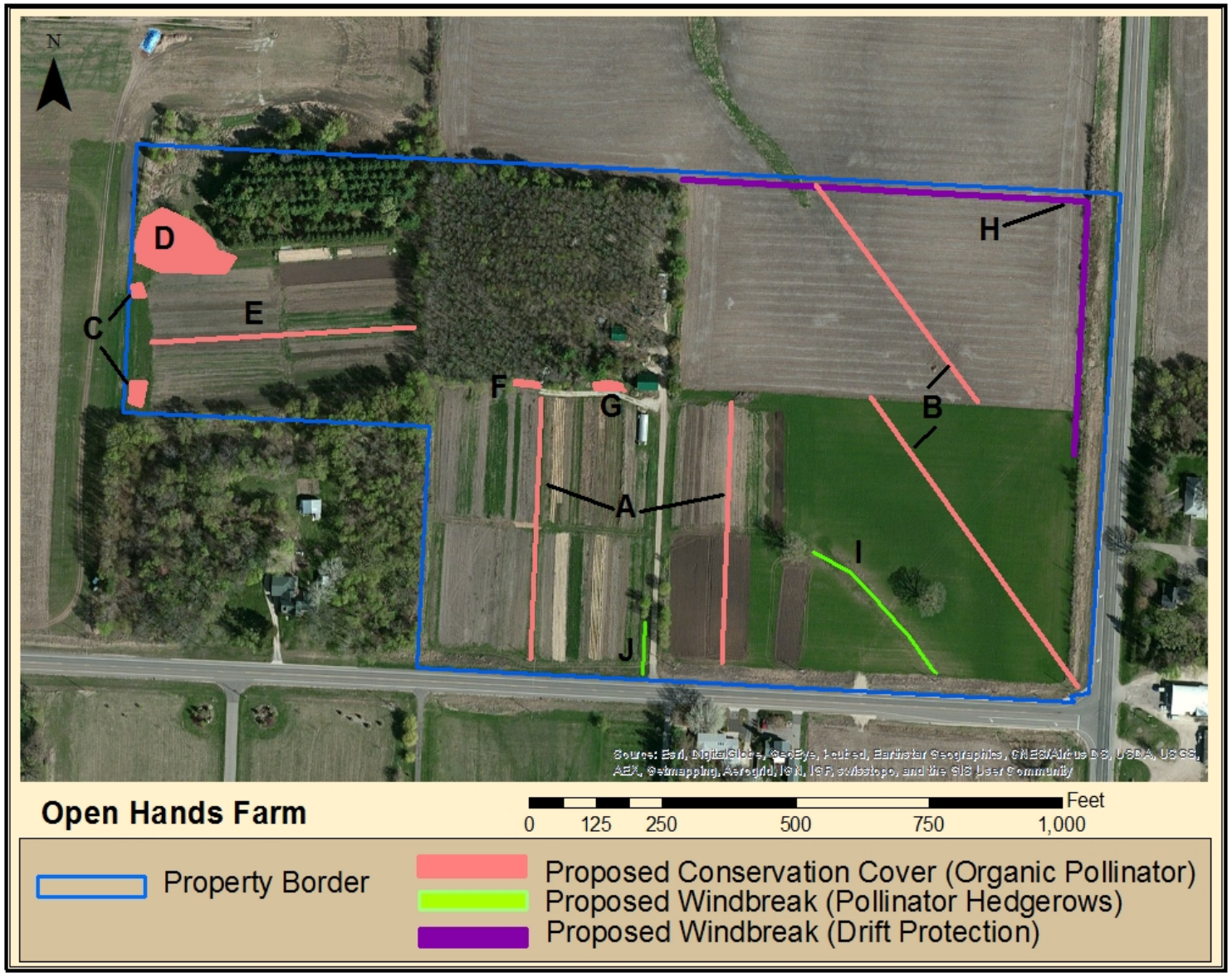
Photo: Sarah Foltz Jordan

Native habitat is multifunctional



Photos: Sue Chaplin, bybio.wordpress.com, Backyard Biology Blog; Justin Wheeler; Sarah Foltz Jordan

There are lots of habitat restoration options for farms



- ❑ **Field Border Plantings; Conversion of Fallow Areas**
- ❑ **Pollinator / Insectary Strips**
- ❑ **Beetle Banks**
- ❑ Cover crops
- ❑ Flowering hedgerows
- ❑ Filter Strips, Contour Strips
- ❑ Understory Plantings
- ❑ Pasture Plantings
- ❑ Drift Protection (non-flowering hedgerows)

Farm Bill Programs, etc.

Map: Sarah Foltz Jordan, Xerces Society

Native Habitat Restoration

Starting from Seed	Starting from Transplants
Low Cost	Can be low cost if you are set up to grow transplants yourself

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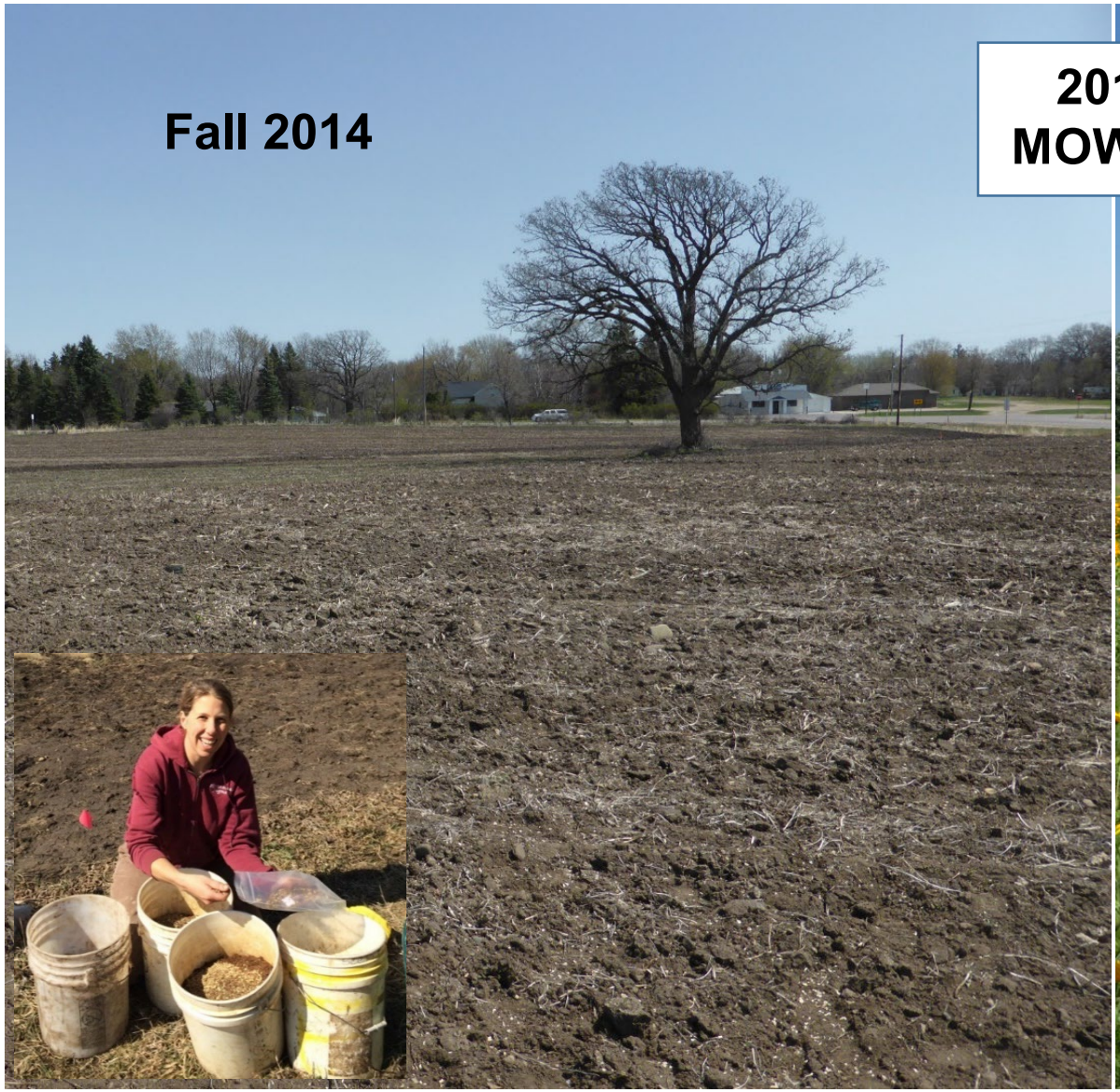
Less Control (design is limited to seed mix)	More Control & Design Opportunities (desired plants can be selected, clustered, evenly distributed, etc.)
Better for large areas	Better for small areas (1/10 acre = 4K plants)
Doesn't need irrigation	May require irrigation or water at time of transplant

Example: Open Hands Farm: ½ acre Native Habitat Restoration *From Seed*



2015: MOWING

Photos: Sarah Foltz Jordan

Example: Prairie Drifter Farm: 1000 ft. Native Habitat Strips *From Transplants*

- Native plants propagated in greenhouse
- Integrated into vegetable fields with same bed width as vegetables
- **Year 1: Irrigated & Cultivated like vegetable crop**
- **Year 2: cultivated once in spring; spot weeded in Sept.**
- **Year 3: spot weeded in Sept.**

Photos: Sarah Foltz Jordan

Rapid Restoration!

- Dense & diverse wildflowers just ONE YEAR after planting
- Very little weed management needed

Prairie Drifter Farm, Litchfield MN

August 2017

Photos: Sarah Foltz Jordan

Example: Prairie Drifter Farm: Native Habitat Strips *From Transplants*

Uproot Farm, Princeton, MN

Photos: Sarah Foltz Jordan

Example: Grinnell Heritage Farm: Native “Beetle Banks” *From Transplants*

Ground beetles in numbers commonly found in Midwestern crop fields can remove:

Up to 4000 cutworms/acre/day

Up to 40 weed seeds/square ft/day

(Menalled and Landis 1997)

Photo: Grinnell Heritage Farm

The combination of seeds and plugs

Example: Start with plugs, mulch and get them going well, add in seed later, after mulch has broken down. Sprinkle in purple prairie clover and black eyed susan, blue grama

Photo: Jon Judson

Example: Combining Seeds and Transplants: Del's Orchard

- Smother Crop Site Prep
- Planted native seed
- Included plugs of Lupin and New Jersey Tea

Invasive Weeds Sum

Buckwhe

Seeding Fa

Summer 2017

Photos: Sarah Foltz Jordan, Del Stubbs

Example: Combining Seeds and Transplants: Heidel Family Farm

- Solarization Site Prep
- Planted native seed
- Included Liatris as a bare root plant
- Mowed around the Liatris when possible

Propagation Considerations: Germination

- Different species have different requirements to break dormancy
- Prairie Moon Cultural Catalog Germination Codes
- A is the easiest (no treatment)
- B needs hot water
- C needs cold-moist stratification for a few days to a few months
- H needs scarification
- Etc.

Propagation Considerations:
Stratification

- Count backwards number of days required for stratification plus growing time.
    - e.g., C(30) requires 30 days of stratification, plus greenhouse growing time, before transplant will be ready to plant outdoors.
- Stratification Media: Moist Sand; Vermiculite; Moist Paper Towel (may depend on if you need to singulate seed after stratification)
- Scarification required for certain species
- Heat treatment required for some species
- Check on Seed Weekly
- Plant seeds when stratification time is up, or sooner if significant sprouting has occurred

Easy Wildflowers to Start With:

* no stratification needed

- Agastache spp. (hyssop)
- Asclepias incarnata (swamp milkweed) (*Germinate well but don't transplant well—sow directly)
- Aster novae-angliae and other spp. (New England aster and others) some*
- Coreopsis spp. (coreopsis)
- Dalea spp. (prairie clover)*
- Desmodium canadense (Canada tick trefoil)*
- Echinacea pallida (echinacea)*
- Eryngium yuccifolium (rattlesnake master)
- Eupatorium spp. (boneset, Joe Pye weed, etc)
- Helianthus spp. (native sunflowers)
- Helenium autumnale (sneezeweed)*
- Monarda spp. (bee balm, spotted bee balm)*
- Pycanthemum spp. (mountain mint)*
- Penstemon spp. (penstemon) (damp off issues)
- Solidago speciosa (showy goldenrod and others)
- Silphium spp. (compass plant, cup plant, etc)
- Verbena spp. (vervain)
- Vernonia spp. (iron weed)

Easy Grasses/Sedges to Start With:

* no stratification needed

- Andropogon gerardii (big bluestem)*
- Bouteloua curtipendula (side-oats grama)*
- Bouteloua hirsuta (hairy grama) *
- Bromus kalmii (prairie brome*
- Carex brevior (plains oval sedge)
- Sporabolis sp. (prairie dropseed and others)
- Elymus spp. (wild rye & bottlebrush grass)*
- Schizachyrium scoparium (little bluestem)*
- Koeleria macrantha (june grass)*
- Panicum virgatum (Switch grass)*
- Sorghastrum nutans (Indian grass) *
- Stipa sp. (porcupine grass) *

Photo: Xerces Society, Karin Jokela

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Other Considerations for Species Selection

- **Soil Type**: Match the species habitat preferences to soil moisture conditions
- **Diversity**! Include representatives from as many plant families as possible
- Include species with **high pollinator value**
- Plan for **bloom succession** (pollinators need bloom all season long). Aggressive species as needed for resisting weed invasion
- **Locally adapted** species/ genotypes

NRCS	Nurseries / Seed Companies
Excessively drained	Dry
Somewhat excessively drained	Dry Mesic
Moderately well drained	Mesic
Well drained	Mesic
Somewhat poorly drained	Wet Mesic
Poorly drained	Wet Mesic
Very poorly drained	Wet

Photos: Sarah Foltz Jordan; Karin Jokela

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Propagation Considerations: Seeding

- Potting Medium
  - Soil-less media ideal (light, well-drained, some fertility)
  - Example Recipe from Tallgrass Prairie Center:

Soil-less Mix Recipe

This recipe makes about 1 cubic yard of potting medium:

Peat moss (4 cu. ft/bag)	*2 bags (8 cu. ft)*
Vermiculite (medium 4 cu. ft/bag)	*1/2 bag (2 cu. ft)*
Perlite (4 cu. ft/bag)	*1/2 bag (2 cu. ft)*
Sterile soil	*two 5-gal buckets*
Composted (sterile) manure	*40-lb bag*
Osmocote® Plus fertilizer 15-9-12 (180 days)	*8 lb*

Photo: Jon Judson

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Propagation Considerations: Seeding

Lots of Options

- Start in Open Flat (10 x 20) → transplant to individual cells

- Start in 128 → transplant to larger cells (leave in 128)

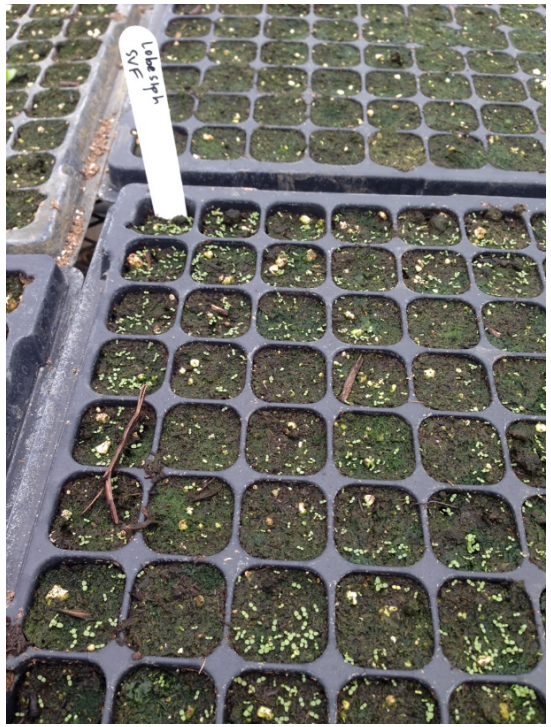

Photo: Karin Jokela

Photos: John Judson

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Propagation Considerations: Seeding

- Sowing Depth
  - Small seeds are often surface sown; see “D” in Prairie Moon Cultural Catalog

- Legumes may benefit from inoculant

Black eyed Susan (*Rudbeckia hirta*)
92,000 seeds/oz

Partridge pea (*Chamaecrista fasciculata*)
2,700 seeds/oz

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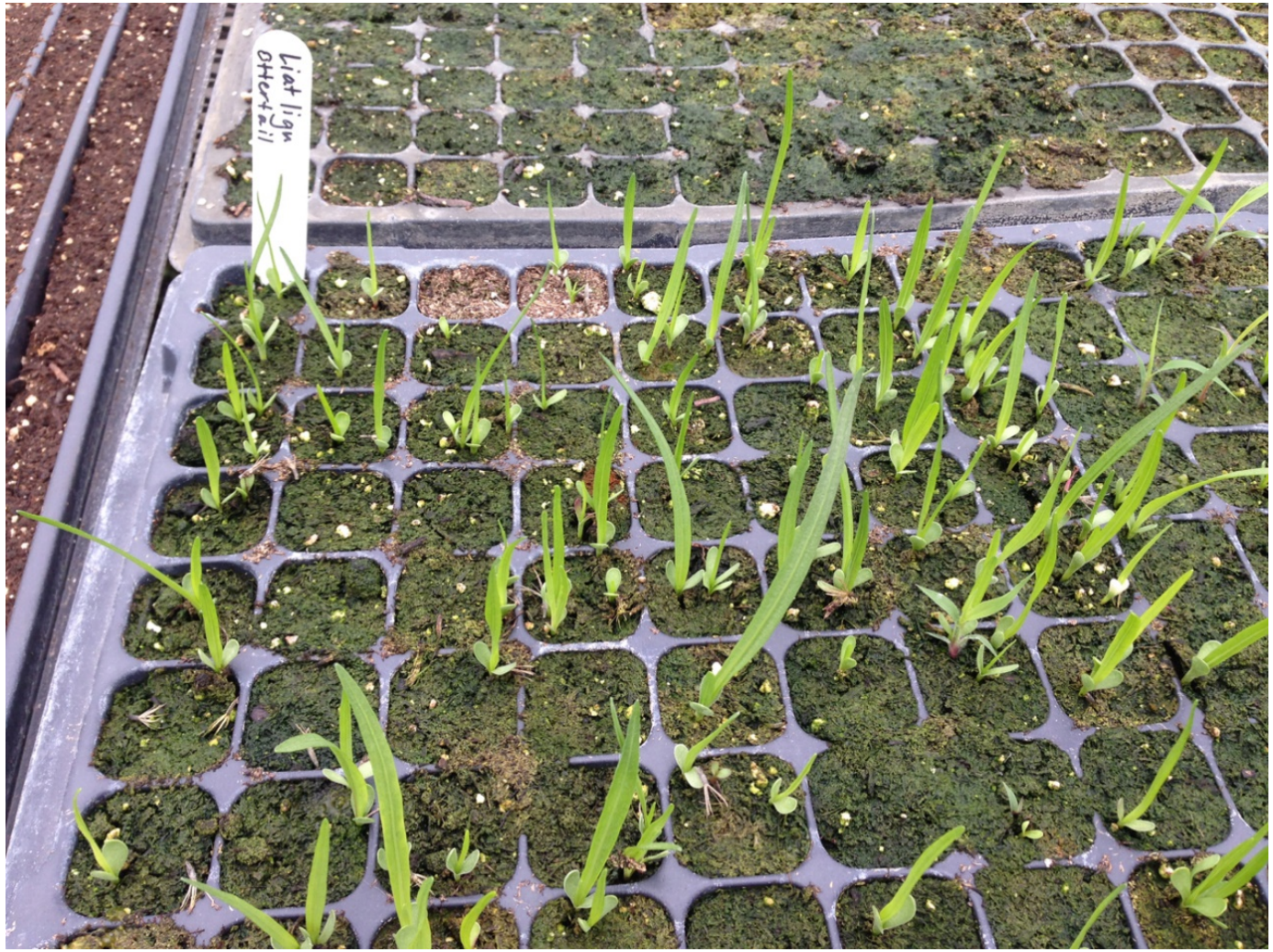
Even if you do everything right, germination is often poor and uneven…. and plant growth is slow. PLAN FOR THIS



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Design Considerations: Site Selection

- Larger is better, but any size is better than none!
- Place plantings where pollination / pest control services are most needed
- Place plantings away from crop fields with pesticide use
- Minimize edges where weeds can encroach

Photo: Jon Judson

Blaauw, B, and Isaacs, R. 2014. Larger patches of diverse floral resources increase insect pollinator density, diversity, and their pollination of native wildflowers. *Basic and Applied Ecology*, 15(8): 701-711.

Perennial Insectary Strips

- Permanent mass wildflower plantings integrated into crop fields
- **Promote movement of pollinators and beneficial insects in the INTERIOR of the farm**

Photo: Jennifer Hopwood

Outplanting your Transplants:

- Different species will be ready to outplant at different times (but can “hold” well in their containers until everything is ready)

- **Spring planting** – allows for growth and possible bloom before winter
- **Fall planting** – more consistent moisture
- Summer planting – ok if irrigation is possible

- Water thoroughly before bringing into the field

- Spacing: plant on 8 to 12 inch centers (or closer/farther depending on species)

- Water-wheel transplanter; by hand; etc.

Outplanting your Transplants: Example: 1.5 days, 17K plants, 30 people!

Photo: Jon Judson

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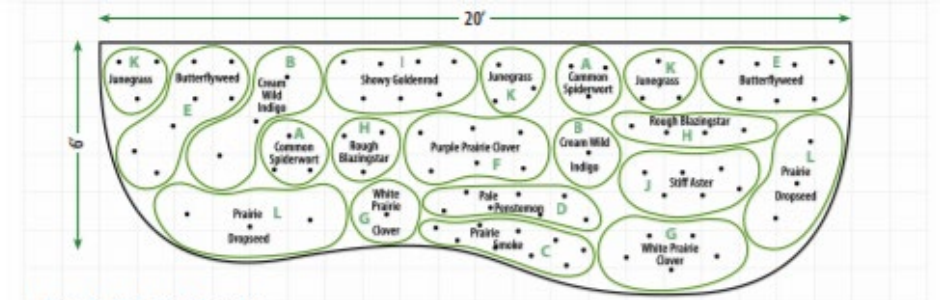
Planting Considerations: Design

- Clustering Species vs. Spreading Evenly

- Integrate plenty of native grasses (50:50 can really help with weedy grass invasion)



Dry Pollinator Garden

	Common Name	Latin Name	No. of Plants	Height	Spacing	Flower Color
	Early Bloomers					
A	Common Spiderwort *	*Tradescantia ohiensis*	6	2'-4'	1'	Blue
B	Cream Wild Indigo	*Baptisia bracteata*	4	1'-3'	1'-3'	Cream
C	Prairie Smoke	*Geum triflorum*	9	6"	6"-1'	Pink
D	Pale Penstemon *	*Penstemon pallidus*	7	1'	6"-1'	White
	Mid Season Bloomers					
E	Butterflyweed	*Asclepias tuberosa*	14	2'-3'	1'-18"	Orange
F	Purple Prairie Clover	*Dalea purpurea*	6	1'-2'	1'	Purple
G	White Prairie Clover	*Dalea candida*	6	1'-2'	1'	White
	Late Season Bloomers					
H	Rough or Meadow Blazingstar	*Liatris aspera* or *Liatris ligulistylis*	7	2'-5'	6"-1'	Purple
I	Showy Goldenrod*	*Solidago speciosa*	7	1'-3'	1'-18"	Yellow
J	Stiff Aster*	*Aster linariifolius*	6	1'-2'	1'	Purple
	Grasses					
K	Junegrass	*Koeleria macrantha*	9	2'-3'	1'-3'	—
L	Prairie Dropseed	*Sporobolus heterolepis*	6	2'-3'	2'-3'	—

* Reseeds readily. Remove spent flowers before the plant goes to seed.

Diagram: Illinois NRCS; Photo: Karin Jokela

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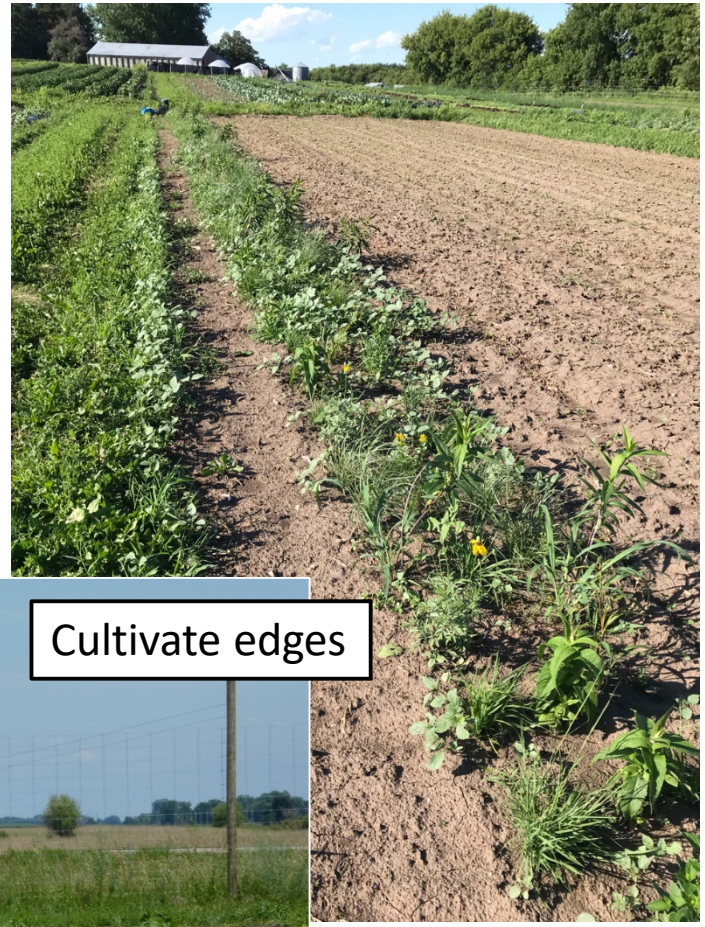
Weed Control at Planting Time

Straw Mulch

Biodegradable Weed Guard

Photos: Xerces Society, Sarah Foltz Jordan

Ongoing Weed Control



Cultivate edges

Mow edges

Controlled Burn

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Crop-Related Concerns:

Photos: Xerces Society / Karin Jokela

Spread of Natives into Crops?

- Mostly not an issue; Tillage keeps most things in check
- Partridge pea (annual legume) can spread

Shading of Adjacent Crops? Flopping?

- Mostly not an issue, but if that's a concern, select shorter stature plants

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Crop-Related Concerns:

Strips may capture snow drift, adding moisture to adjacent fields → slower drying, slower warming in spring

Photos: Xerces Society / Karin Jokela

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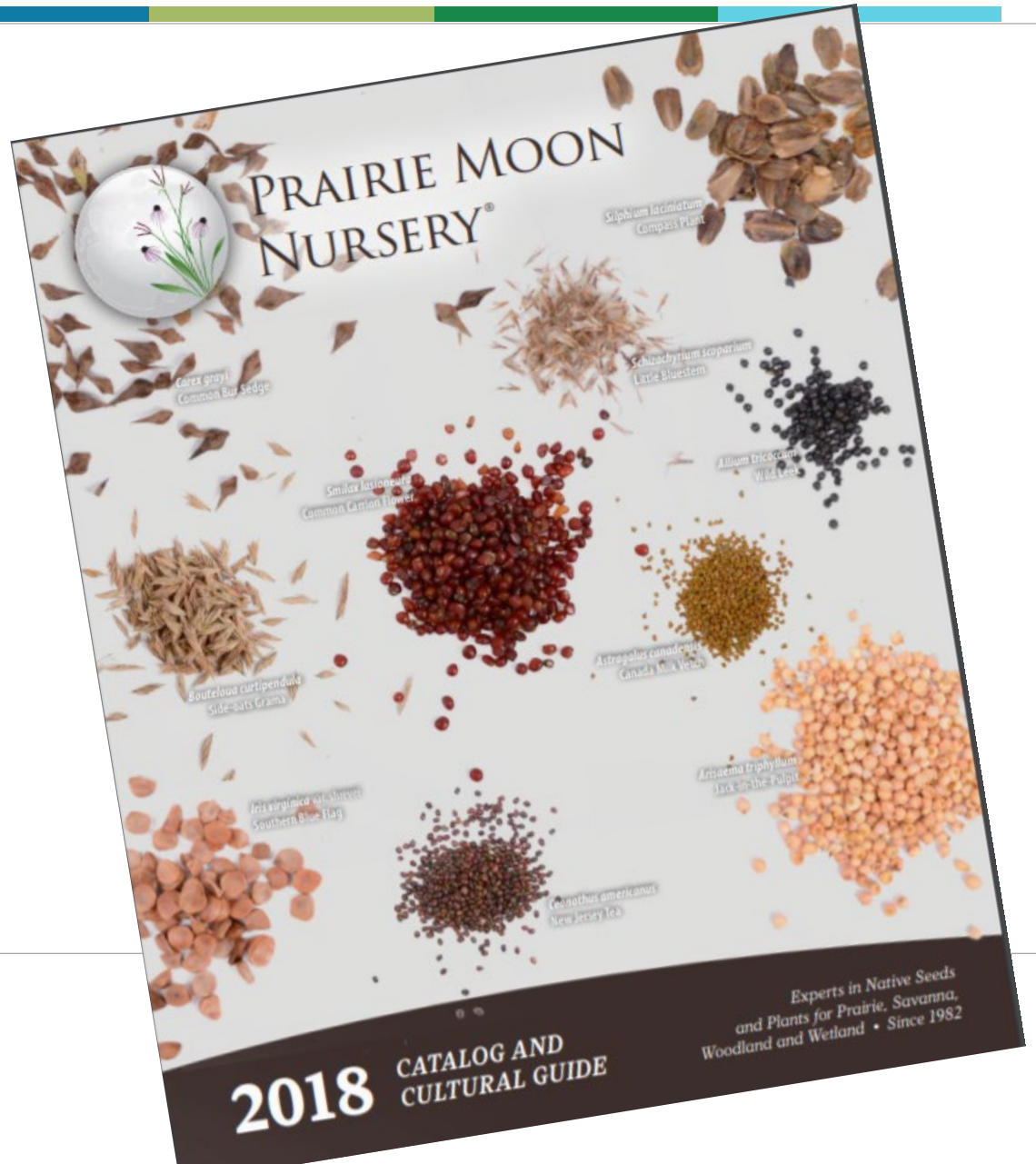
Additional Resources: Tallgrass Prairie Center Technical Guides

https://tallgrassprairiecenter.org/technical-guides

1. Seed collecting from tallgrass prairies
2. Drying, cleaning and storing prairie seed
3. Propagating native plants
4. Recognizing and appreciating tallgrass prairie remnants
5. Native seed source and quality
6. Designing seed mixes
7. Site preparation
8. Seeding
9. Initial post seeding and early reconstruction management
10. Evaluating stand establishment

Additional Resources: Prairie Moon Cultural Catalog



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Additional Resources: Xerces Society: Harvesting & Using Your Own Seed

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Additional Resources: Xerces Site Preparation / Weed Control

METHOD	WHEN TO USE	WHEN NOT TO USE
SOLARIZATION	✓ Flat or gently sloping sites with low risk of erosion ✓ Sunny sites ✓ Small sites, ≤½ ac (see page 10 for solarization options for large sites) ✓ Cultivation equipment is unavailable ✓ Used clear UV-stable plastic is available or new is affordable ✓ Minimal maintenance of the site during summer is desired	✗ Steep slopes or areas with microtopography ✗ Shady or wet sites ✗ Large sites (>½ ac) ✗ Regions where average summer temperatures are low ✗ Clear UV-stable plastic is unavailable or unaffordable ✗ Sites where deer pressure is high, as deer can easily puncture plastic
SMOTHER CROPPING	✓ Flat or gently sloping, sunny, and well-drained sites ✓ Cover crop rotations are already used or easily fit into existing operations ✓ Weed pressure is low to moderate ✓ Timelines can be strictly followed throughout entire site prep process ✓ Proper equipment is available and can be calibrated and operated specifically for cover-cropping ✓ Irrigation is available and can be used as needed ✓ Minimal maintenance of the site during summer is desired	✗ Steep slopes/sites with high erosion potential or poor drainage ✗ Cover crop rotations are not used or do not fit into farm plan ✗ Weed pressure is high (i.e., fallow fields) ✗ Timelines cannot be strictly followed (see text) ✗ Proper equipment for planting and termination are not available ✗ Irrigation is not available or easily accessed ✗ In designated wetlands or area with poorly drained soil ✗ Where planting non-native plants is prohibited or native plants may be threatened by the unintentional escape of non-native/cultivated species
REPEATED SHALLOW CULTIVATION	✓ Flat or gently sloping, sunny or shady sites ✓ Transitioning crop fields or sites with low weed pressure ✓ Proper equipment is available and can be used for this purpose ✓ Irrigation is available ✓ Timelines can be strictly followed throughout entire site preparation process	✗ Steep slopes ✗ Where erosion is of concern ✗ Site is fallowed or weed pressure is medium to high ✗ Shallow tillage equipment is unavailable (see Appendix B) ✗ Irrigation is unavailable ✗ Designated wetlands or areas with poorly drained or fragile soil
SHEET MULCHING	✓ Flat or gently sloping, sunny or shady, and humid sites ✓ Small sites, up to ~½ ac ✓ Cultivation is impractical (e.g., rocky conditions, weed pressure, etc.) ✓ Minimal maintenance of the site is desired ✓ Mulching materials are available or affordable ✓ Solarization is impractical (e.g., plastic unavailable/unaffordable, shady)	✗ Steep slopes or arid sites without irrigation ✗ Large sites (>½ ac) ✗ Arid or semi-arid climates without access to irrigation ✗ Site contains aggressive or persistent deep-rooted, perennial, rhizomatous or woody weeds ✗ Mulching materials are unavailable or unaffordable (see text)
SOIL INVERSION	✓ Flat/gently sloping sites; sites where soil erosion is not a concern ✓ Large sites, >½ ac ✓ Sites with medium to high weed pressure or dense grass sod ✓ Effective on sunny or shady sites ✓ Moldboard plow is available or affordable and an experienced operator is available	✗ Steep slopes ✗ Erosion concerns are very high ✗ Moldboard plow is unavailable or unaffordable ✗ Abundant deep-rooted perennial weeds (less susceptible to method) ✗ Weed pressure is low and other methods can be used
ORGANIC HERBICIDE APPLICATIONS	✓ Flat to sloping, sunny or shady sites ✓ Cultivation is impractical (e.g., rocky conditions or conservation concerns) ✓ Targeted weeds are annual broadleaf species (see text) ✓ Targeted weeds are at seedling stage	✗ Application equipment is unavailable or unaffordable ✗ Targeted weeds are monocots (grasses), succulents, or perennials ✗ Targeted weeds are taller than 6" ✗ Water pollution concerns are high
SOD REMOVAL	✓ Sites composed of dense sod, regularly mowed for several years ✓ Small sites (<⅛ ac) where sod removal is feasible	✗ Large sites where sod removal would be impractical

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

Photos Sarah Foltz Jordan

Special thanks to PFI, our farm partners, Xerces members, and supporters

xerces.org

OUR FARMERS:

Agua Gorda Cooperative
Blue Gate Farm
Casey Bailey Farm
Del's Orchard
Grinnell Heritage Farm
Genuine Faux Farm
Mustard Seed Community Farm
Helgelson Farm
Heidel Family Dairy Farm
Longdale Farm
Little Hill Berry Farm
Melon Patch Herbs
Nelson Family Farm
Open Hands Farm
Prairie Drifter Farm
Paul Mugge Farm
Rabinowitz Farms
Stone Creek Farm
Sogn Valley Farm
Spring Winds Farm
Taproot Farm
Uproot Farm
Vilicus Farms
Waxwing Farm
York Farm
AND MANY MORE…..

XERCES SUPPORT FROM:

Xerces Society Members
Annie's
Bently Foundation
Cascadian Farm
Ceres Trust
Cheerios
Cinco
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Disney Conservation Fund
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