Interseeding:

Bringing back flower diversity to your grasslands

Rae Powers, Farm Bill Pollinator Conservation Planner, Nebraska

Mace Vaughan, Pollinator Program Co-Director and NRCS Partner Biologist, WNTSC

Webinar July 19, 2018

Photo: Sarah Foltz Jordan

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Introduction to Xerces Society

Conservation planning, education, research, restoration, and advocacy to protect invertebrates and habitat

Staff in Nebraska, Iowa, Minnesota, Wisconsin, Oklahoma, North Carolina, New Jersey, North Dakota, Connecticut, California, Oregon, Washington, Maine

- Ten joint Xerces / USDA-NRCS positions
- Diverse staff background and expertise

Photos: Ann Avervill/University of Massachusetts; Xerces Society; Sarah Greenleaf

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Webinar Outline

Today's webinar…

- Importance and decline of pollinators
- Importance of maintaining diverse wildflower stands
- **Interseeding process**
- Where to go for more information

Photo: Nancy Adamson

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Pollinators and flowering plants

More than 85% of flowering plants require an animal, mostly insects, to move pollen.

Ollerton et al. 2011

Photo: Rollin Coville

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Pollinators and human nutrition

Pollinators are valuable to our economy and our nutrition.

- 35% of crop production, worldwide
- Over $18 to $27 billion value of crops in U.S. ($235-$577 billion worldwide)
- Many of our vitamins and minerals are from insect-pollinated plants

Photo: Deanna Dykstra, flickr

Morse and Calderone 2000; Klein et al. 2007; Eilers et al. 2011; IPBES, 2016

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Importance of Pollinators: Valuable for Wildlife

Fruits and seeds are a major part of the diet of many birds and mammals

Pollinators and other insects are food for wildlife, including 89% of birds!!

Pollinator habitat supports the needs of other wildlife

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PhotosWildreturn, Flickr; Ron Nichols, NRCS; : Xerces Society / Matthew Shepherd; Karen Ward, NPS.

Meet the pollinators

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Photos: Bryan E. Reynolds (2); Sarah Foltz Jordan; David Inouye; Bruce Newhouse; Mace Vaughan

Bees: The most efficient pollinators

- Bees actively collect and transport pollen
- Bees exhibit flower constancy
- Forage in area around nest

Photo: Rollin Coville

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Status of Pollinators

Evidence of managed and wild pollinators in decline

Parallel Declines in Pollinators and Insect-Pollinated Plants in Britain and the Netherlands

J. C. Biesmeijer,[1*] S. P. M. Roberts,[2] M. Reemer,[3] R. Ohlemüller,[4] M. Edwards,[5] T. Peeters,[6] A. P. Schaffers,[7] S. G. Potts,[2] R. Kleukers,[1] C. D. Thomas,[4] J. Settele,[8] W. E. Kunin[1]

Despite widespread concern about declines in pollination services, little is known about the patterns of change in most pollinator assemblages. By studying bee and hoverfly assemblages Britain and the Netherlands, we found evidence of declines (pre- versus post-1980) in local be diversity in both countries; however, divergent trends were observed in hoverflies. Depending the assemblage and location, pollinator declines were most frequent in habitat and flower specialists, in univoltine species, and/or in nonmigrants. In conjunction with this evidence, outcrossing plant species that are reliant on the declining pollinators have themselves declined relative to other plant species. Taken together, these findings strongly suggest a causal connect between local extinctions of functionally linked plant and pollinator species.

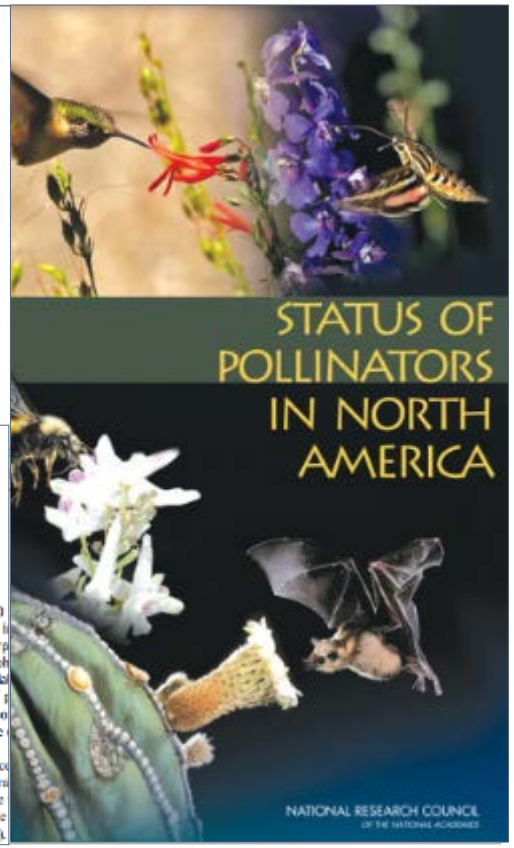
SPECIAL COLLECTION: LONG-TERM TRENDS IN EASTERN NORTH AMERICAN MONARCH BUTTERFLIES

Long-Term Trends in Eastern North American Monarch Butterflies: A Collection of Studies Focusing on Spring, Summer, and Fall Dynamics

ANDREW K. DAVIS[1,2] AND LEE A. DYER[3]

Ann. Entomol. Soc. Am. 108(5): 661–663 (2015); DOI: 10.1093/aesa/sav070

KEY WORDS Monarch, Eastern North America, Conservation



PNAS

Patterns of widespread decline in North American bumble bees

Sydney A. Cameron[a,1], Jeffrey D. Lozier[a], James P. Strange[b], Jonathan B. Koch[b,c], Nils Cordes[a,2], Leellen F. Solter[d], and Terry L. Griswold[b]

[a]Department of Entomology and Institute for Genomic Biology, University of Illinois, Urbana, IL 61801; [b]United States Department of Agriculture-Agricultural Research Service Pollinating Insects Research Unit, Utah State University, Logan, UT 84322; [c]Department of Biology, Utah State University, Logan, UT 84321; and [d]Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois, Champaign, IL 61820

Edited* by Gene E. Robinson, University of Illinois, Urbana, IL, and approved November 24, 2010 (received for review October 3, 2010)

Bumble bees (*Bombus*) are vitally important pollinators of wild plants and agricultural crops worldwide. Fragmentary observations, however, have suggested population declines in several North American species. Despite rising concern over these observations in the United States, highlighted in a recent National Academy of Sciences report, a national assessment of the geographic scope and possible causal factors of bumble bee decline is lacking. Here, we report results of a 3-y interdisciplinary study of changing distributions, population genetic structure, and levels of pathogen infection

study in the United States identified lower genetic diversity and elevated genetic differentiation (F_{ST}) among Illinois populations of the putatively declining *B. pensylvanicus* relative to those of a codistributed stable species (19). Similar patterns have been observed in comparative studies of some European species (8), but most investigations have been geographically restricted and based on limited sampling within and among populations.

Although the investigations to date have provided important information on the increasing rarity of some bumble bee species in

Plant-Pollinator Interactions over 120 Years: Loss of Species, Co-Occurrence, and Function

Laura A. Burkle,[1,2*] John C. Marlin,[3] Tiffany M. Knight[1]

Using historic data sets, we quantified the degree to which global change over 120 disrupted plant-pollinator interactions in a temperate forest understory community i USA. We found degradation of interaction network structure and function and extir 50% of bee species. Network changes can be attributed to shifts in forb and bee ph resulting in temporal mismatches, nonrandom species extinctions, and loss of spatia co-occurrences between extant species in modified landscapes. Quantity and quality of p services have declined through time. The historic network showed flexibility in respo disturbance; however, our data suggest that networks will be less resilient to future

Almost 90% of flowering plant species, including many important crop species (1), rely on animal pollinators (2). Plant-pollinator interaction networks may be particularly susceptible to anthropogenic changes, owing

physiology, and relative abundanc species (3). Alternatively, the overa plant-pollinator networks might be turbations because of a high degree and redundancy in interactions (4).

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Status of Pollinators

Large scale loss of pollinator diversity

- >40% of global invertebrate pollinator species facing extinction, particularly bees and butterflies

Photo: Xerces Society / Kelly Gill

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
http://www.ipbes.net/article/press-release-pollinators-vital-our-food-supply-under-threat

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Bumble Bees in Decline

Photo: *Bombus fraternus,* by Jennifer Hopwood

Bumble bees

- Critical pollinators of crops and wildflowers
- Important example of relatively well studied group of native bees

Cameron et al. 2011; Hatfield et al. 2014 Xerces Society-IUCN status review; Cameron et al. 2016

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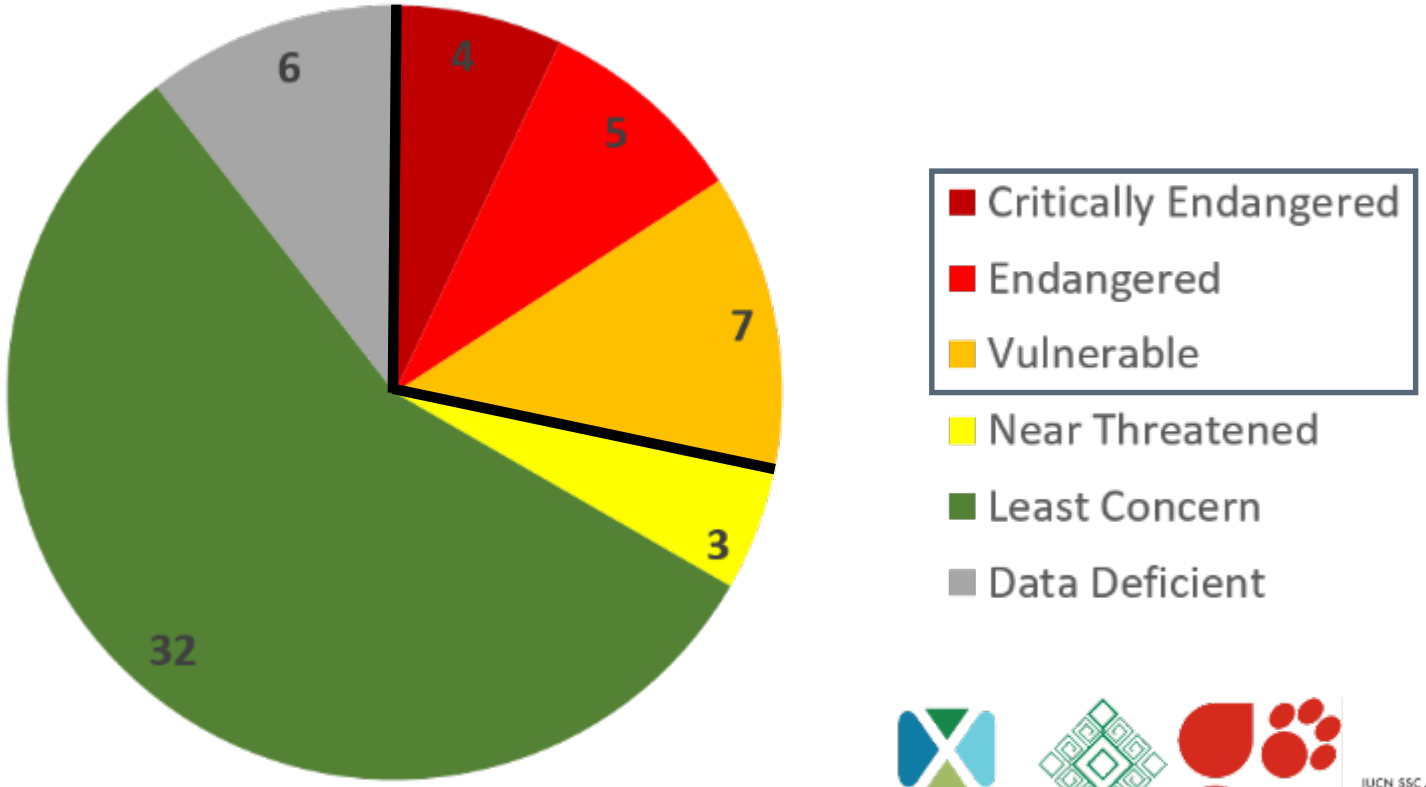
Bumble Bees in Decline

Used a database of 250,000+ specimen records to evaluate changes between recent and historic populations

28% of bumble bees in Canada, the United States, and Mexico are in an IUCN Threatened Category



Source: Hatfield et al. 2015

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Butterflies in decline

More than 17% of North American butterfly species at risk

This includes both habitat specialists and formerly common and widespread species

Photo: Mace Vaughan, Xerces Society

Source: NatureServe

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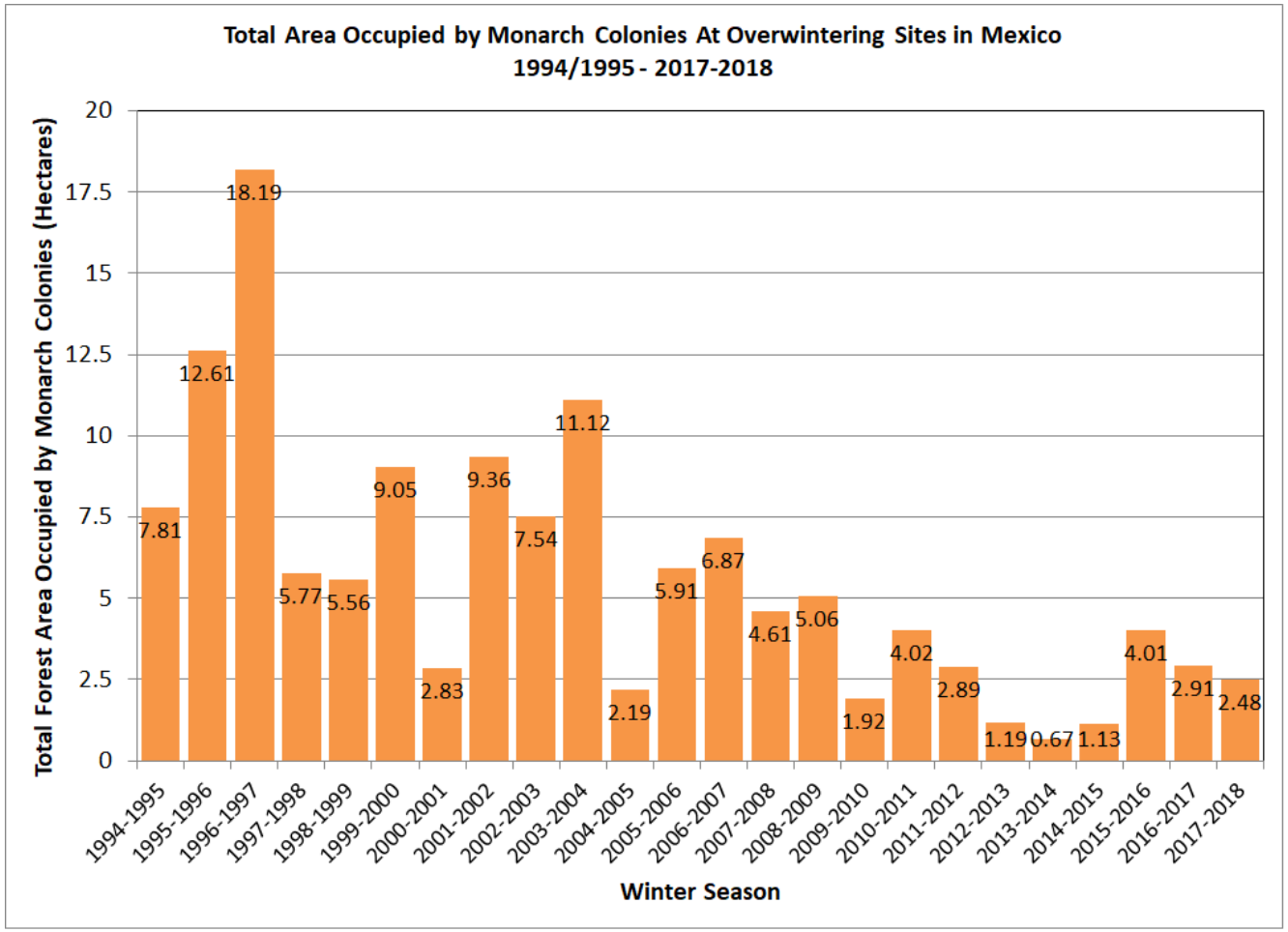
Butterflies in Decline: Monarchs



Data from 1994-2003 were collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Protected Natural Areas (CONANP) in Mexico. Data from 2004-2018 were collected by the WWF-Telcel Alliance, in coordination with the Directorate of the MBBR. 2000-01 population number as reported by Garcia-Serrano et. al (The Monarch Butterfly : Biology and Conservation, 2004)

- Monitored in hectares of forest occupied
- 84% decline from population high in 1996

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Honey Bee Hive Loss

The European honey Bee: our most familiar commercial crop pollinator

- Before 1995:
  - Less than 15% per year
- 1995-2006 (Before CCD):
  - 15% - 22% per year
- 2006-today (After CCD):
  - 22% - 45% per year

National Research Council. 2007; Bee Informed Partnership 2018

Photo: USDA-ARS / Scott Bauer

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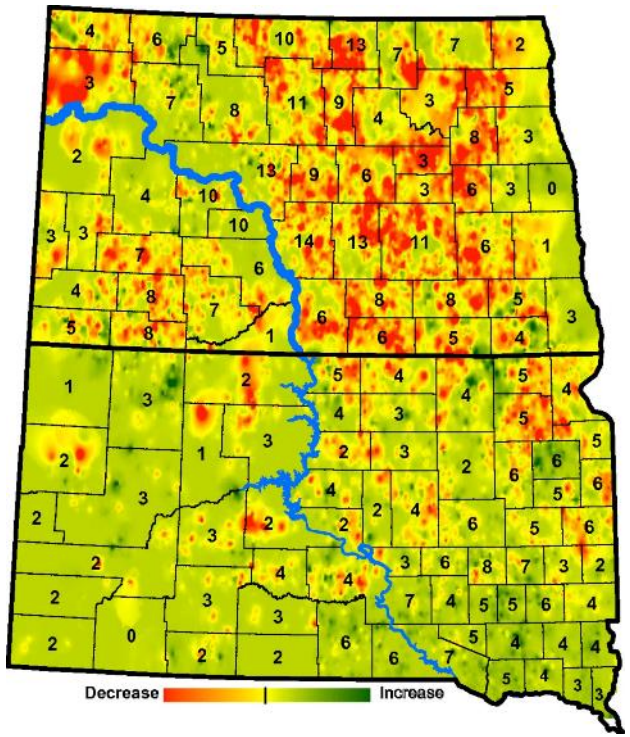
Honey Bees

Forb-rich CRP Important for Beekeepers

- The Great Plains are a critical honey bee resting ground and honey-producing area for beekeepers
- Significant loss of CRP acres means that remaining CRP needs to be even more nectar- and pollen-rich.



Map: Otto et al, 2018
(http://www.pnas.org/content/115/29/7629)

Photo: Jennifer Hopwood / Xerces Society;

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What we can do to help

Photo: Jennifer Hopwood

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Conservation Across Landscapes

We must actively work to protect, manage, enhance, and restore resilient habitats where plants and pollinators can survive and thrive.

Photos: Rod Gilbert; Eric Lee-Mäder

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Protect and manage existing habitat

Protect and manage areas of high-quality or potential habitat

- Land enrolled in CRP or other conservation programs
- Native range
- Prairie pockets
- Old fields
- Pivot corners and field margins

Photo: Jennifer Hopwood

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Protect and manage existing habitat

Often there are opportunities to better manage existing habitat for the benefit of pollinators.

Photos: Heritage Seedlings, Inc.; NYSDOT; Xerces Society / Anne Stine; Yamhill County Council

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Photos; USDA-ARS; Audubon California

Habitat management with pollinators in mind

Management as the first consideration in increasing wildflower abundance and pollinator quality

- In some circumstances, management alone can restore or increase wildflower diversity and should be the first course of action
- Time management for when most effective against target grasses or weeds, or during dormant season for wildflowers
- Allow for sufficient recovery times
- When managing high quality habitat, ideally disturb no more than 1/3 of area each year to allow for pollinator refuge

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If management isn't going to do the job…

- No viable wildflower seed bank
- Previously cropped or CRP ground now dominated by grasses

…Now we start to think about interseeding.

Photo: Rae Powers

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Interseeding

Photo: Xerces Society / Sarah Foltz-Jordan

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What is interseeding?

- Adding diversity to existing vegetation
- Overseeding
- Litter removal before interseeding
- Process of vegetation suppression before and after interseeding
- Careful selection of wildflower species

Photo: Xerces Society / Jennifer Hopwood

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Kremen et al. 2004; Winfree et al.. 2008; Morandin and Winston 2006; Garibaldi et al 2011; Blauuw and Isaacs 2014

When to start over

- High noxious weed pressure
- Aggressive non-native cool season grasses are very dominant (reed canary grass, smooth brome, crested wheatgrass, tall fescue)

Photo: Dave Williams

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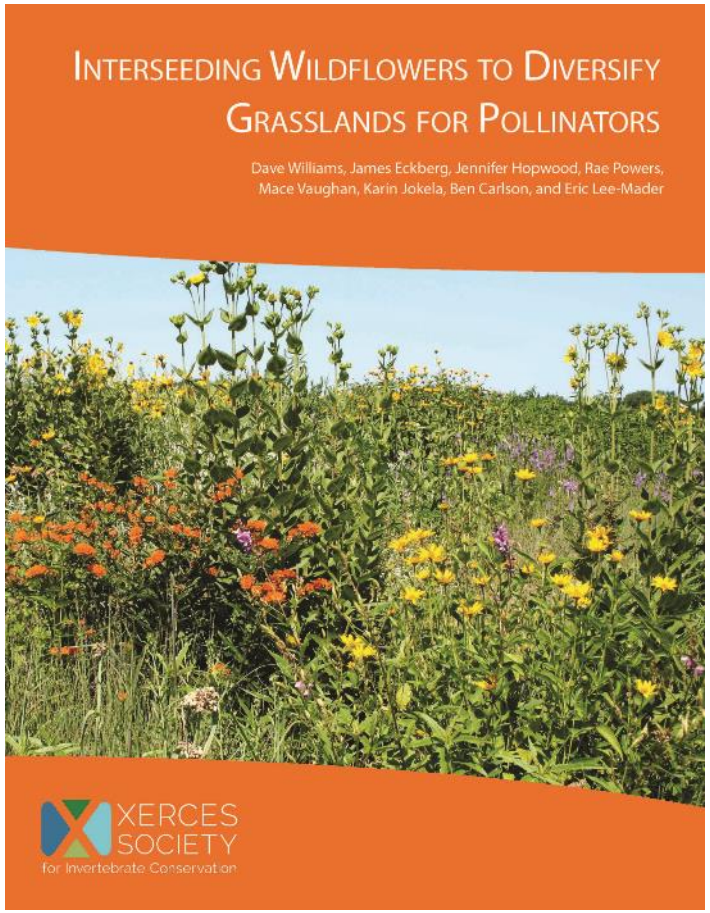
Bringing Back Flower Diversity to Grasslands

FSA-funded guidelines and brochure in development



- Review of published restoration research primarily from Great Plains and Midwest states
- Survey responses from and follow up conversations with land managers, researchers, and landowners
  - Experience with interseeding
  - Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, and North Dakota

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Bringing Back Flower Diversity to Grasslands

Key Considerations

Interseeding Process

Strategies from the field

Ongoing management

- NRCS Opportunities
- Additional Resources

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Key Considerations

What is already there?

- Grass Phenology
- Soil type, Drainage Class, and Landscape Position
- Species Selection
- Invasive Weeds
- Litter Management
- Precipitation

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Cool Season Grasses

- Active growth in spring and fall
- Introduced species are of primary concern
- Pasture or turf grasses
- Sod forming
- May require more grass suppression

- Smooth brome (*Bromus inermis)*
- Kentucky bluegrass (*Poa pratensis*)

- Reed Canary Grass (*Phalaris arundinacea)*
- Tall Fescue (*Schedonorus arundinaceus*)

Photo: Dave Williams, Karin Jokela

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Warm Season Grasses

- Active growth entire growing season
- Native species and non-native
- Remnant or planted
- Typically bunchgrasses
- May require some grass suppression

- Big Bluestem (*Andropogon gerardii)*
- Indian Grass (*Sorghastrum nutans)*

- Switchgrass (*Panicum virgatum*)
- Little Bluestem (Schizachyrium scoparium)

Photo: Dave Williams, Karin Jokela

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Mixed Season Grass Stands

- Active growth throughout growing season
- Native species and introduced species
- Remnant or planted
- Bunchgrasses and sod formers
- May require some grass suppression, but less than stands dominated by introduced cool season

Photo: Chris Helzer, Rae Powers

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Photo: Chris Helzer / The Nature Conservancy; Sarah Foltz-Jordan / Xerces Society

Invasive weeds

- Invasive broadleaf weeds need control before interseeding
- Grass suppressing techniques can stimulate invasive weeds
- May outcompete interseeded wildflowers
- When invasive weed pressure is high, complete restoration may be more efficient and cost effective

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Litter Management

Photo: Karin Jokela

- Seed–soil contact!
- Sunlight to seedlings
- Burning, Haying, Grazing
- More important with broadcast seeding

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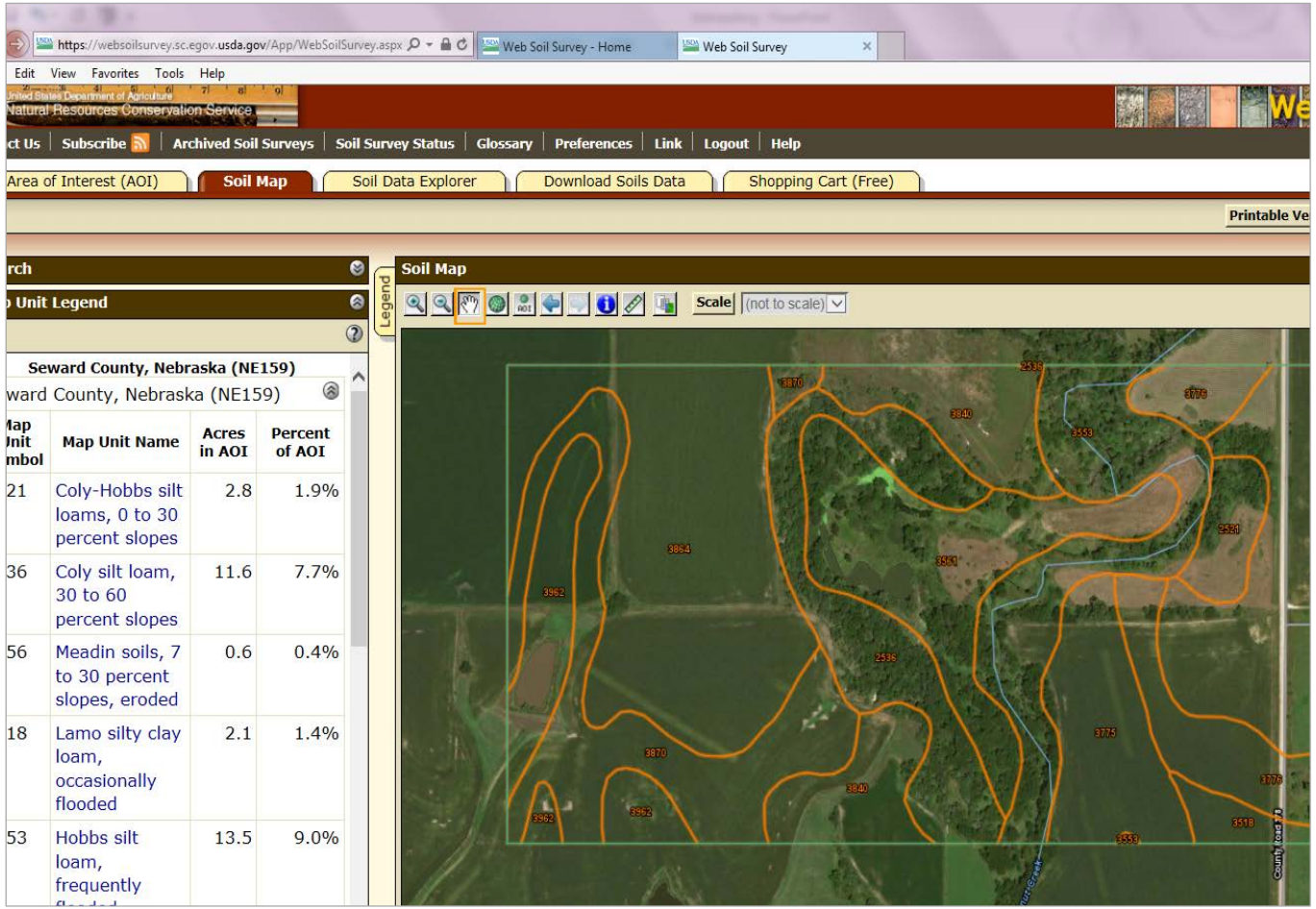
Soil type, Drainage Class and Landscape Position

- May have more success in sandy, gravelly, low fertility soils
- Saturated, nutrient rich soils can be difficult to interseed



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Species Selection

- Plant native species that thrive in similar environments
- Choose wildflowers that bloom in different seasons
- Consider interseeding grasses or sedges if missing from plant community
- USDA Plants, Biota of North America (BONAP), nearby diverse restored or remnants

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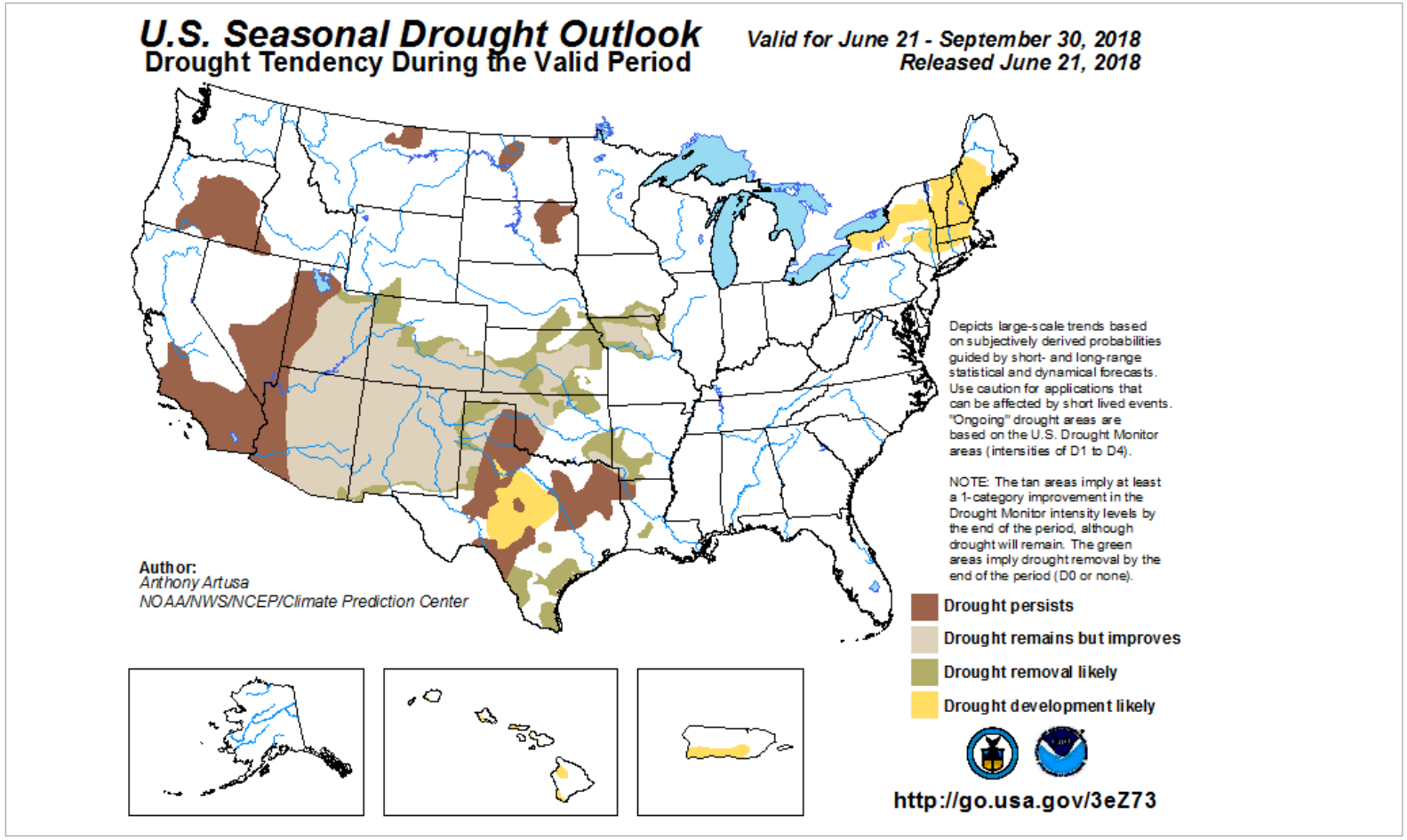
Precipitation



- Average or above average precipitation increases success
- Longer establishment time in drought conditions

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Bringing Back Flower Diversity to your Grasslands

- ✓ Key Considerations
- Interseeding Process
- Strategies from the field
- Ongoing management

- NRCS Opportunities
- Additional Resources

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The Interseeding Process

- Prior to Interseeding: Suppressing highly competitive vegetation and litter management
- Interseeding: Seeding methods, seeding rates, and timing
- Seedling establishment management

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Before Interseeding

Grass Suppression and Litter Management

Disturbance	Grass Suppression and Weed Control	Litter Management
Herbicide	✓	
Grazing	✓	✓
Burning	✓	✓
Haying	✓	✓
Mowing	✓	

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Before Interseeding-Herbicides

- Non-selective
- Grass selective
- Cool season grasses – 2+ applications
- Warm season grasses – 1 application
- Invasive weed species control
- Litter management needed

Photo: David O'Shields

<u>Non-selective</u>

- Glyphosate
  - Round-up

<u>Somewhat selective</u>

- Imazapic
  - Plateau

<u>Grass selective</u>

- Clethodim
  - Select, Envoy
- Sethoxydim*
  - Poast
- Fluazifop-P-butyl
  - Fusilade

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Before Interseeding: Grazing

- Time to target dominant grass
- Moderate-intense grazing removes litter

Photo: Chris Helzer

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Before Interseeding: Burning, Haying, Mowing

- Time to suppress dominant grass
- Often used in tandem with herbicide, grazing or both
- One time disturbance

- Can create bare soil for seeding
- Remove litter if mowing

Photo: Jeff Vanuga, Dave Williams, David O'Shields, Chris Helzer

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Interseeding

Broadcast

- Hand broadcast, fertilizer spreader, drop seeder
- Bare soil essential!
- Cultipacking recommended
- Mid-contract management seed rate requirements

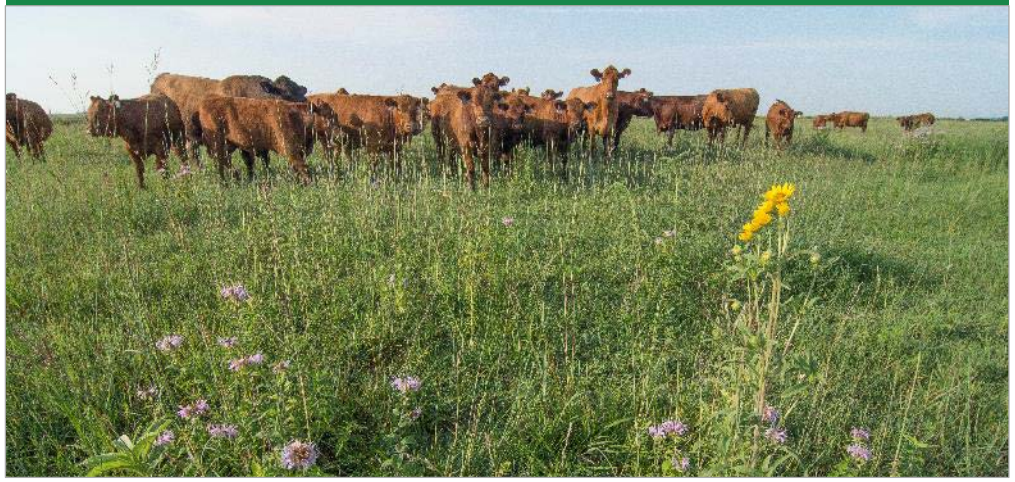
Drill

- Native seed drill essential
- Can plant into light stubble layer
- Plant ¼” or shallower, target depth to seed size
- Check calibration frequently

Photo: Sarah Foltz Jordan, Dave Williams

After Interseeding: Establishment management

- First and second growing season after planting
- New seedlings need light, moisture, and space above and below ground
- May need to continue grass suppression
- Don’t damage new seedlings



- Herbicide (grass selective only)
- Grazing
- Invasive weed control
- Haying/mowing

Photo: Chris Helzer, Dave Williams, David O’Shields

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Bringing Back Flower Diversity to your Grasslands

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Cool Season Grass Scenarios

Late-Summer Mow → Fall Spray → Dormant Interseed → Consider Spring Spray

Fall Burn → Dormant Interseed → Spring Spray

Fall Graze → Fall Spray → Spring Interseed → Late-Spring Graze → Early-Fall Graze

Multiple Late-Spring Mowing or Burning → Late-Spring Interseed → Multiple Late-Spring Disturbances

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Warm Season Grass Scenarios

Fall Burn → Fall Interseed → Summer High Mow or Hay

Summer Burn → Dormant Interseed → Summer Graze

Late-Summer Mow or Hay → Dormant Interseed → Late-Spring Spray → Summer Mow

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Mixed Season Grass Scenarios

Graze all seasons → Dormant Interseed → Graze or Hay Multiple Seasons

Spring Burn → Spring Interseed → Graze or Hay Multiple Seasons

Fall Burn → Dormant Interseed → Mow or Hay Multiple Times or Graze

Late Summer/Fall Burn → Fall Spray → Dormant Interseed → Spray Grass Selective Multiple Seasons or Hay Once per Year, Multiple Years and Varied Seasons

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Bringing Back Flower Diversity to your Grasslands

- ✓ Key Considerations
- ✓ Interseeding Process
- ✓ Strategies from the field
- Ongoing management

- NRCS Opportunities
- Additional Resources

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Photo: Dave Williams

Ongoing Management

- Disturbance is key!
- Leave undisturbed refuges (disturb only 1/3-1/5 of site each year)
- Adaptive management
- Vary management type, timing and location

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FSA and NRCS Opportunities for Interseeding

Programs

- CRP – Conservation Reserve Program
  - Mid-contract management
  - Re-enrollments
- EQIP – Environmental Quality Incentives Program
- CSP – Conservation Stewardship Program

Practices

- Range Planting
- Conservation Cover
- Upland Wildlife Habitat Management
- Herbaceous Weed Control
- Prescribed Grazing
- Prescribed Fire
- Forage Harvest Management

Photo: Dave Williams, Chris Helzer

Conservation Technical Assistance (CTA)

Farmers, ranchers, and other landowners can visit an NRCS field office to get technical support, including the development of a farm- or ranch-specific pollinator conservation plan.

Photo: Eric Mader

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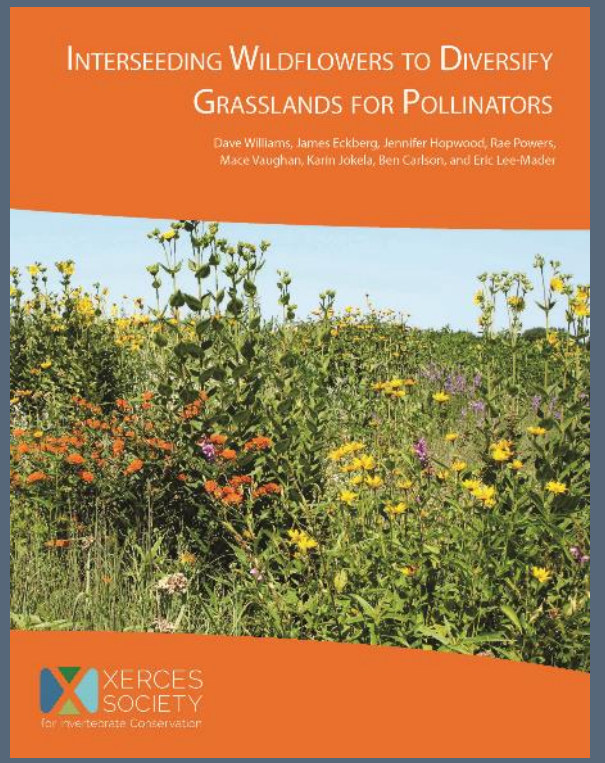
Additional Resources

- Interseeding guidelines and brochure are in final stages of development
- Placeholder on the Xerces Society website
  - https://xerces.org/interseeding-grasslands-for-pollinators/



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Additional Resources

- The Xerces Society website (www.Xerces.org)
  - Pollinator Conservation Resource Center
  - Guides to establish and maintain pollinator habitat
  - Plant lists
  - Regional seed and plant vendors
- NRCS local service centers
  - nrcs.usda.gov
  - Field Office Technical Guide
  - Regional information on interseeding

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Acknowledgments

Thanks and Questions

- Funding from FSA (grant award number CCC-DAFP-6-059)
- Sarah Cline and Rich Iovanna (FSA) for helping to organize this webinar
- Thanks also to the dozens of practitioners who agreed to be interviewed and consulted as we developed these guidelines.

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