Conservation Buffers to Support Beneficial Insects on Organic Farms

Presented by Mace Vaughan
Pollinator Program Co-Director, The Xerces Society for Invertebrate Conservation
Joint Pollinator Conservation Specialist, USDA NRCS West Nat'l Tech Support Center

Photo: Jessa Cruz, Xerces Society

What is the Xerces Society?

Since 1971, the Society has worked to protect wildlife through the conservation of invertebrates and their habitat.

Xerces blue butterfly (*Glaucopsyche xerces*), the first U.S. butterfly to go extinct due to human activities.

Photos: California NRCS and Ed Ross

Today's webinar, in six parts…

Overview

- New biodiversity guidance from the USDA organic program
- Beneficial insects and their habitat needs
- Buffers for beneficial insects
- Habitat installation
- USDA conservation programs and buffer practices
- Resources

Photo: Mace Vaughan (Xerces Society)

Organic Defined by the USDA:

"A production system that is managed…by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity" *(7 CFR 205.2)*

Organic Food Production Act, 1990

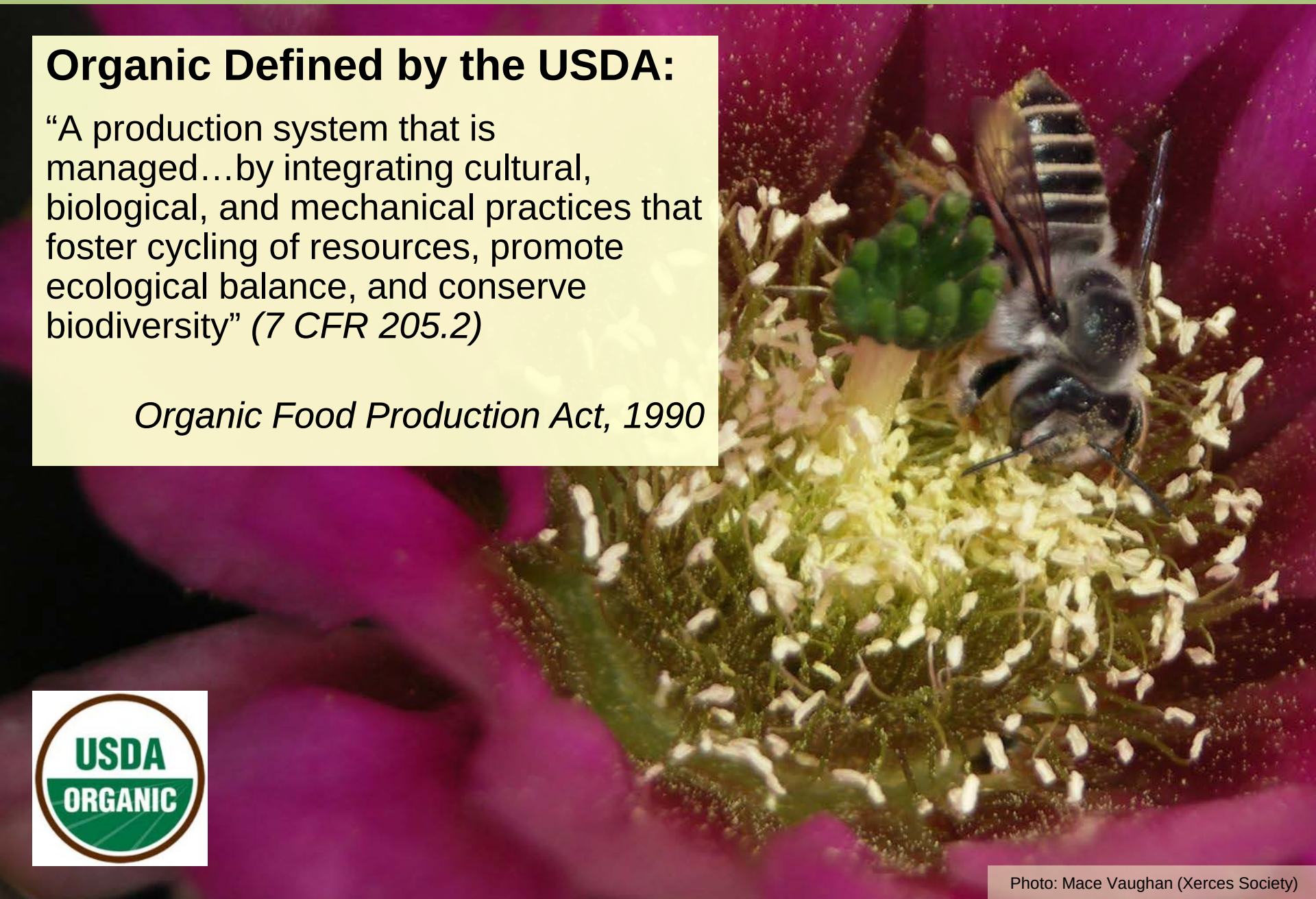
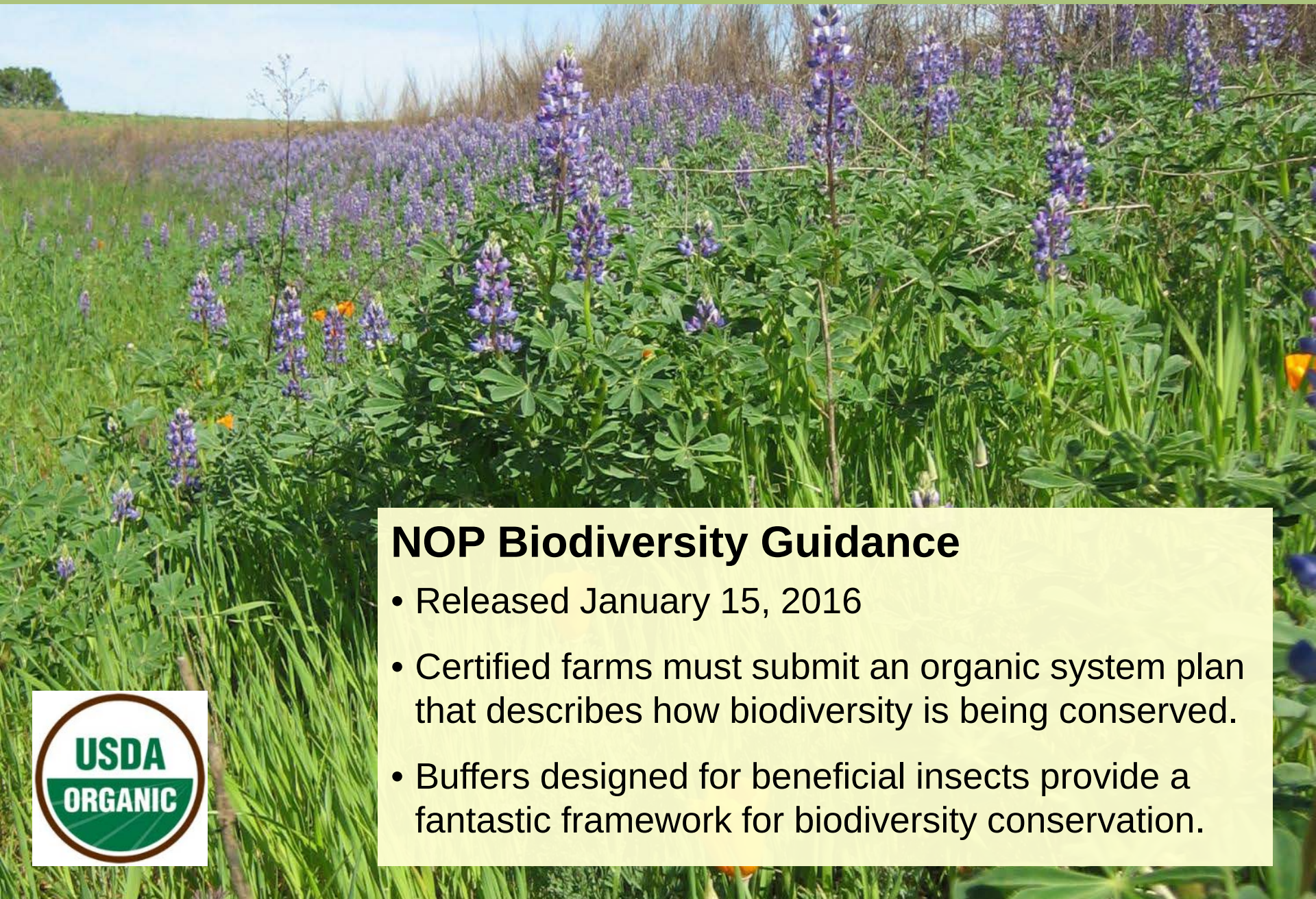


Photo: Mace Vaughan (Xerces Society)



NOP Biodiversity Guidance

- Released January 15, 2016
- Certified farms must submit an organic system plan that describes how biodiversity is being conserved.
- Buffers designed for beneficial insects provide a fantastic framework for biodiversity conservation.

USDA ORGANIC

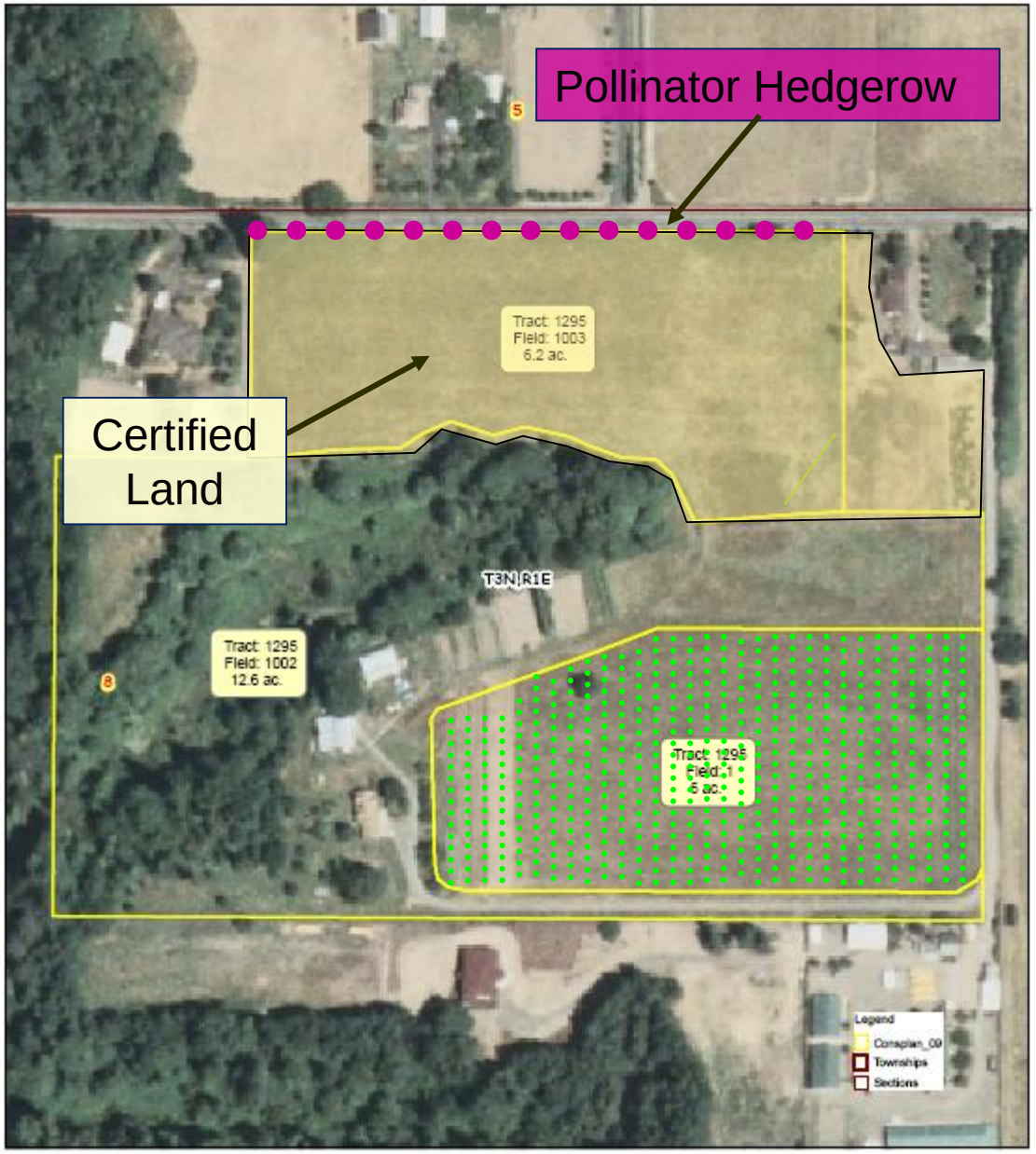
NOP Biodiversity Guidance

- Operation can use a conservation plan or Farm Bill conservation program contract as part of documentation

NOP Biodiversity Guidance

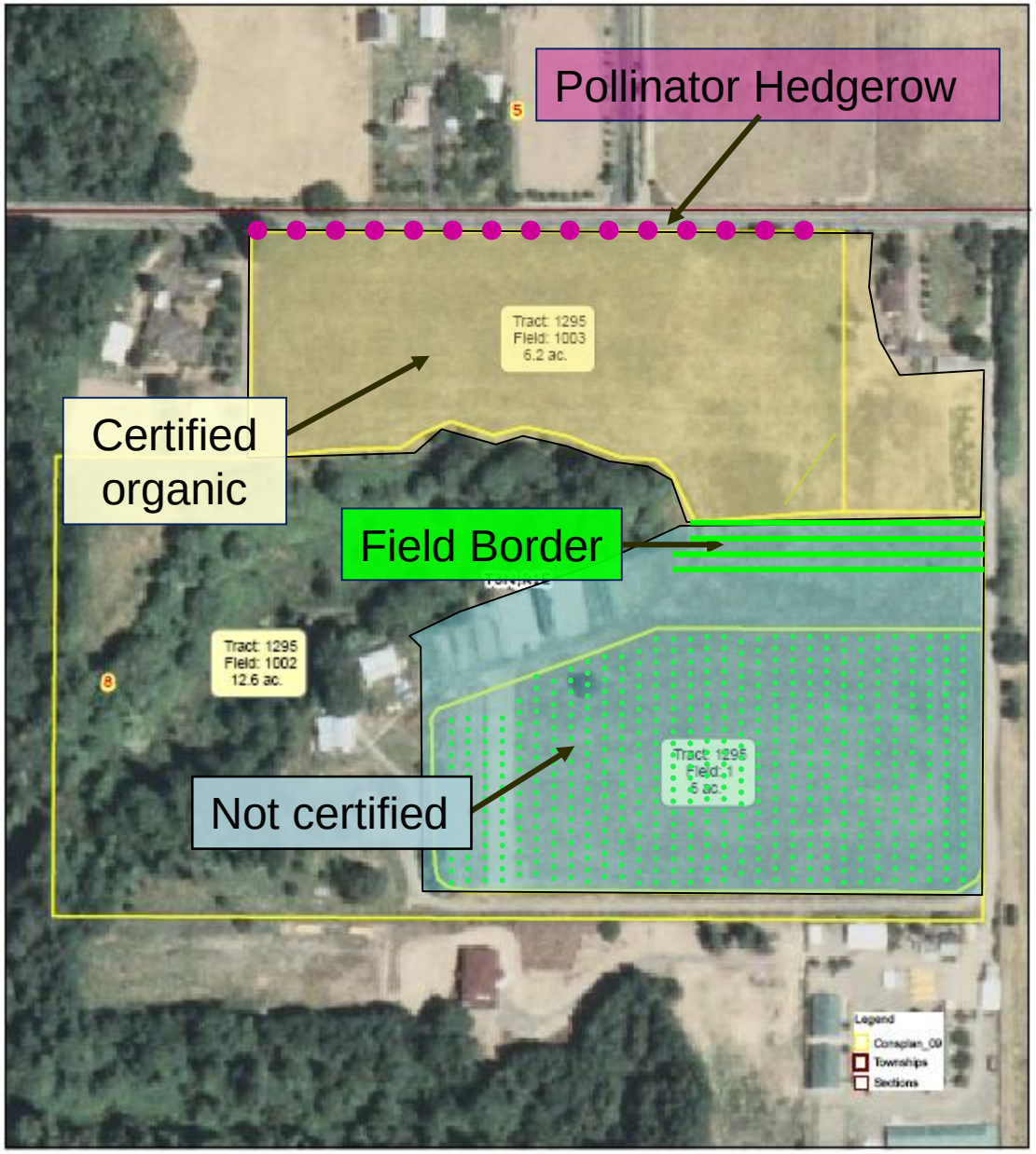
- Operation can use a conservation plan or Farm Bill conservation program contract as part of documentation

For example: Hedgerow conservation practice (422) designed for pollinators.



NOP Biodiversity Guidance

- Operation can use a conservation plan or Farm Bill conservation program contract as part of documentation
- For split operations with certified and non-certified land, practices to support biodiversity can be established adjacent to certified land so long as it directly benefits the certified land.

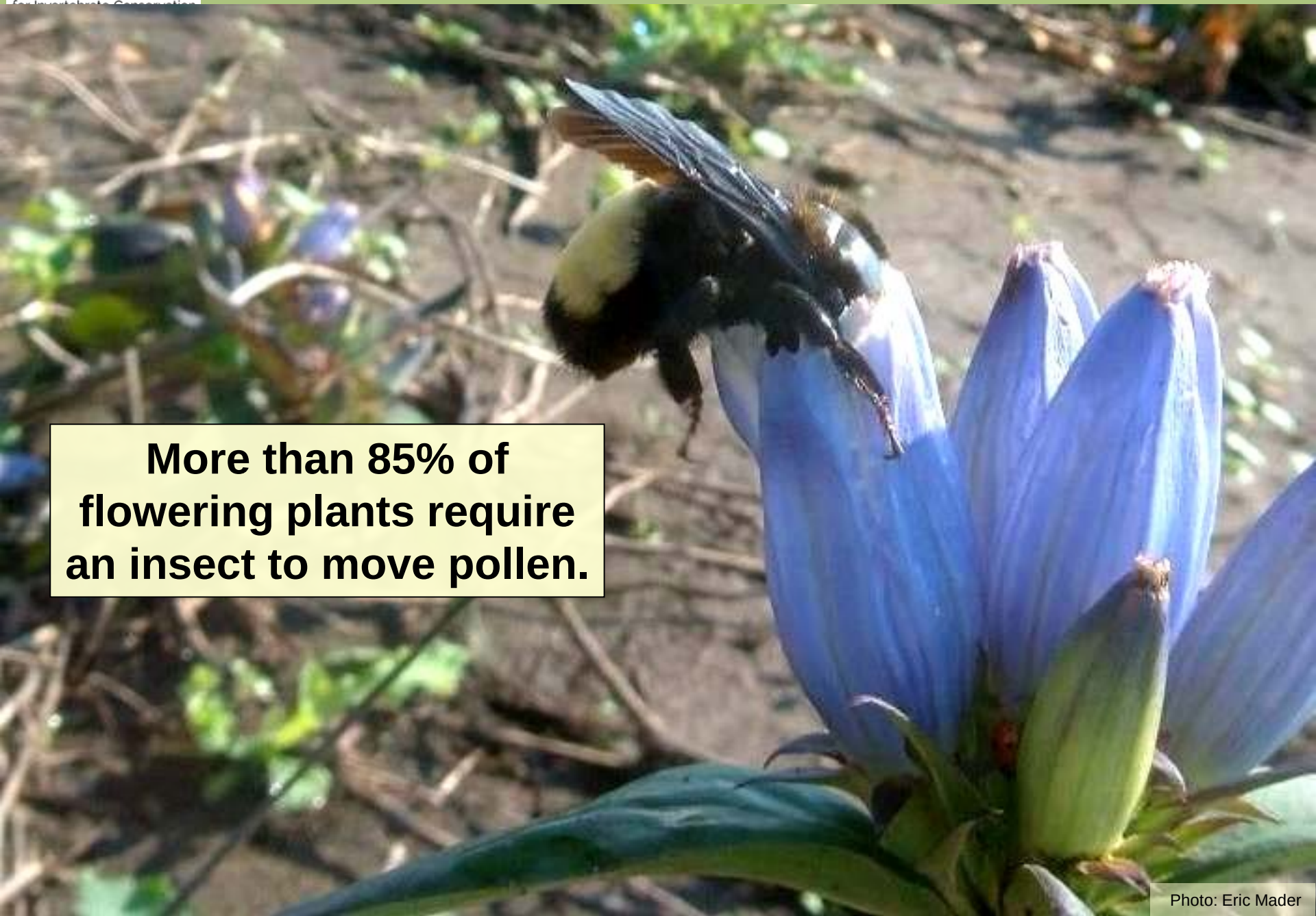


Part 2. Beneficial Invertebrates and Their Habitat Needs

Rusty patch bumble bee (*Bombus affinis*)

Photo: Pheasant Branch Conservancy

Beneficial Insects: Pollinators



More than 85% of flowering plants require an insect to move pollen.

Photo: Eric Mader

Pollinators provide an ecosystem service to agriculture.

- 35% of crop production, worldwide
- Over $18 to $27 billion value of crops in U.S. ($217 billion worldwide)
- One in three mouthfuls of food and drink we consume
- Most of our vitamins and minerals are from insect-pollinated plants
- Also fibers, essential oils, and more

Morse RA, Calderone NW. 2000. The value of honey bees as pollinators of U.S. crops in 2000. Bee Culture 128: 1–15.

Klein et al. 2007. Importance of pollinators in changing landscapes for world crops. Proc. R. Soc. B 274: 303-313.

Photo: USDA-ARS/Peggy Greb

Benefits to Other Wildlife

- 25% of the bird and mammal diets consist of pollinator-produced seeds/fruit
- Pollinators are food for wildlife
- Habitat with high native plant diversity supports abundant beneficial insects, other wildlife, and overall biodiversity

Dickscissel (*Spiza americana*)

Photo: Bobby Harrison

"The greatest single factor in preventing insects from overwhelming the rest of the world is the internecine warfare which they carry out among themselves"

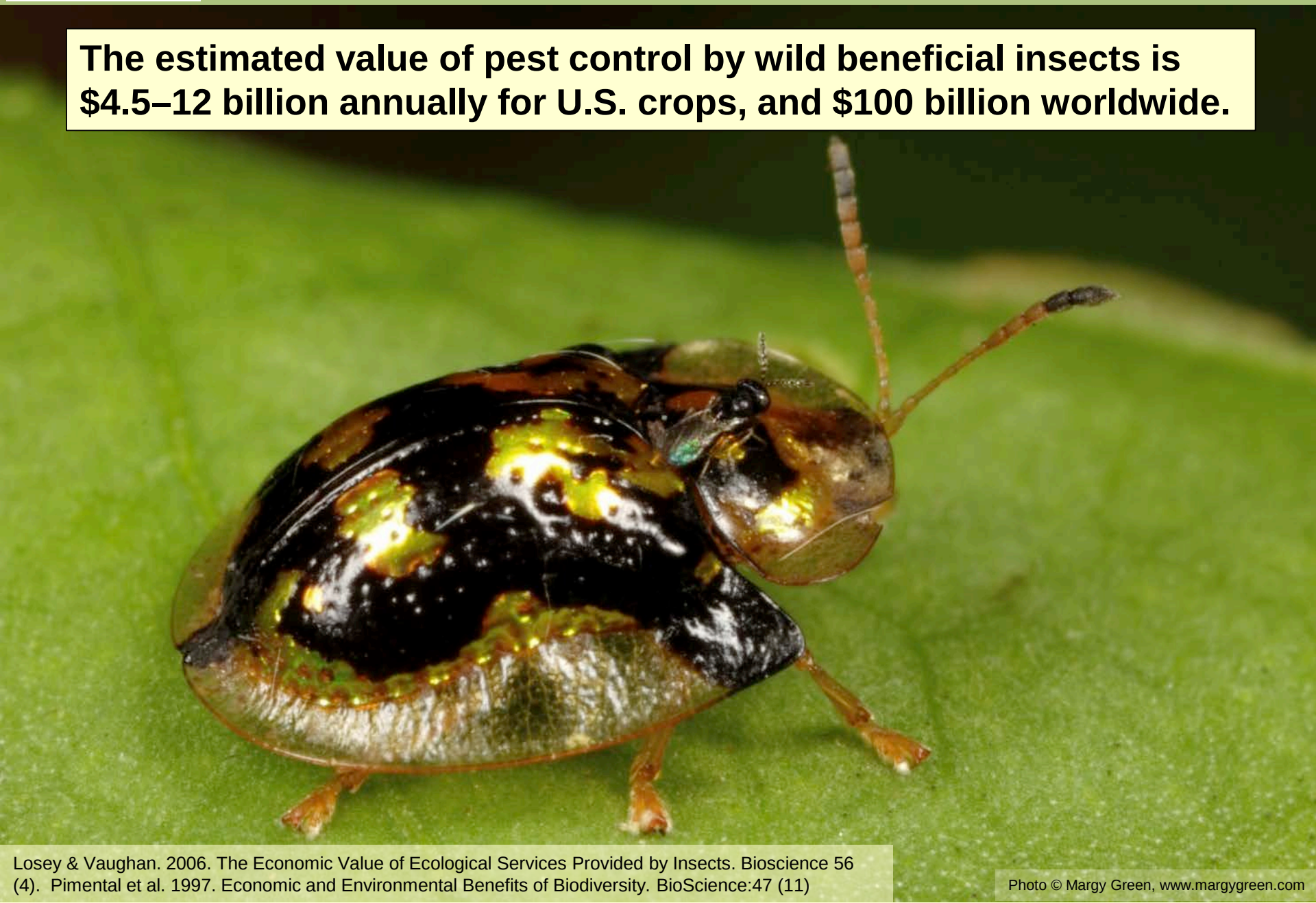
- Dr. Robert Metcalf

Assassin bug eating stink bug on raspberry

Photo: Nancy Adamson

Beneficial Insects: Pest Control

The estimated value of pest control by wild beneficial insects is $4.5–12 billion annually for U.S. crops, and $100 billion worldwide.



Losey & Vaughan. 2006. The Economic Value of Ecological Services Provided by Insects. Bioscience 56 (4). Pimental et al. 1997. Economic and Environmental Benefits of Biodiversity. BioScience:47 (11)

Beneficial Insects: Pest Control

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Parasitoid wasp attacking a mottled tortoise beetle

Losey & Vaughan. 2006. The Economic Value of Ecological Services Provided by Insects. Bioscience 56 (4). Pimental et al. 1997. Economic and Environmental Benefits of Biodiversity. BioScience:47 (11)

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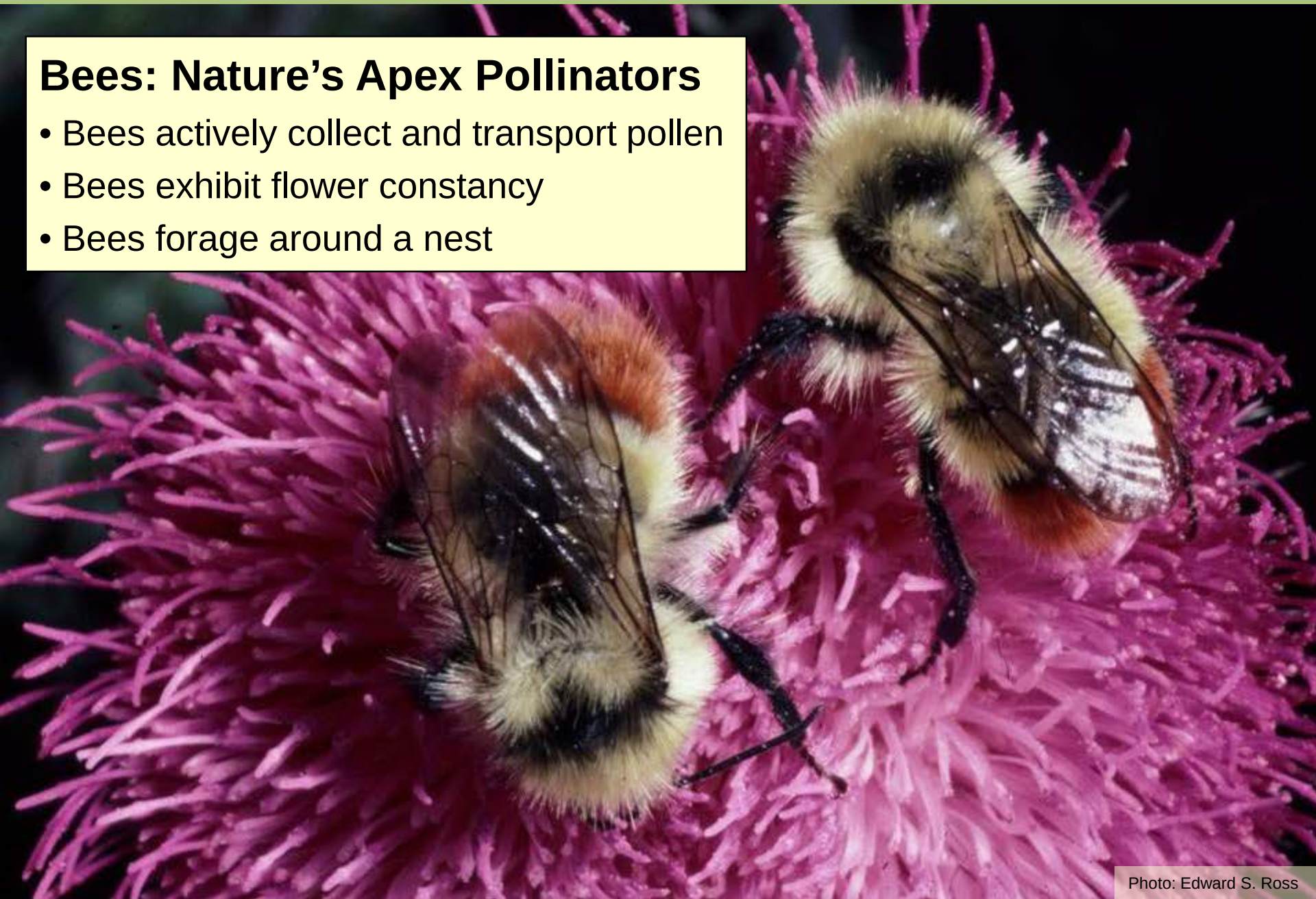
for Invertebrate Conservation

Beneficial Insects: Main Groups of Pollinators

Photos: Mace Vaughan, Bob Hammond, David Inouye, Bruce Newhouse

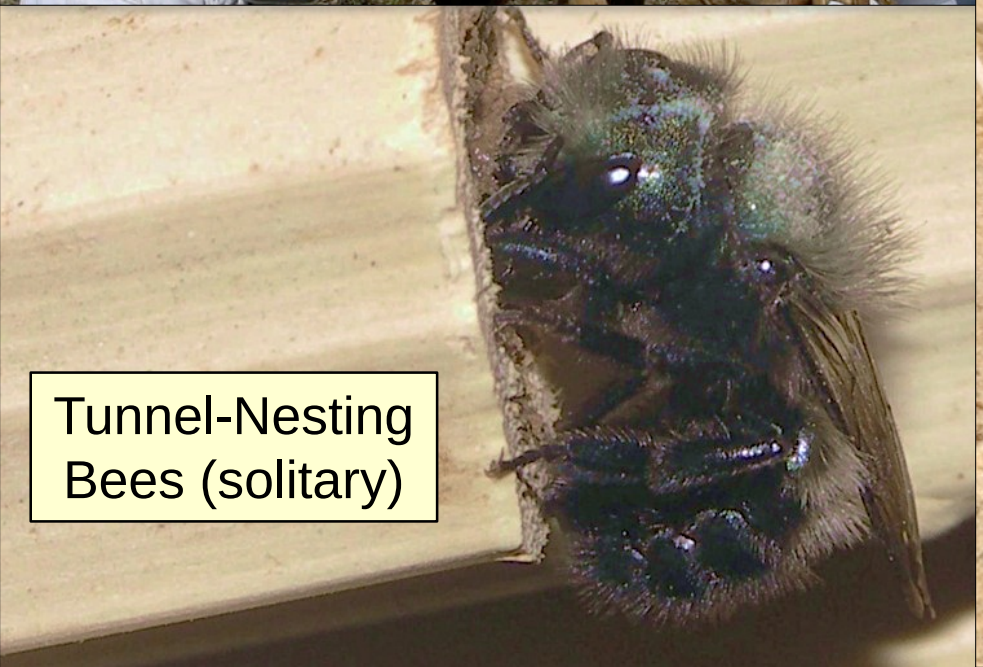


Bees: Nature's Apex Pollinators

- Bees actively collect and transport pollen
- Bees exhibit flower constancy
- Bees forage around a nest

Photo: Edward S. Ross

Beneficial Insects: Bee Diversity and Ecology

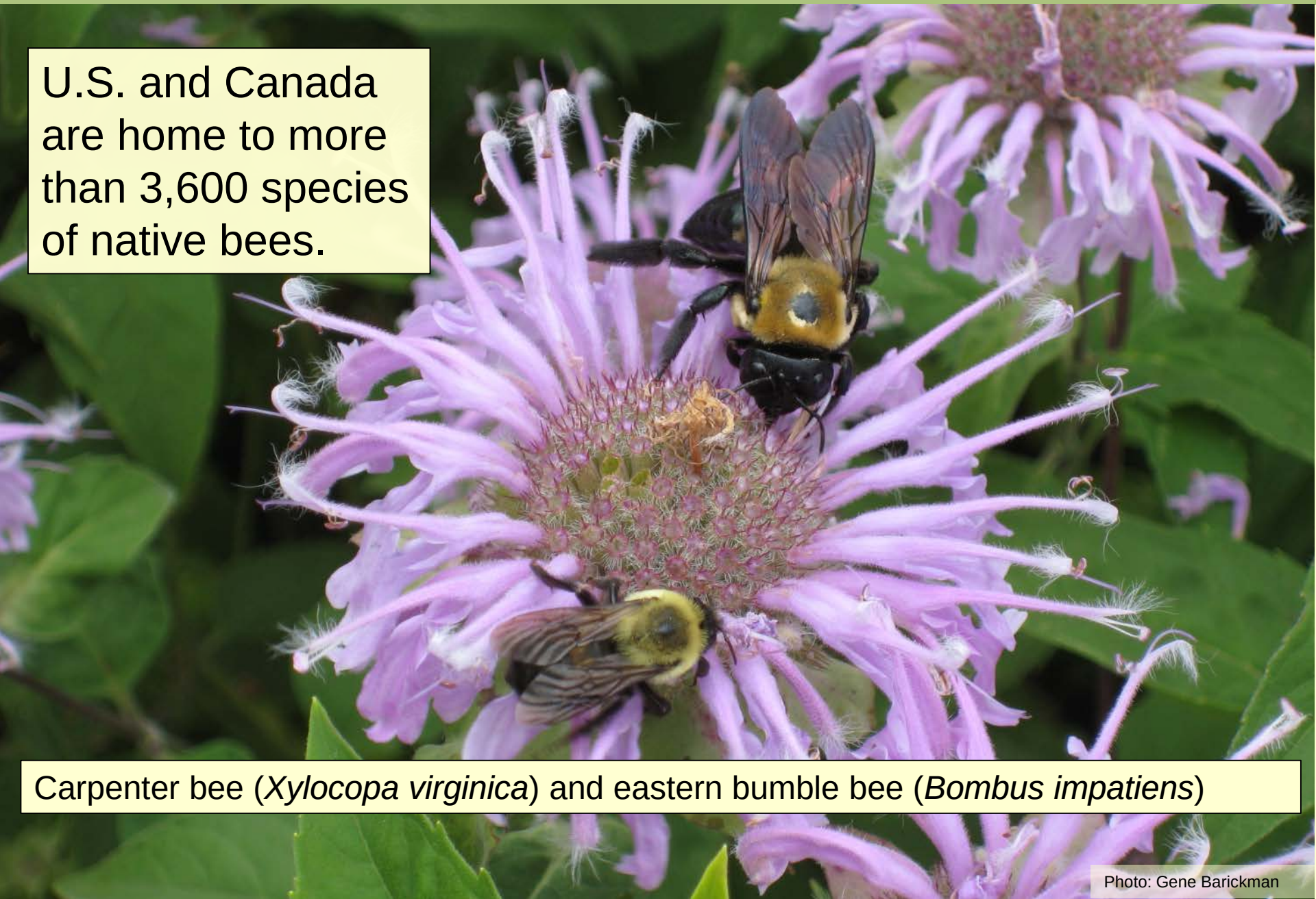


Photos: Eric Mader, Elaine Evans, Mace Vaughan, Rollin Coville

Honey Bees (*Apis mellifera*)

- Division of labor: queen, workers, drones
- 20,000+ workers per hive
- Generalist pollinators of many crops
- Colonies can live for many years

Photo: Eric Mader



U.S. and Canada are home to more than 3,600 species of native bees.

Carpenter bee (*Xylocopa virginica*) and eastern bumble bee (*Bombus impatiens*)

Photo: Gene Barickman

Bumble Bees (*Bombus* spp.)

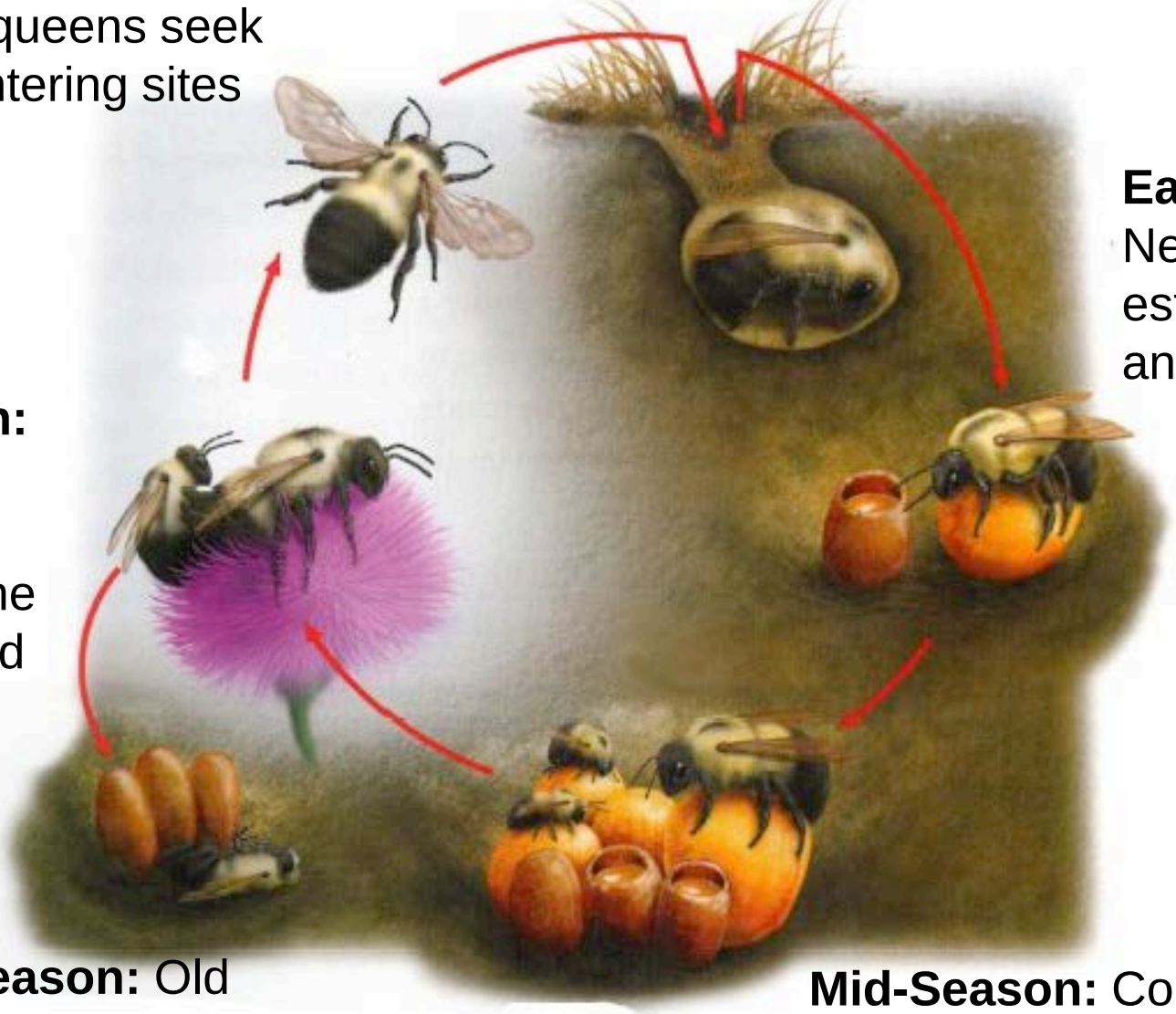
- 45+ species in U.S.
- Social: queen, workers, drones
- 20-400 workers per nest
- Colonies last only one season
- Nests in abandoned rodent burrows or under lodged grasses
- Active in cooler weather

Photo: Elaine Evans, Eric Mader

Beneficial Insects: Bee Diversity and Ecology

Late Season: Mated queens seek overwintering sites

Dormant Season: Hibernating queen



Early Season: Nest establishment and egg laying

Late Season: New queens leave the nest and mate

Late Season: Old queen dies

Mid-Season: Colony peak

Illustration: David Wysotski

Solitary Bees

- ~95% of all bee species on earth are solitary
- No division of labor
- Many flower specialists
- Nests in the ground or in tunnels in woody plants

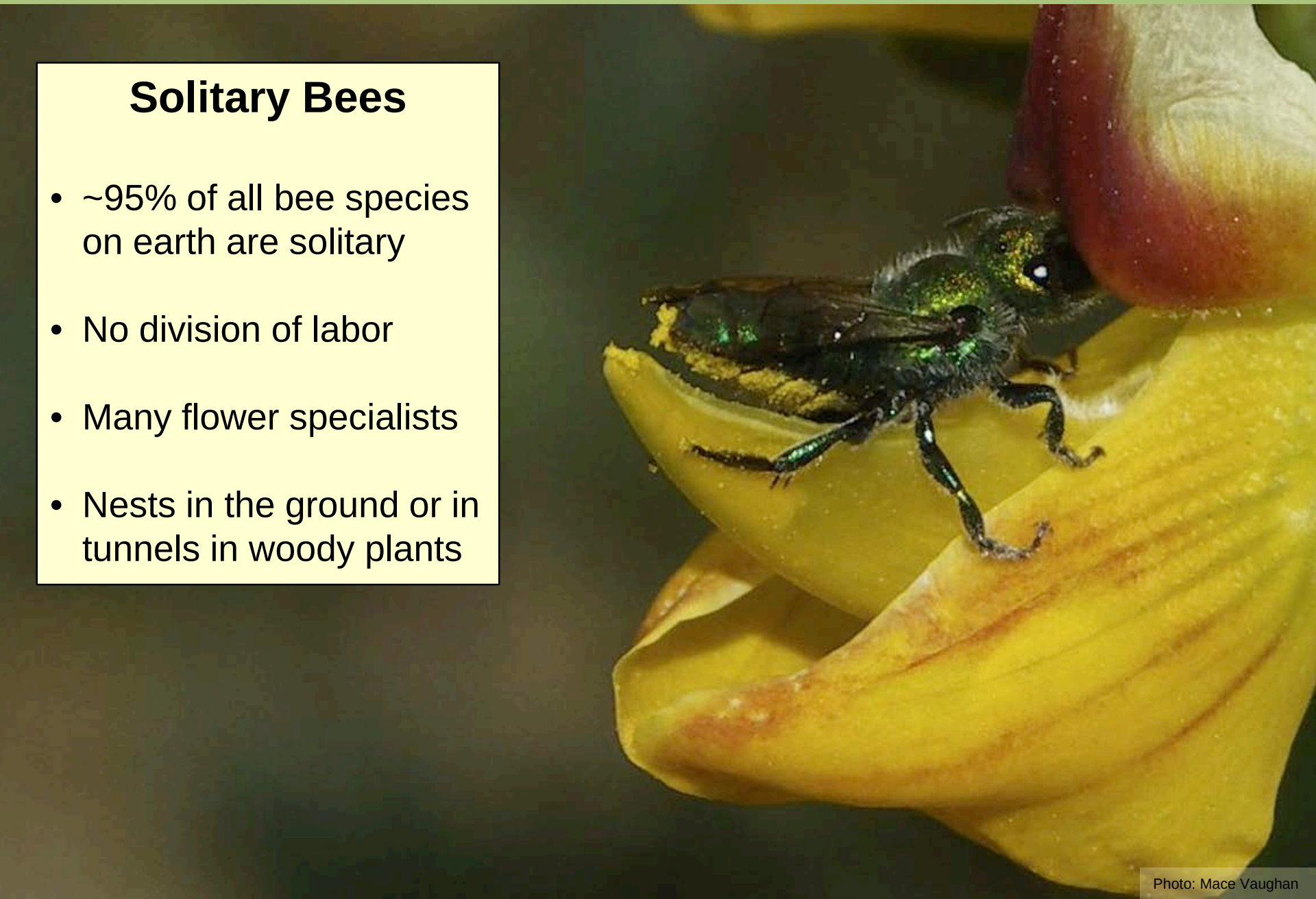
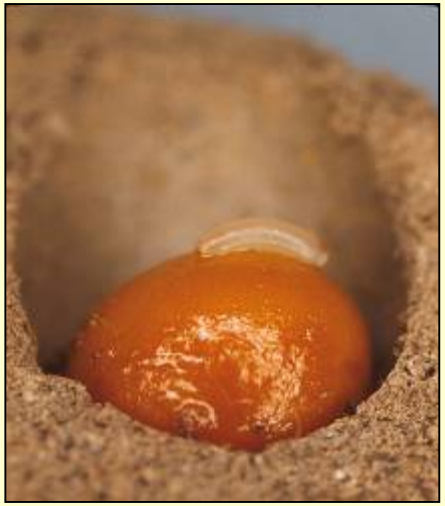


Photo: Mace Vaughan

Beneficial Insects: Bee Diversity and Ecology

Mining bee (*Andrena* sp.): a year in its underground nest as egg, larva, and pupa before emerging to spend a few weeks as an adult.

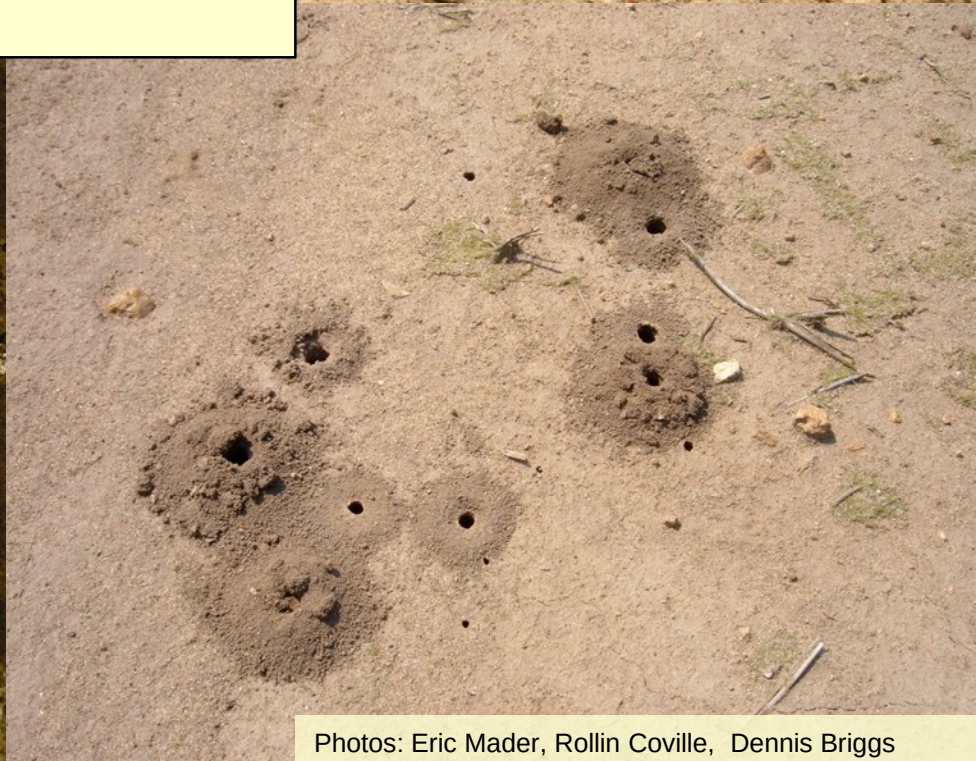


Photos: Dennis Briggs

Beneficial Insects: Bee Diversity and Ecology

Roughly 70% of native bee species nest underground.

- Resemble ant-nests from above ground
- Nest chambers are lined with waxy glandular secretions



Photos: Eric Mader, Rollin Coville, Dennis Briggs

Wood-Nesting Bees

- 30% of bee species
- Hollow stems, beetle borer holes
- Nest nest entrances sealed with mud or leaf pieces
- Artificially managed for some crops
- Conserve stumps and dead trees, plants with pithy stems

Photos: Ed Ross, Eric Mader and Katharina Ullmann

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for Invertebrate Conservation

Beneficial Insects: Pest Control

Photo: Mace Vaughan (Xerces Society)

Beneficial Insects: Pest Control

Photo: Mario Ambrosino

XERCES SOCIETY
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Beneficial Insects: Pest Control

Photo: SABeebe (bugguide.net)

XERCES SOCIETY
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Beneficial Insects: Pest Control

Photo: Richard Greene

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Photo: Alex Wild

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for Invertebrate Conservation

Beneficial Insects: Pest Control

Tomato hornworm parasitzed by
a braconid wasp, *Cotesia congregatus*

Photo: VegEdge, UMN

Buffers can be designed to provide food and shelter for the insects that attack crop pests.

Photos: Paula Kleintjes-Neff

Habitat: Food

- Many predatory insects eat pollen or nectar when prey are not available
- Some switch diets depending on their life stage, or use the energy from nectar to fuel increased egg-laying

Photos: Mace Vaughan, Alex Wild, Ed Ross

Habitat: Alternate Prey

Habitat can harbor alternate prey when crop pests are absent

Lady beetle larva on milkweed

Eating oleander aphids (not a crop pest)

Photos: Alex Wild

Habitat: Shelter

Over-wintering & egg-laying

Lacewing eggs

Nesting Isodontia wasp (grass-hopper hunter)

Photos: insecte.org; Alex Wild

Part 3. Buffers for Beneficial Insects

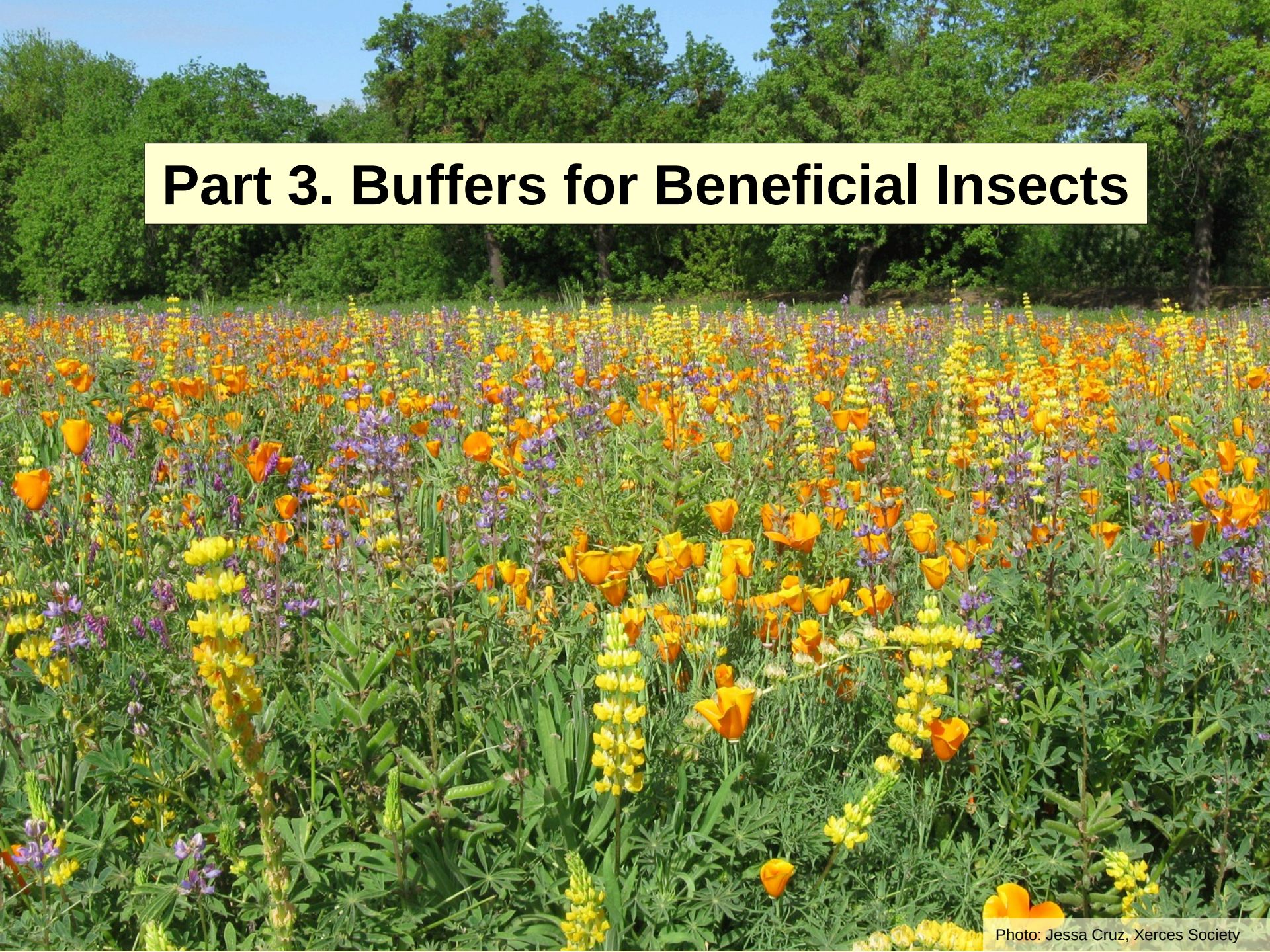


Photo: Jessa Cruz, Xerces Society

Conservation Buffers

- Buffer against neighboring pesticide use
- Water quality protection
    - Sediment capture
    - Nutrient capture
- Screening, noise reduction
- Wildlife corridors
- Weed seed capture
- Increase crop isolation distances
- **PLUS, beneficial insects!!**

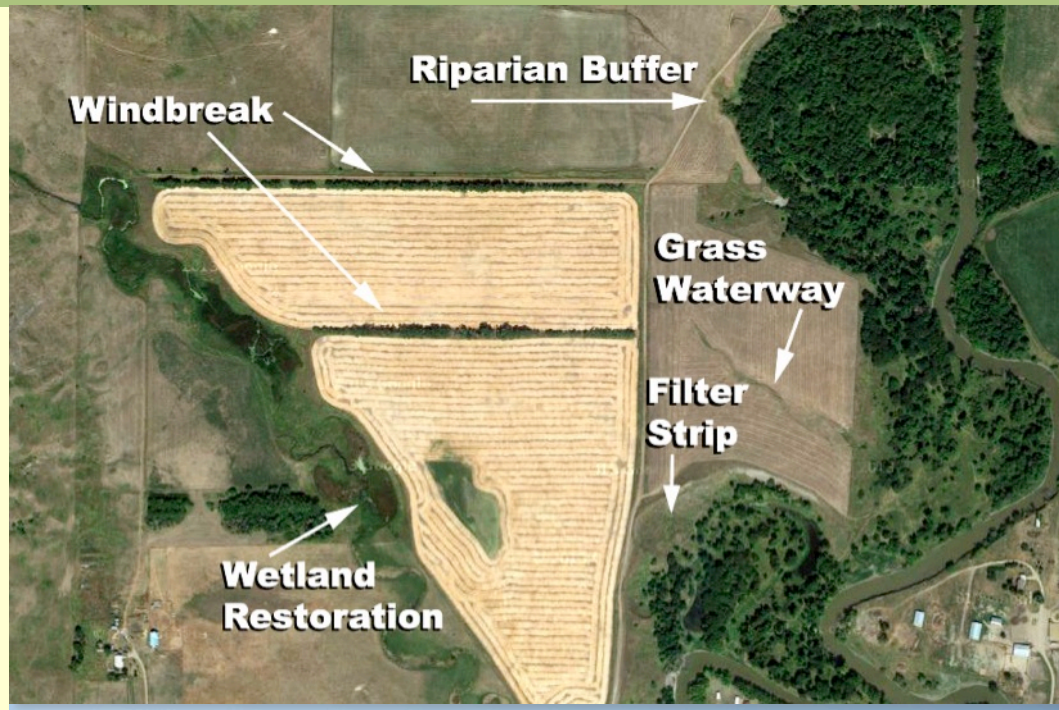


Photo: Mace Vaughan

Design Considerations

- High floral diversity, especially of native plants designed to support pollinators and other beneficial insects
  - Nectar and pollen
  - Alternative hosts
- Undisturbed from pesticides
- Management only to maintain habitat, and then – ideally – only manage 30% at a time
- Nesting and overwintering habitats: a diversity of structures

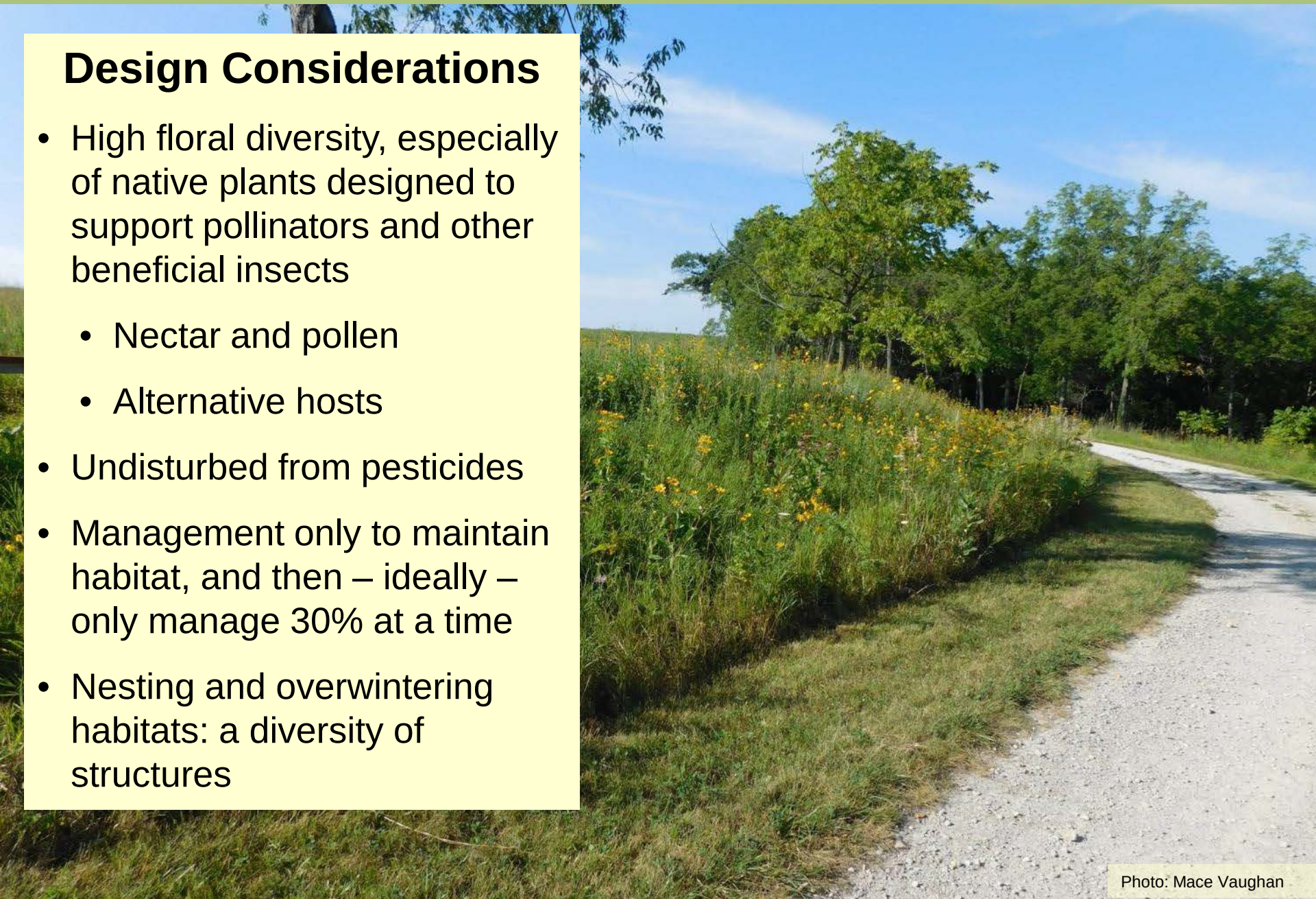


Photo: Mace Vaughan

Hedgerows (422)

Farm hedgerow in California

Photo: Jessa Guisse

Example: Xerces California Hedgerow Project

One-mile in length, supporting organic field crop production for Muir Glen tomatoes

November 2012

Photos: Jessa Guisse


Xerces California Hedgerow Project
June 2013
Photos: Jessa Guisse

Xerces California Hedgerow Project

July 2014

Photos: Jessa Guisse

Xerces California Hedgerow Project


California Fuschia


Silver Lupine


California Gumplant


Elderberry


Showy Milkweed

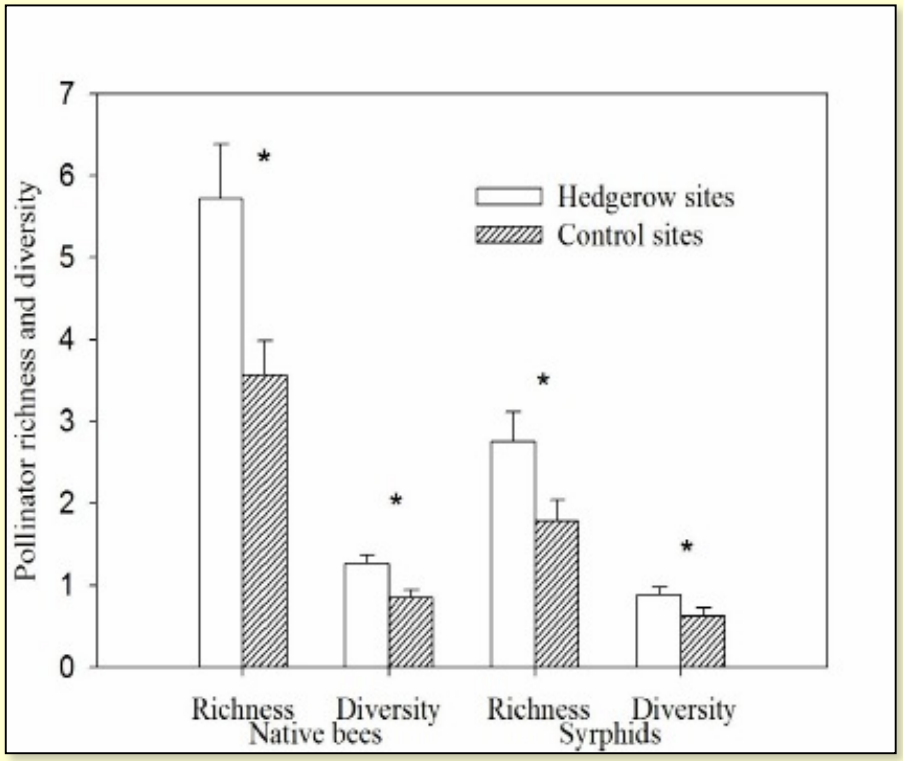
Purple Salvia

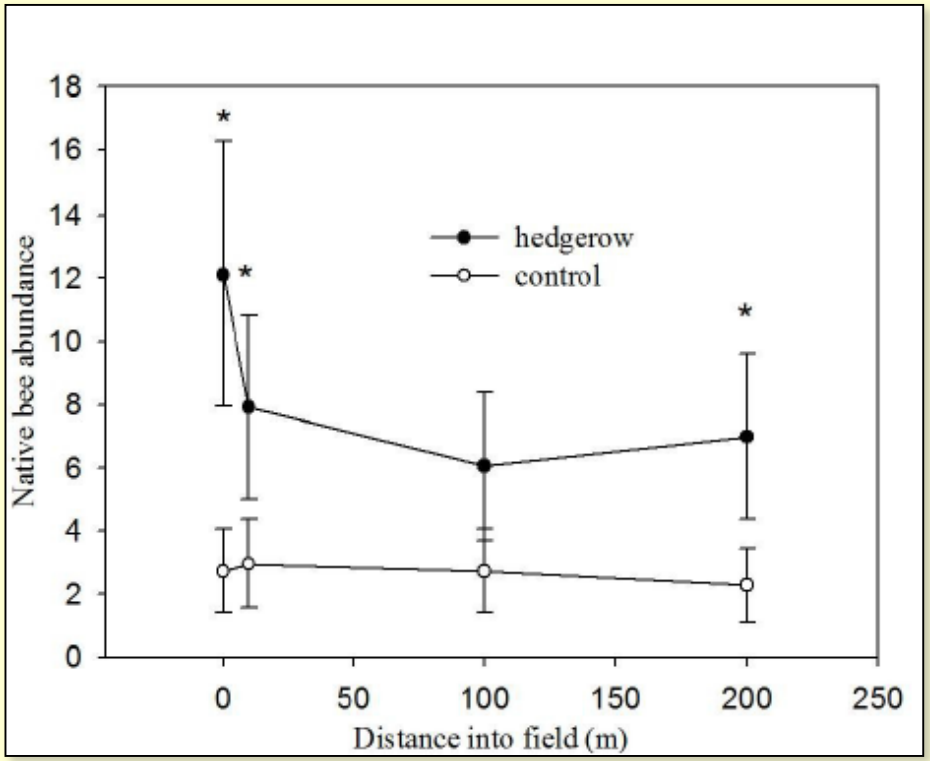
Photos: Jessa Guisse

Hedgerows Export Wild Pollinators to Nearby Crops

A 6-Year UC Berkeley / Xerces Society Case Study

- More wild bees present on farms with native plant habitat
- Habitat is a “source” not a “sink” for pollinators of nearby crops





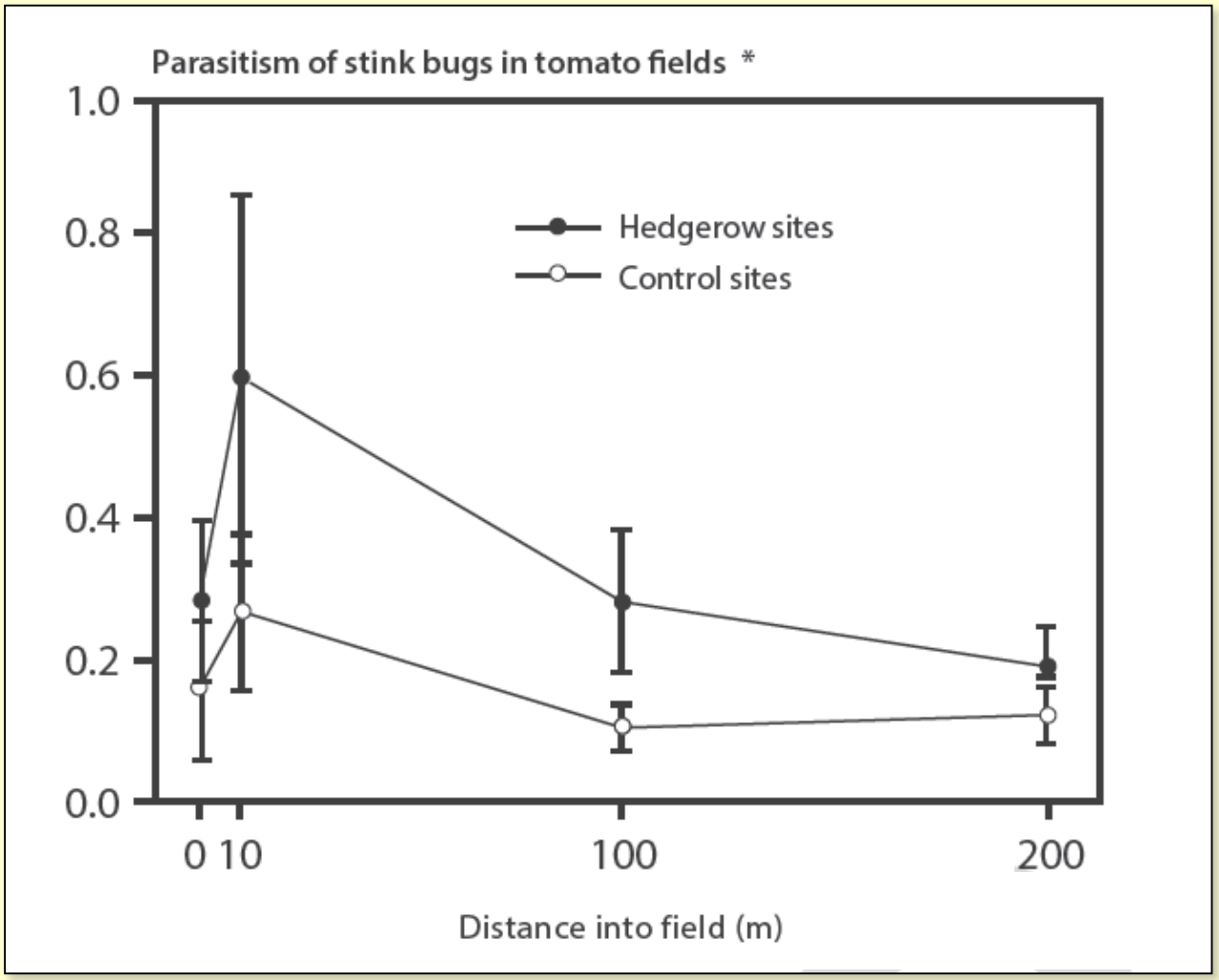
*Morandin et. al 2014

Graph: Lora Morandin

Hedgerows Enhance Pest Control

A 6-Year UC Berkeley / Xerces Society Case Study

- More stink bug eggs parasitized (by wasps) in fields with nearby native plant hedgerows (than in fields without)
- Vertical axis is proportion of parasitized egg masses observed at distances from the field edge



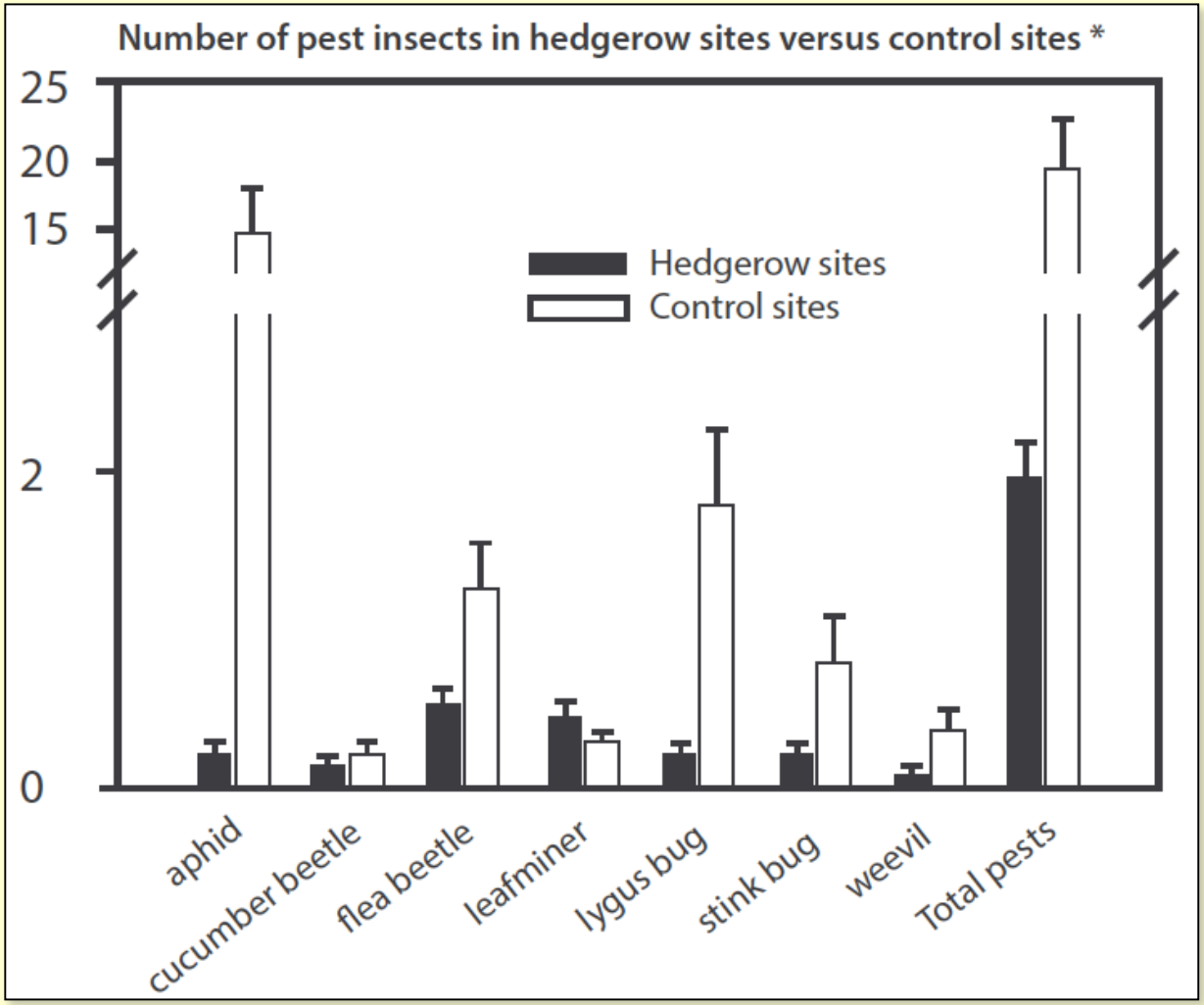
*Morandin et al. 2014

Graph: Lora Morandin

Hedgerows Do Not Increase Pest Populations

A 6-Year UC Berkeley / Xerces Society Case Study

- Sweep net samples of insect activity
- Native plant hedgerows versus weedy field edges
- Fewer pests (except leafminers) at the hedgerow sites



*Morandin et al. 2014

Graph: Lora Morandin

Wildflower Field Borders (323 or 327)

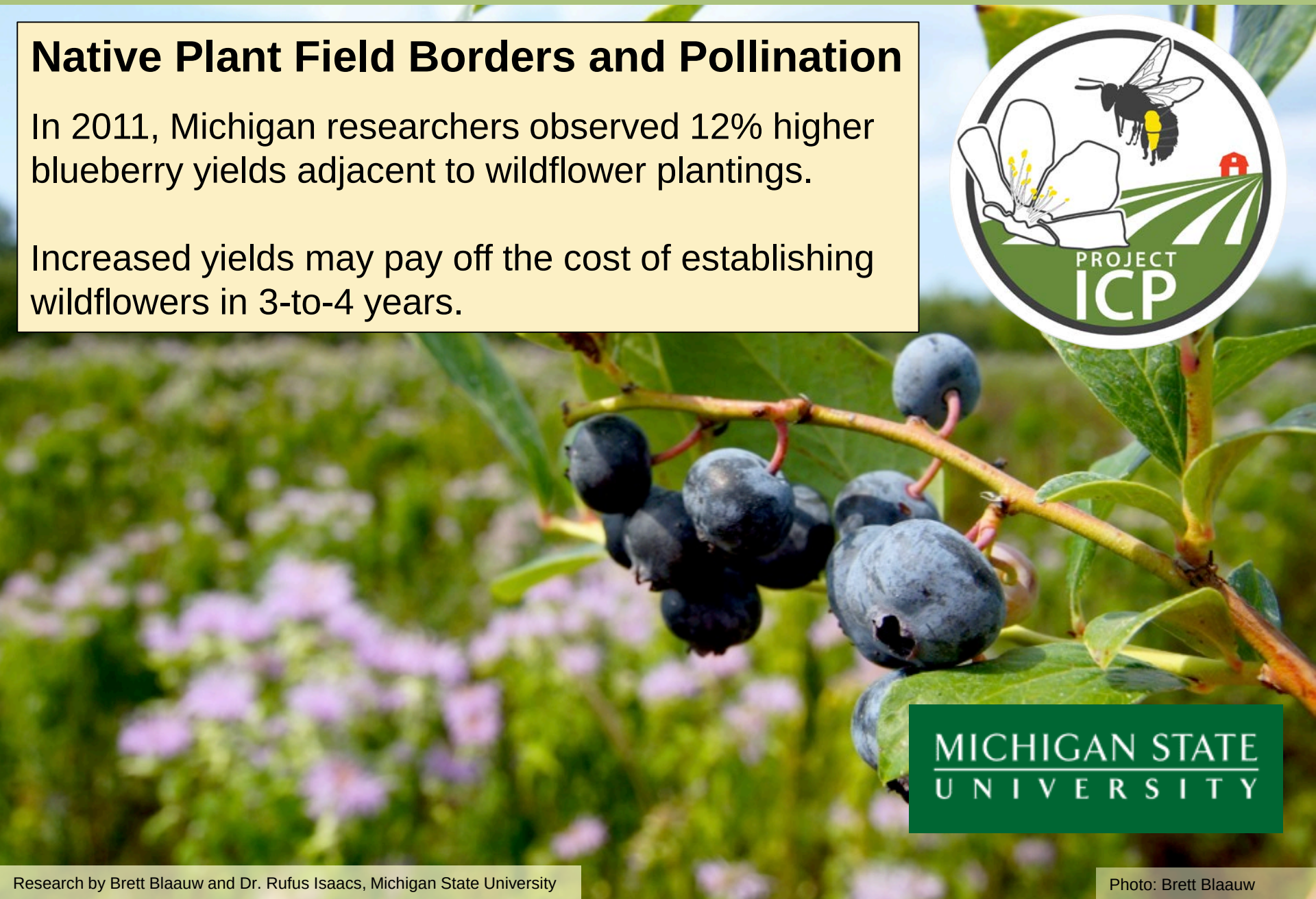
New Hampshire pollinator field border

Photo: Don Keirstead

Native Plant Field Borders and Pollination

In 2011, Michigan researchers observed 12% higher blueberry yields adjacent to wildflower plantings.

Increased yields may pay off the cost of establishing wildflowers in 3-to-4 years.



PROJECT ICP

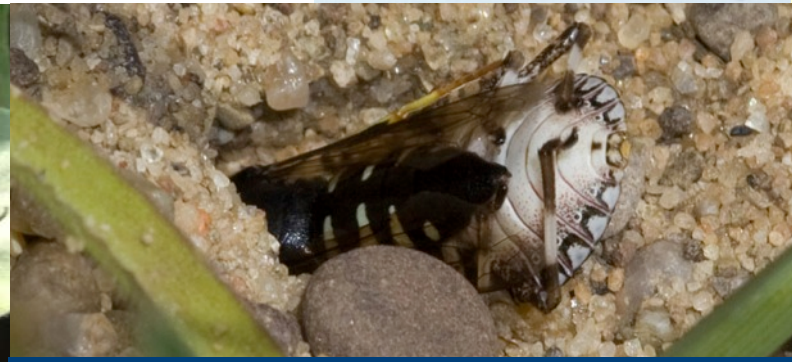
MICHIGAN STATE UNIVERSITY

Research by Brett Blaauw and Dr. Rufus Isaacs, Michigan State University

Photo: Brett Blaauw

Native Plant Field Borders and Pest Management

- Emerging Research: Sand wasp predation of brown marmorated stinkbugs
- Spotted bee balm (*Monarda punctata*) and mountain mint (*Pycnanthemum* spp.) as nectar plants for wasps



Research by Dave Biddinger, Penn State University; Photos: Alex Suricia, Mace Vaughan, Scott Seigfried

PENNSTATE College of Agricultural Sciences

Example: Vilicus Farm, Montana

- 4,000+ Acres (small grains, pulses, oilseed crops)
- Native plant field borders throughout
- 20+ species of native forbs and grasses (replacing crested wheatgrass)

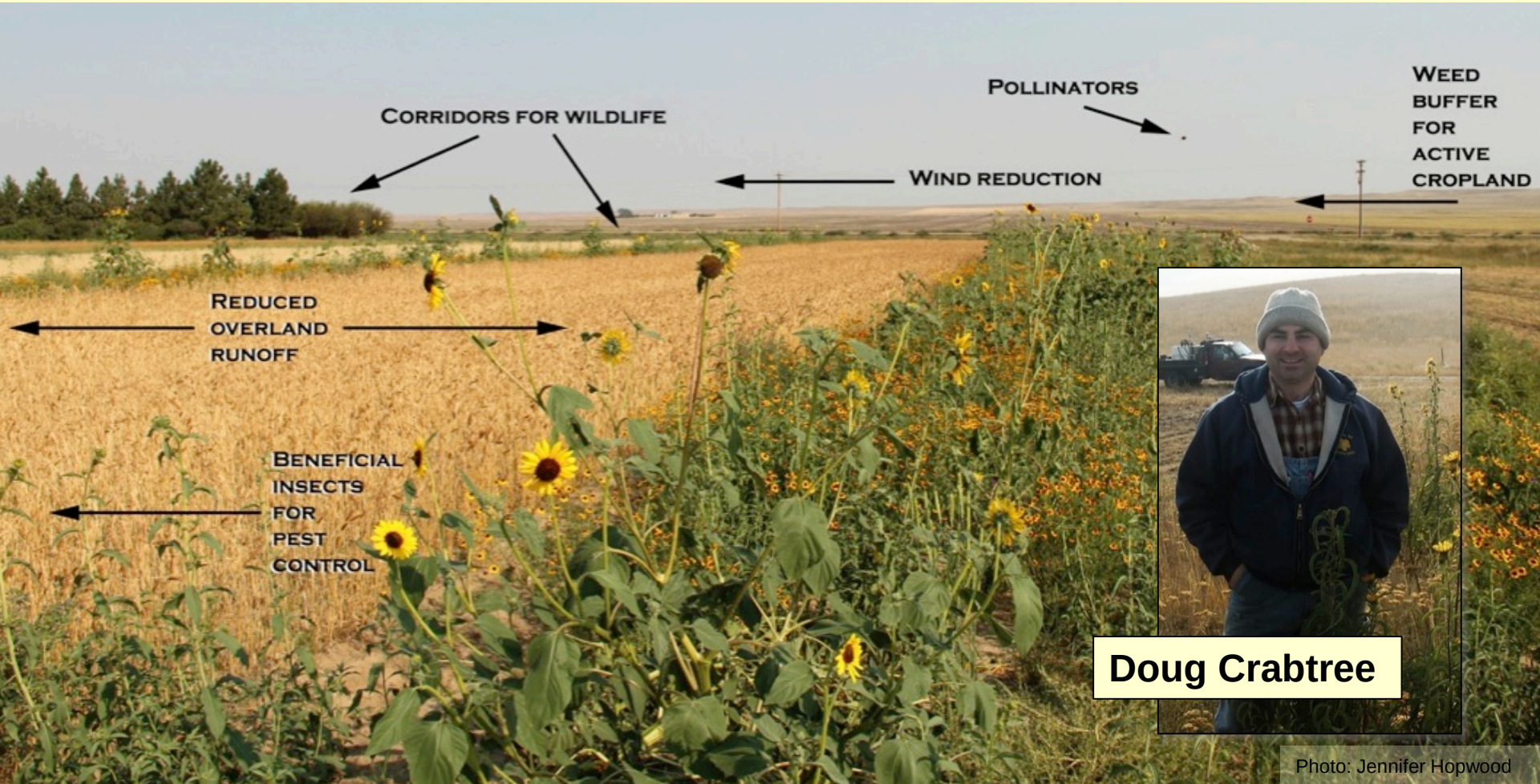


Photo: Jennifer Hopwood

Example: California almond orchard field border

Photo: Jessa Guisse

Conservation Buffers: Wildflower Field Borders

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Conservation Buffers: Wildflower Field Borders

Example: Blueberry farm, New Hampshire

Photos: Don Keirstead

Filter Strips (393)

Native plant filter strip, California

Photo: John Anderson

Example: Native plant filter strip, California

Captures sediment, excess nutrients, increases infiltration to reduce flooding

Photo: Katharina Ullmann, Xerces Society;

Part 4. The Habitat Installation Process

Photo: Eric Mader, Xerces Society

Habitat Installation: Site Preparation

MOST IMPORTANT PART OF THE RETORATION PROCESS!!

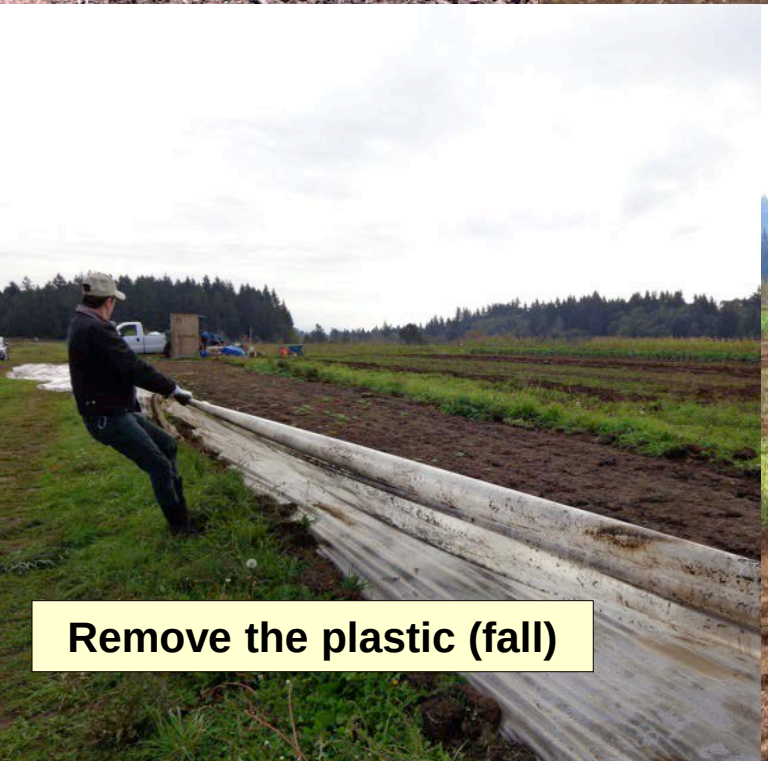
- Good site preparation is critical
- May require more than one season
- May require more than one method
- Focus on invasive, persistent perennial weeds

Photo: Matthew Shepherd

Site Preparation: Solarization

Cultivate or mow to create a seed bed (spring)

Lay solarization plastic (summer)



Remove the plastic (fall)

Broadcast seed (fall)

Flowering habitat (next season)

Site Preparation: Solarization

- Plastic available in widths from ~6 to 64 ft.
- 6 ml high tunnel plastic
- COSTLY but REUSABLE
- Used plastic is an option

Site Preparation: Smother Cropping

Buckwheat Example

•Spring: Till, before winter/spring annuals flower/set seed

•Two weeks later: Shallow cultivation (sweep / harrow)

•Two weeks later: Repeat shallow cultivation - IMMEDIATELY seed buckwheat smother crop. **Broadcast at 70 lb/ac** or **drill seed at 50 lb/acre.**

- MAKE SURE THERE IS ENOUGH WATER

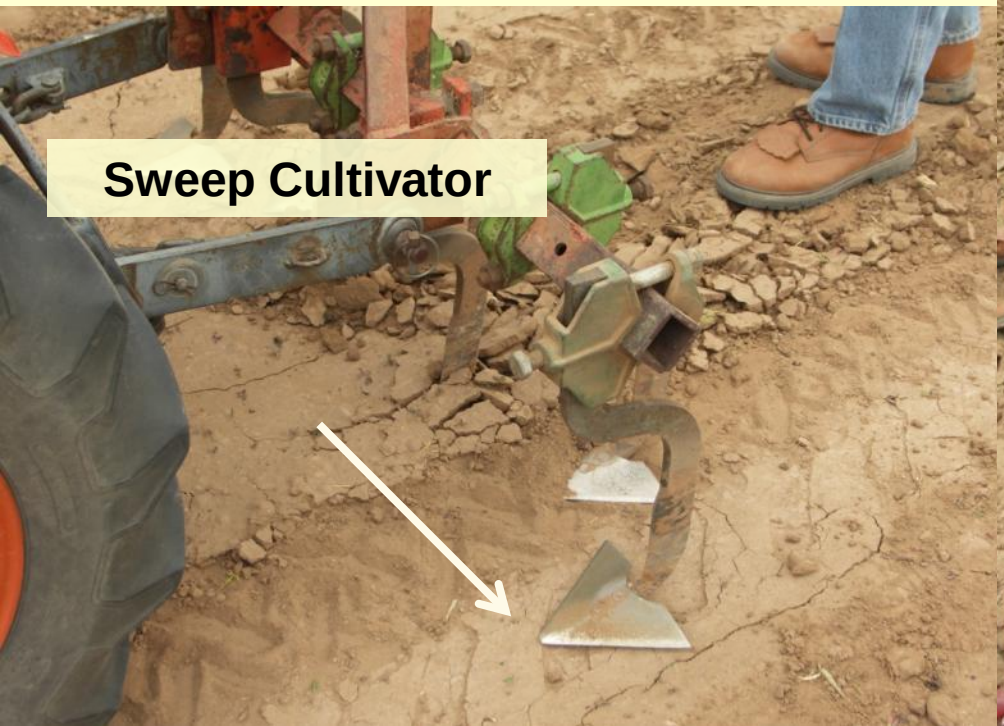
•Six weeks later: Mow, remove debris, and **reseed**

•Six weeks later: Mow or crimp and leave debris on surface

Photos: Commons

Site Preparation: Repeated Cultivation

- Early spring: Deep cultivation (1x)
- Then: Shallow cultivation (2 in.)
- Repeat: 4 to 6 week intervals
- Irrigation may be needed
- ONLY use implements that can be set to shallow depth (scratching surface)



Photos: Mace Vaughan, Xerces Society

Habitat Installation: Seeding Methods

Photos: Sarah Fo

Habitat Installation: Seeding Methods

- Mechanical Seeding -- Drill
  - Find an expert!
  - Calibrate equipment
  - Can be difficult with small quantities of seed
  - Requires less seed
  - Cultipacker not needed

Jessa Cruz

- Mechanical Seeding -- PTO Broadcaster
  - Easier to operate
  - Requires more seed
  - Post-seeding: roll with cultipacker (unless dormant seeding)

Habitat Installation: Broadcast Seeding

Preparing to Seed:

- Bulk up the seed mix with an inert carrier (e.g. peat moss or sawdust) for **broadcasting**

Sarah Foltz Jordan, Xerces Society

Habitat Installation: Seeding

- Plant in the dormant season (late Oct to March): BEST!!
- Plant in spring (April to June)

Sarah Foltz Jordan

Sarah Foltz Jordan

Habitat Installation: Broadcast Seeding

Spring seeding: Immediately after broadcast seeding

- Roll seed to ensure seed-soil contact
- Cultipacker, lawn roller, lawn rake
- Chain harrow

Not as critical when dormant seeding or when drilling

Photos: Sarah Foltz Jordan, Mace Vaughan, Jesse Guiasa

Habitat Management

The Year After Seeding:

- Mow to 6-8 inches whenever plants reach about 10-12 inches or annual weeds are close to setting seeds.
- Spot treat problem weeds.

Long Term Management:

- Mowing, burning, haying, grazing should occur at infrequent intervals, and patchily (~1/3 of the habitat per year)

IN SUMMARY…

Key lessons for establishing new wildflower plantings on weedy ground:

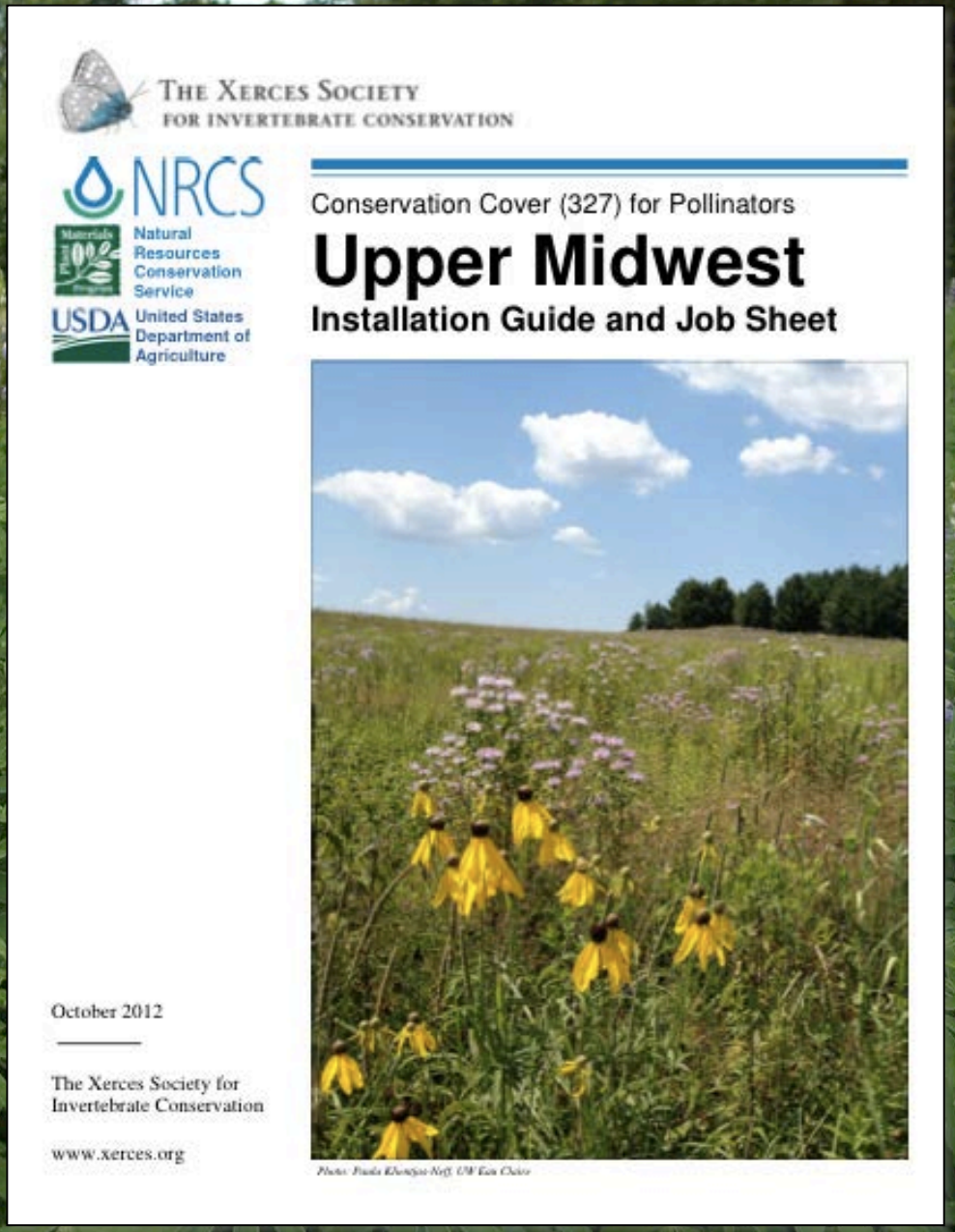
- Aggressively remove weeds prior to planting
- Do not disturb dormant weed seed
- Make a clean seed bed
- Plant it well, with good seed-soil contact
- Plant native wildflower seed during the dormant season
- Manage weeds with mowing

Photo: Brianna Borders (Xerces Society)

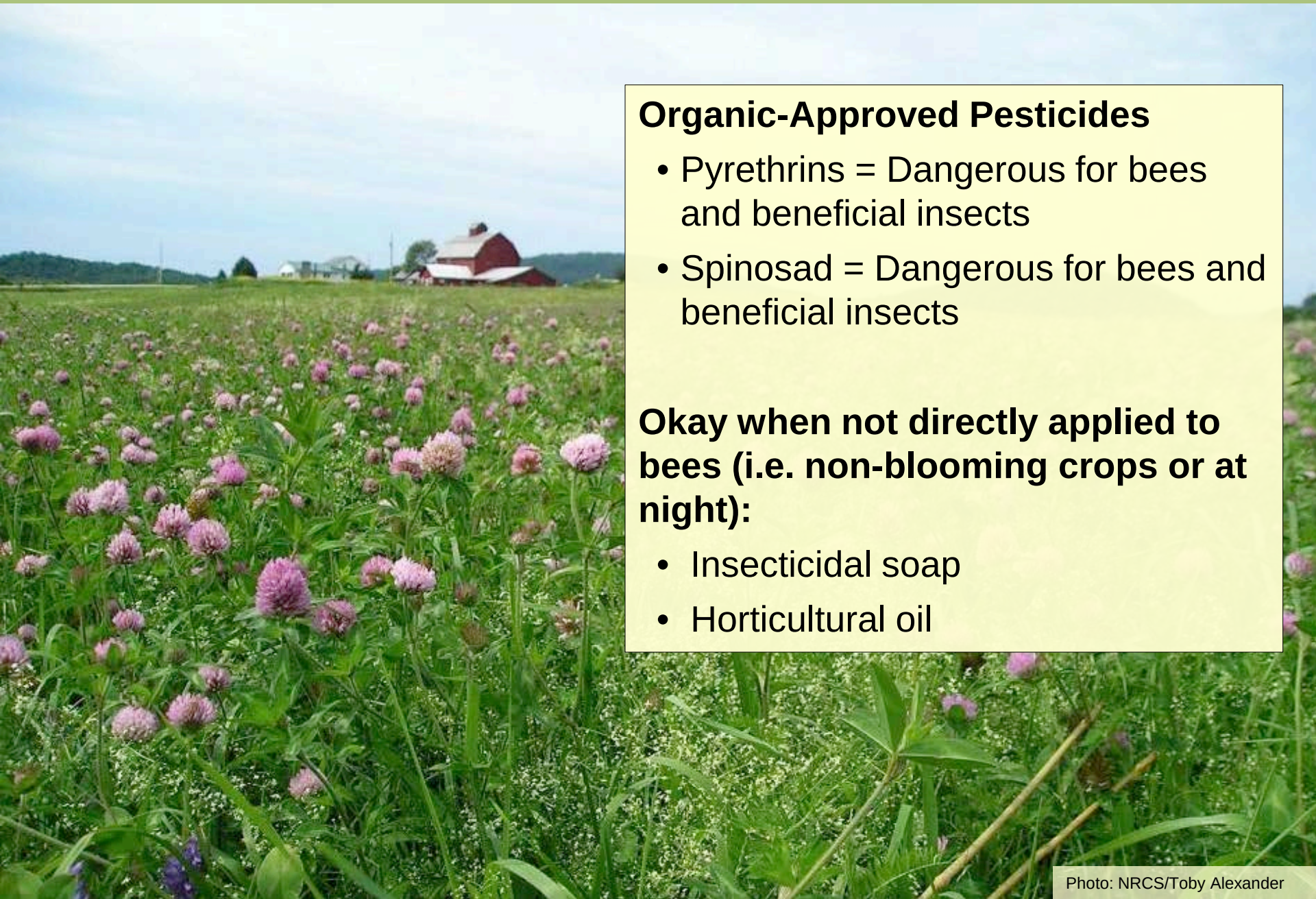
Xerces Habitat Installation Guides and Seed Mix Calculators

Wildflower meadow and hedgerow installation guidelines for multiple regions of the U.S.

www.xerces.org



Protecting Farm Buffers from Disturbance



Organic-Approved Pesticides

- Pyrethrins = Dangerous for bees and beneficial insects
- Spinosad = Dangerous for bees and beneficial insects

Okay when not directly applied to bees (i.e. non-blooming crops or at night):

- Insecticidal soap
- Horticultural oil

Photo: NRCS/Toby Alexander

Control Drift and Over Application

- Calibrate equipment annually
- Select proper nozzle type
- Avoid temperature inversions and windy conditions
- Establish buffer strips

Photos: USDA-ARS

Part 5. NRCS Conservation Programs and Practices

Sweat bee (*Lasioglossom spp.*)

Photo: Rollin Coville

Farm Bill: Pollinator Conservation Provisions

The 2008 Federal Farm Bill

- Made pollinator habitat a priority for every USDA land manager and conservationist (NRCS & FSA)
- Encouraged the inclusion of pollinator habitat in all USDA conservation programs

Photo: Katharina Ullmann

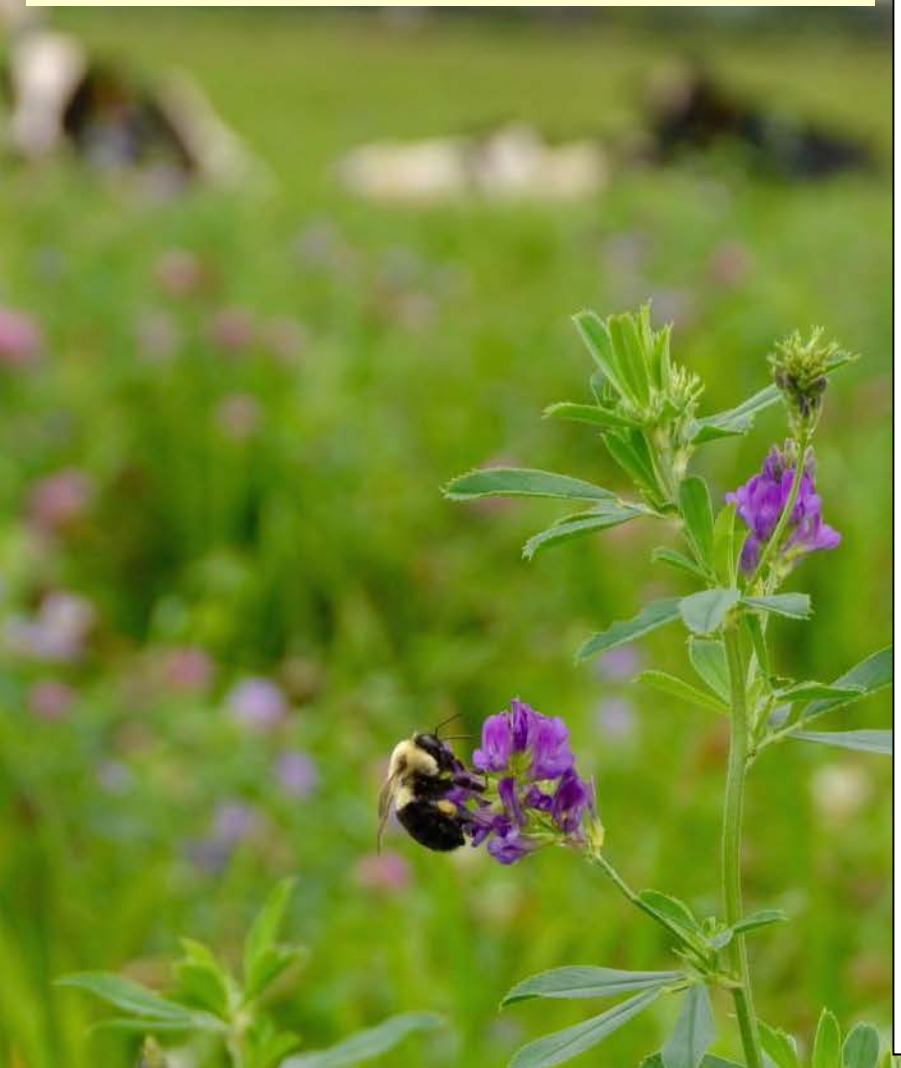
Farm Bill: Pollinator Conservation Provisions

2014 Farm Bill

- Maintained provisions for pollinators from 2008
- Additional provisions on the creation of habitat to support honey bees

Photo: Mace Vaughan (Xerces Society)

Summary of USDA Technical and Financial Assistance Programs supporting pollinator conservation



USDA United States Department of Agriculture

May 2015

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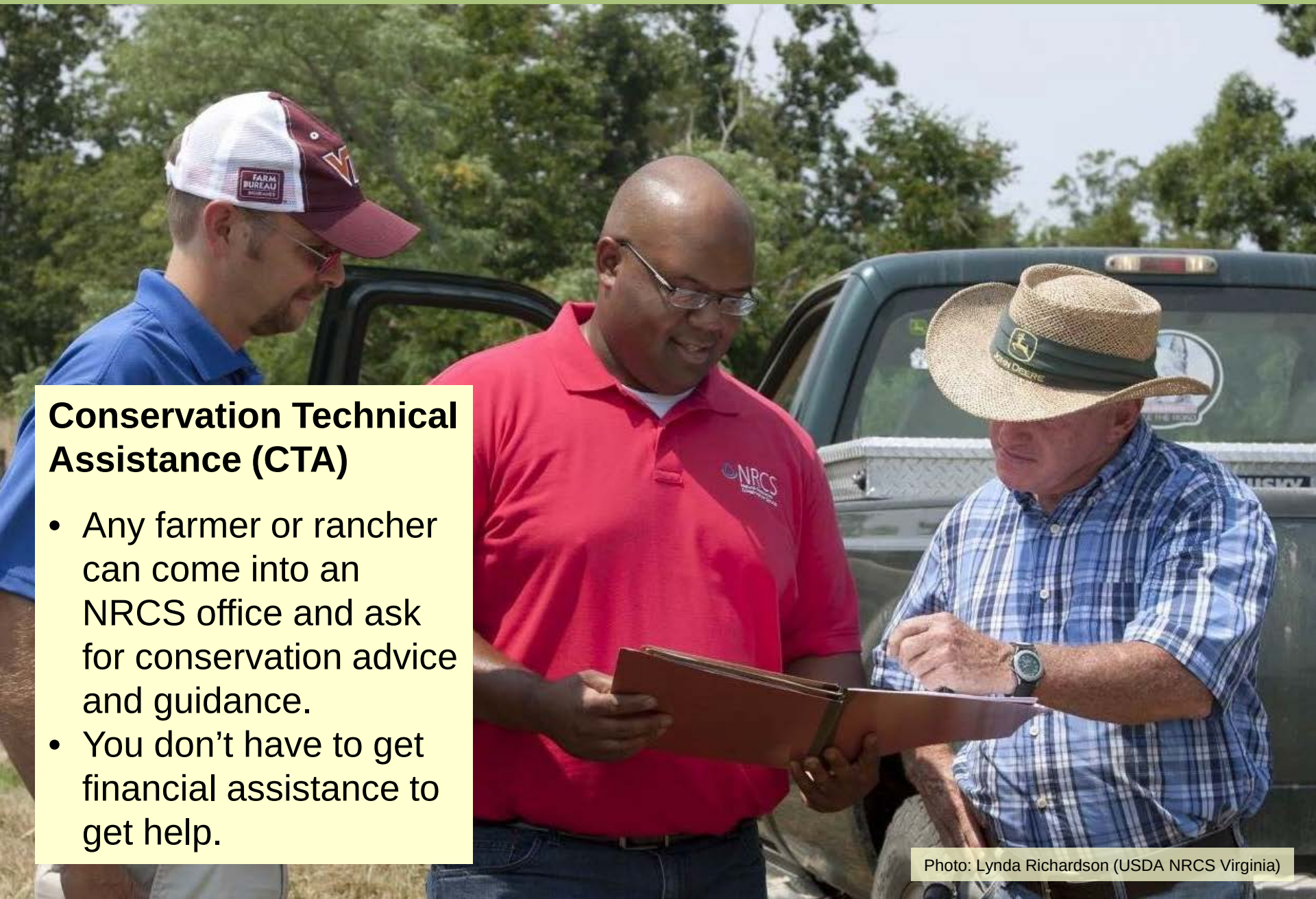
Using 2014 Farm Bill Programs for Pollinator Conservation

http://plants.usda.gov/pollinators/Using_2014_Farm_Bill_Programs_for_Pollinator_Conservation.pdf

Farm Bill Programs for Pollinators

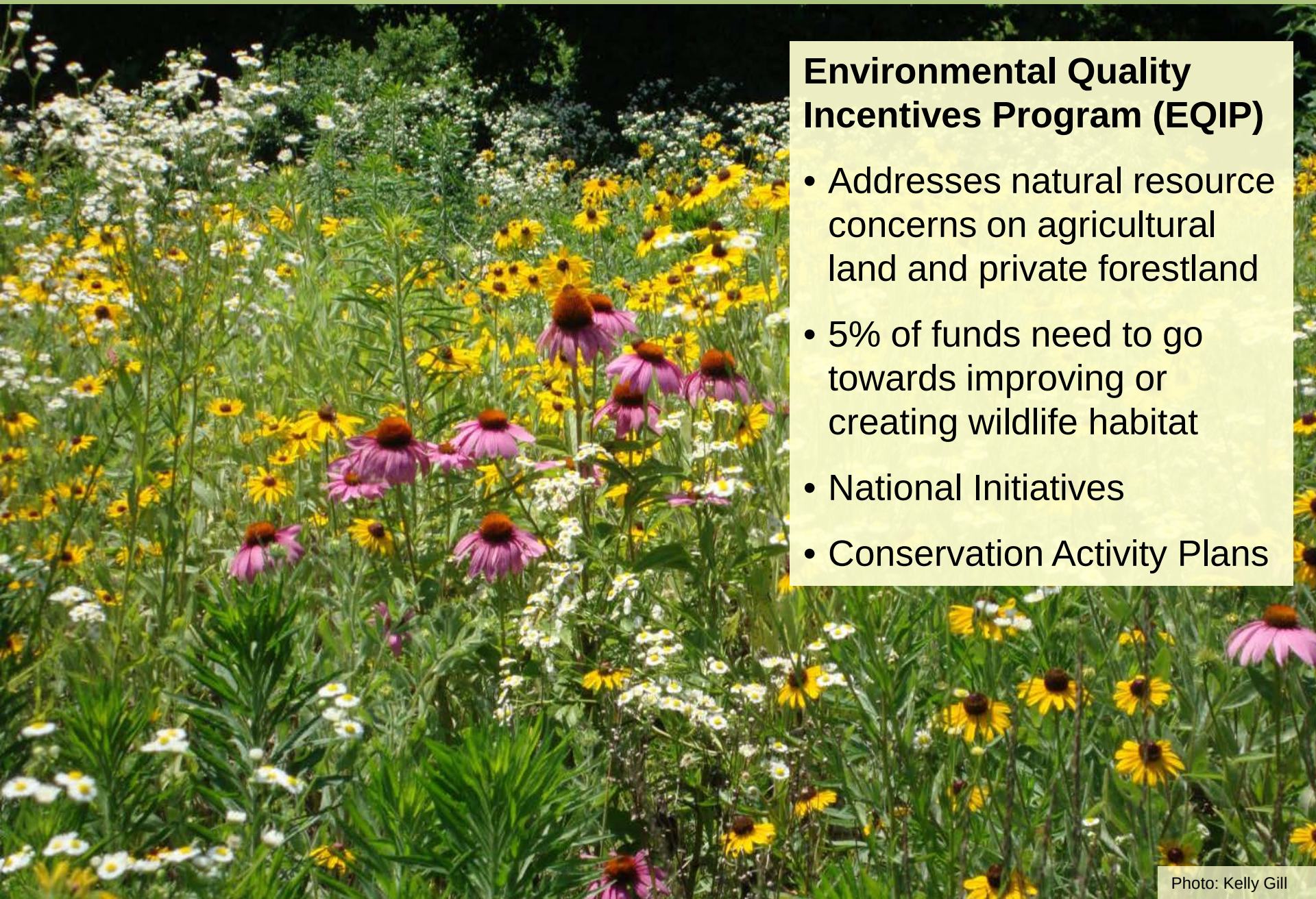


Conservation Technical Assistance (CTA)

- Any farmer or rancher can come into an NRCS office and ask for conservation advice and guidance.
- You don't have to get financial assistance to get help.

Photo: Lynda Richardson (USDA NRCS Virginia)

Farm Bill Programs for Pollinators



Environmental Quality Incentives Program (EQIP)

- Addresses natural resource concerns on agricultural land and private forestland
- 5% of funds need to go towards improving or creating wildlife habitat
- National Initiatives
- Conservation Activity Plans

Photo: Kelly Gill

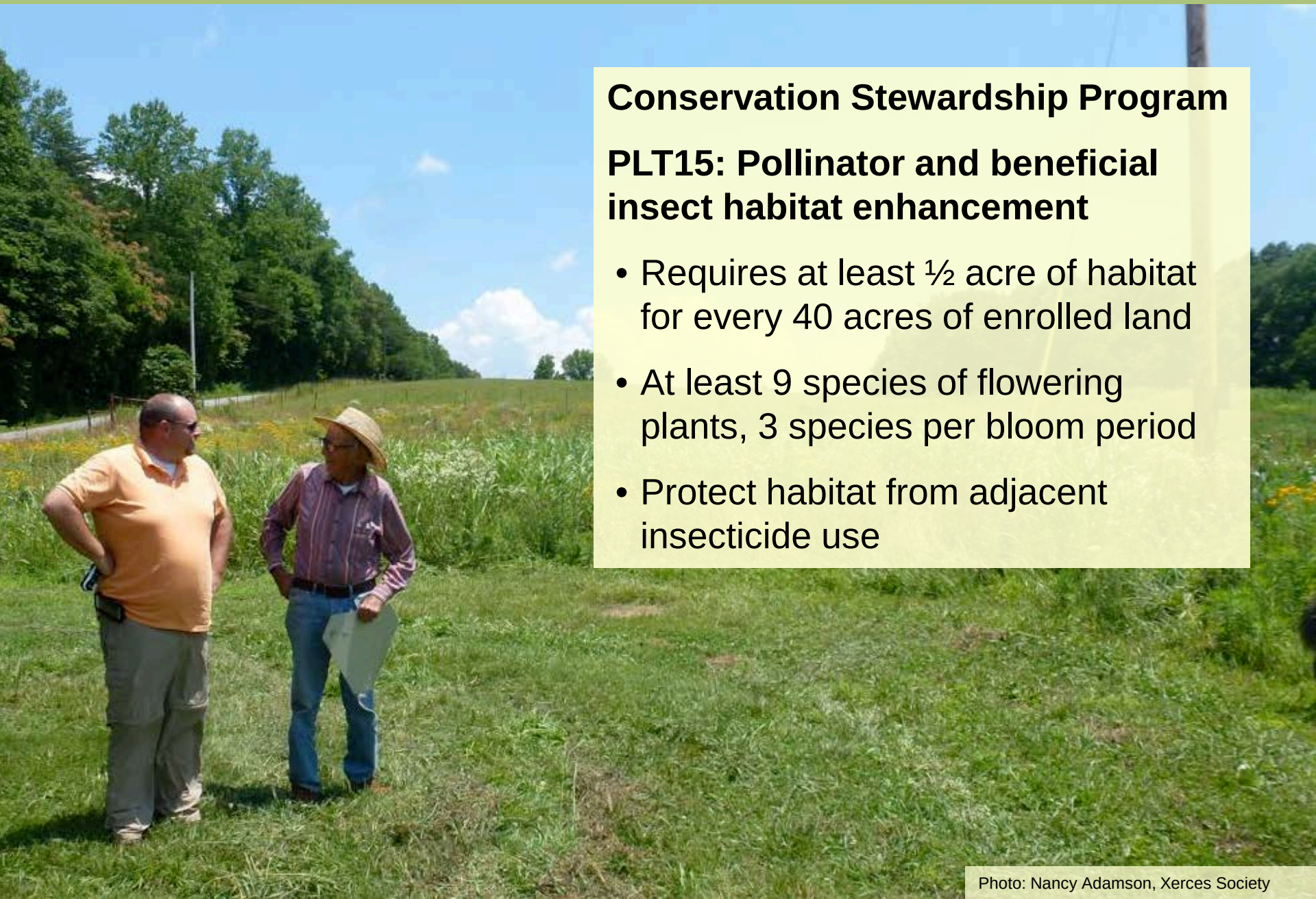
Farm Bill Programs for Pollinators

Conservation Stewardship Program (CSP)

- CSP rewards growers who are already implementing good conservation and sustainable farming practices.
- If landowners rank high enough and qualify for a financial reward, they can be funded to implement additional practices.

Photo: David Biddinger, Penn State University

Farm Bill Programs for Pollinators

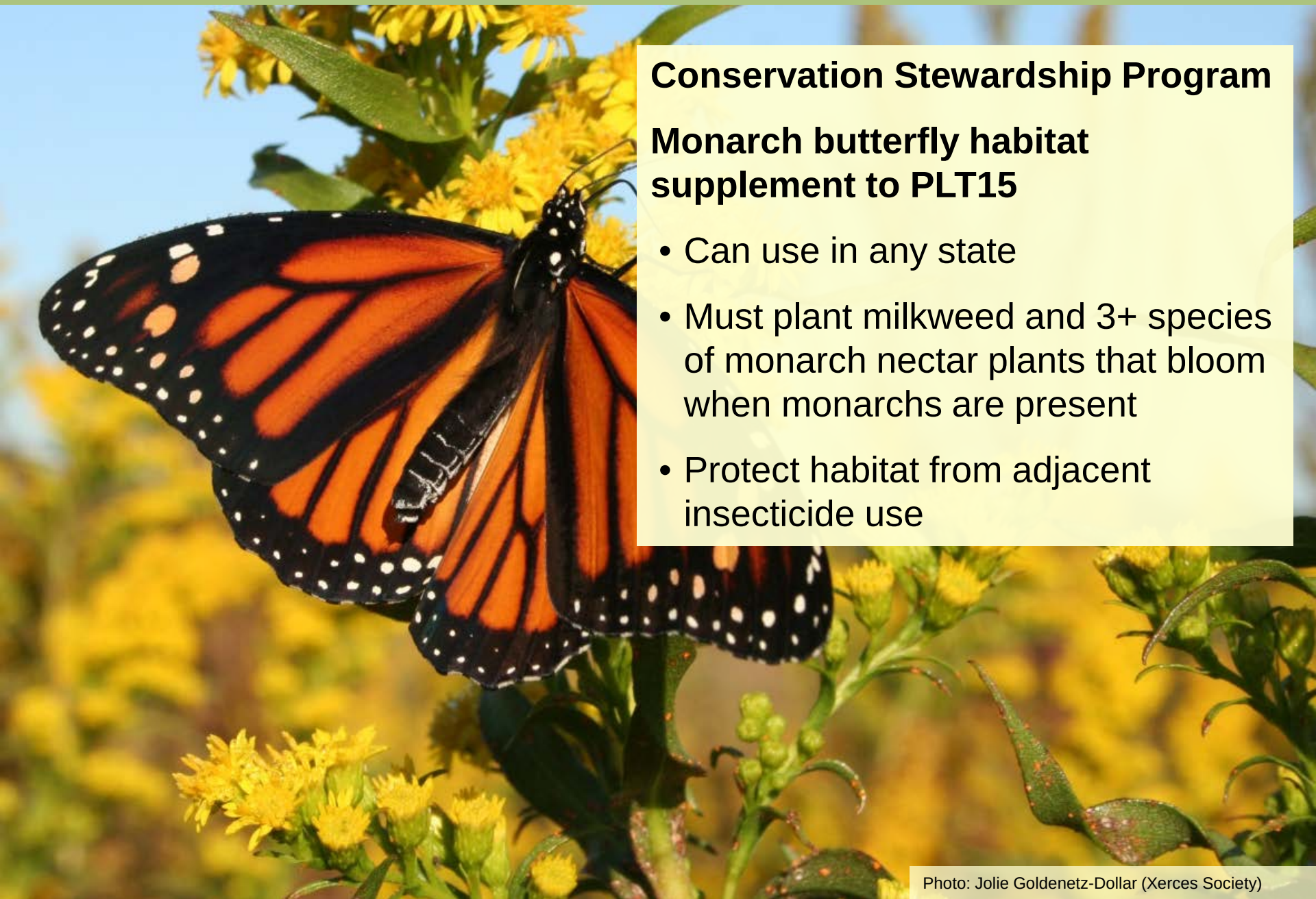


Conservation Stewardship Program

PLT15: Pollinator and beneficial insect habitat enhancement

- Requires at least ½ acre of habitat for every 40 acres of enrolled land
- At least 9 species of flowering plants, 3 species per bloom period
- Protect habitat from adjacent insecticide use

Photo: Nancy Adamson, Xerces Society



Conservation Stewardship Program

Monarch butterfly habitat supplement to PLT15

- Can use in any state
- Must plant milkweed and 3+ species of monarch nectar plants that bloom when monarchs are present
- Protect habitat from adjacent insecticide use

Photo: Jolie Goldenetz-Dollar (Xerces Society)

Agricultural Conservation Easement Program (ACEP)

- 2014 Farm Bill: combined formerly separate easement programs, such as the Wetland Reserve Program (WRP) and Grassland Reserve Program (GRP), into a single easement program.
- Can cover 50% to 100% of the cost of restoration, depending upon the length and type of easement.

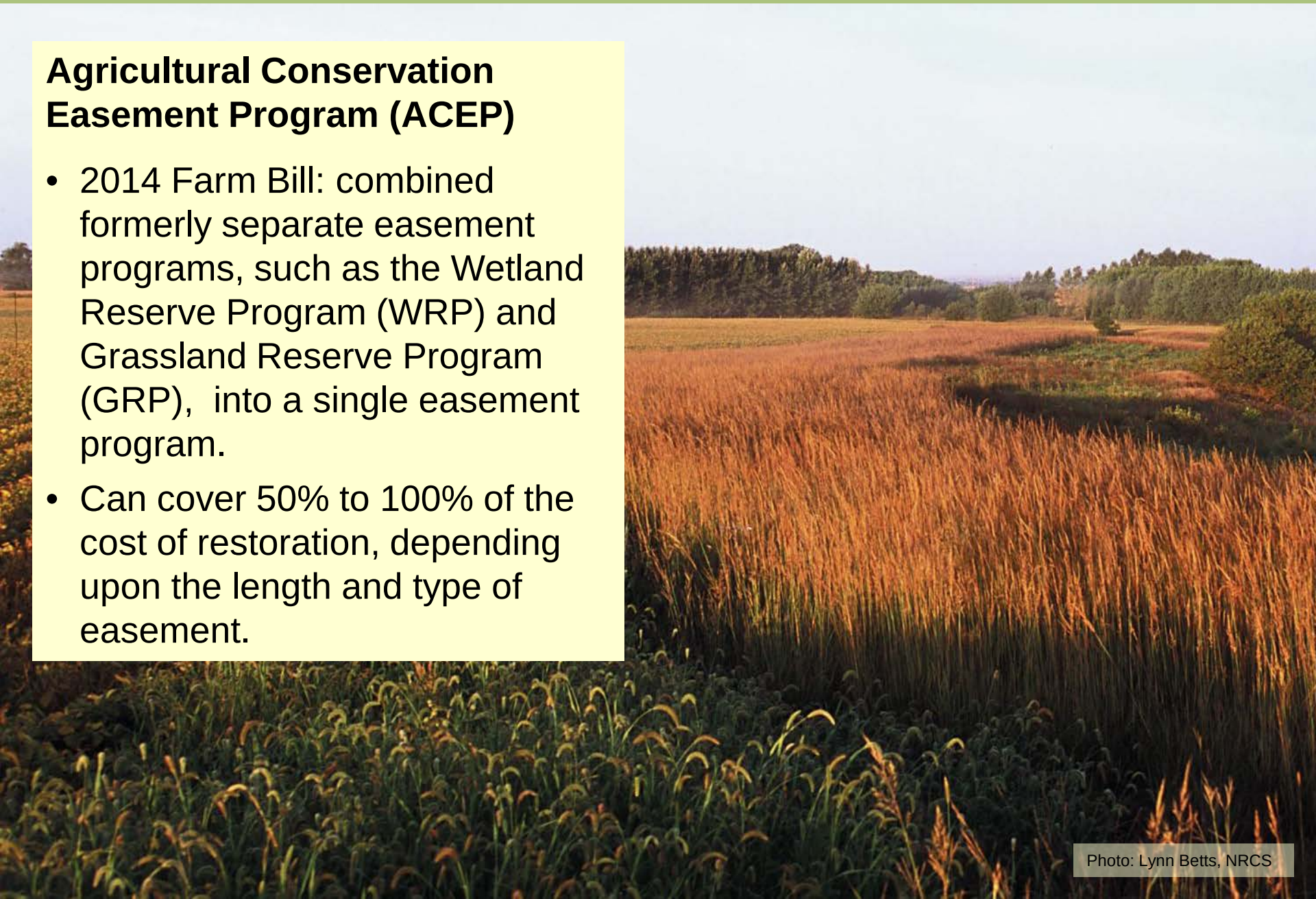
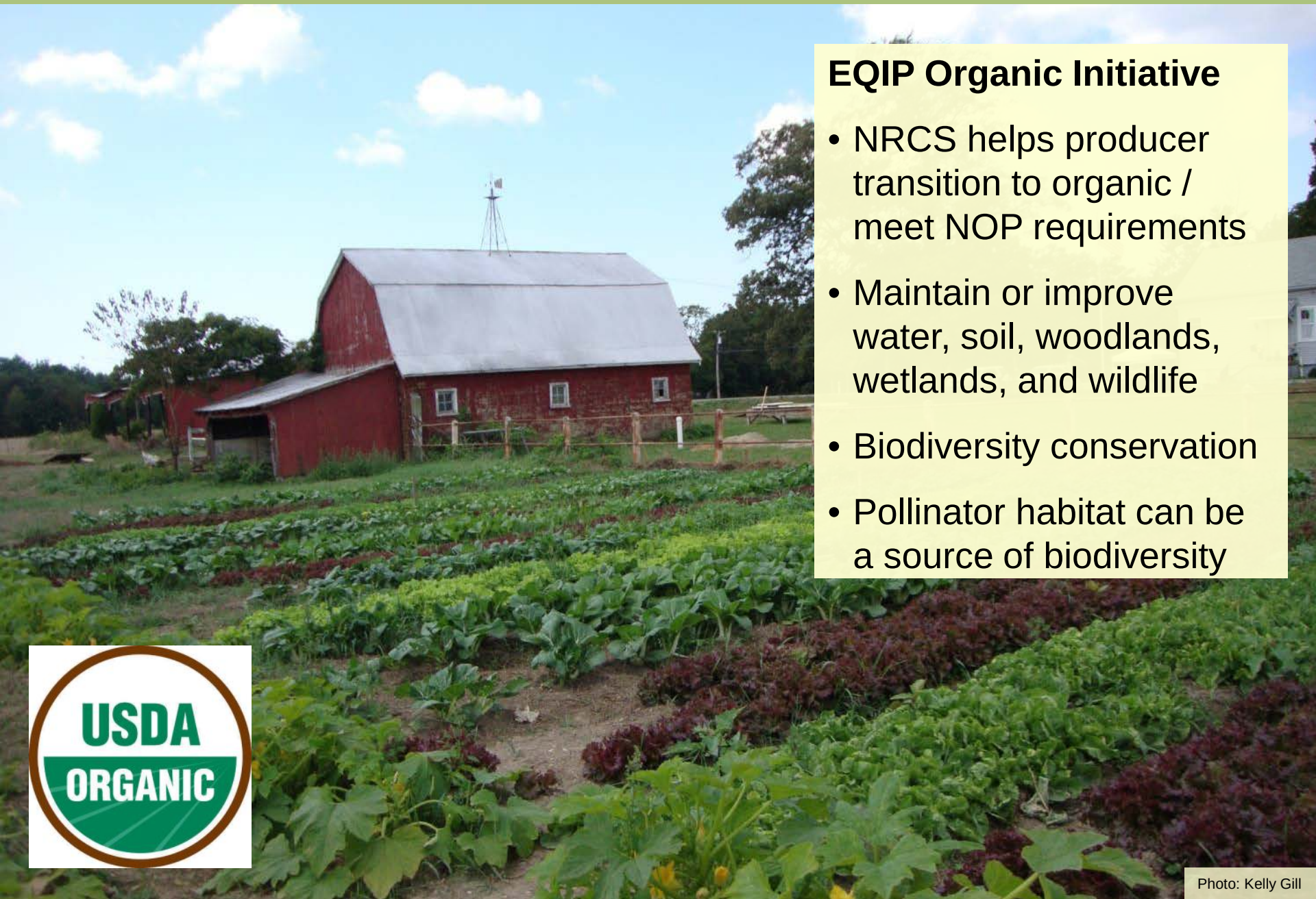


Photo: Lynn Betts, NRCS

Farm Bill Programs for Pollinators



EQIP Organic Initiative

- NRCS helps producer transition to organic / meet NOP requirements
- Maintain or improve water, soil, woodlands, wetlands, and wildlife
- Biodiversity conservation
- Pollinator habitat can be a source of biodiversity

USDA ORGANIC

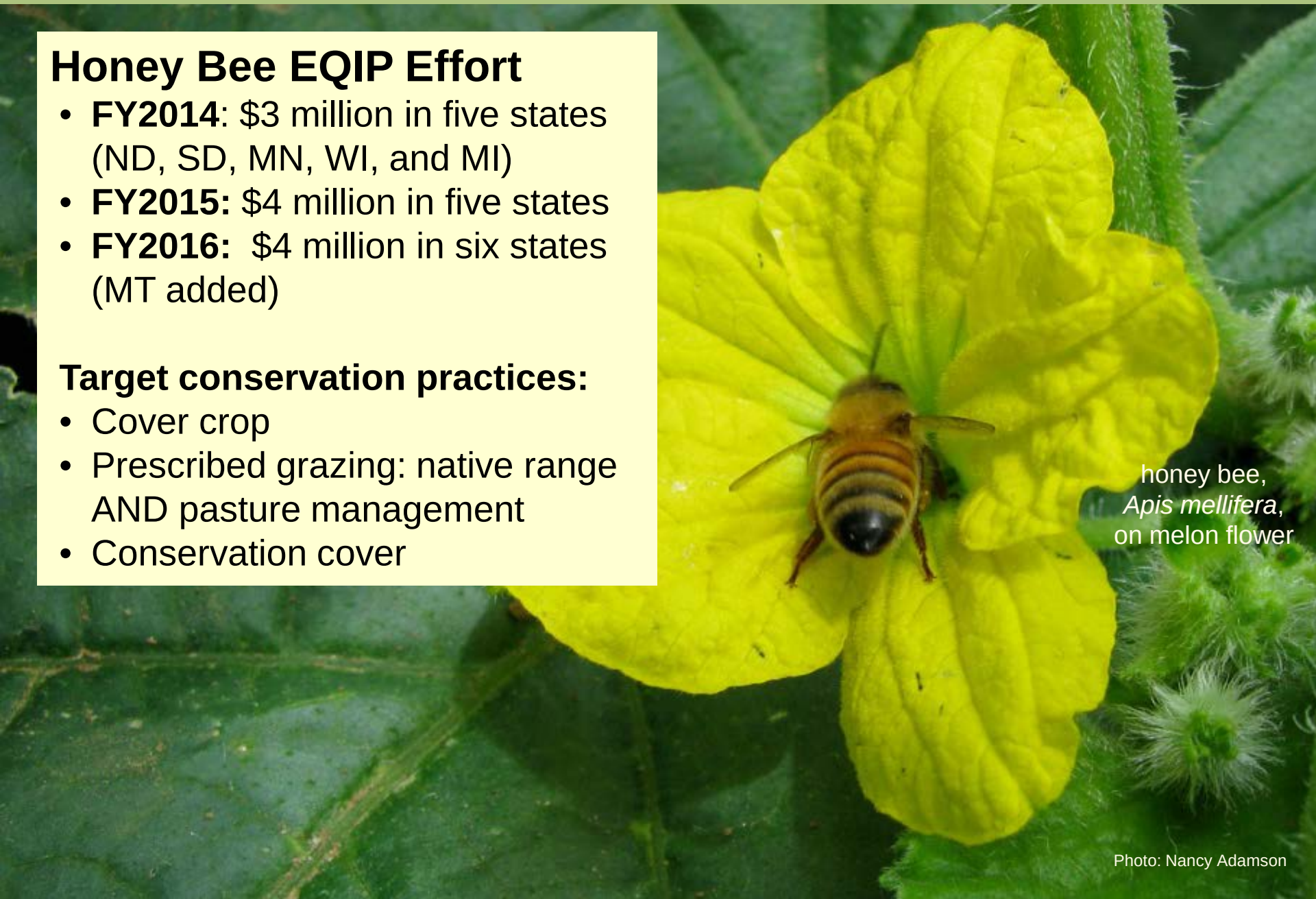
Photo: Kelly Gill

Honey Bee EQIP Effort

- **FY2014**: $3 million in five states (ND, SD, MN, WI, and MI)
- **FY2015:** $4 million in five states
- **FY2016:** $4 million in six states (MT added)

Target conservation practices:

- Cover crop
- Prescribed grazing: native range AND pasture management
- Conservation cover



honey bee, *Apis mellifera*, on melon flower

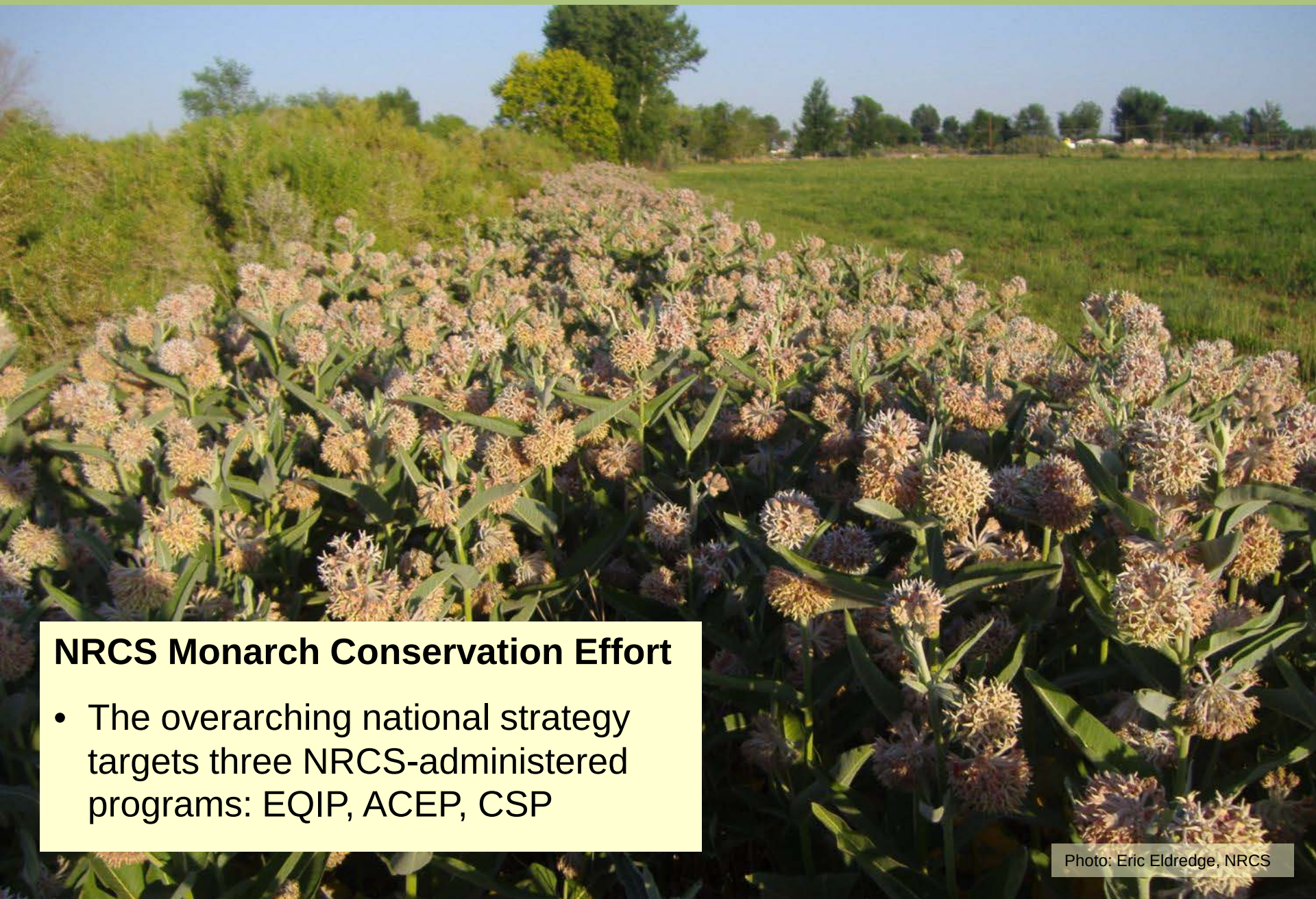
Photo: Nancy Adamson

Monarch Conservation Initiative

Launched November 12, 2015

Photo: Janet E. Powell

New NRCS Monarch Conservation Initiative



NRCS Monarch Conservation Effort

- The overarching national strategy targets three NRCS-administered programs: EQIP, ACEP, CSP

Photo: Eric Eldredge, NRCS

New NRCS Monarch Conservation Initiative

NRCS Monarch Conservation Effort

Ten states at the heart of the migration

- Missouri, Iowa, Illinois, Indiana, Ohio, Minnesota, and Wisconsin
- Texas, Oklahoma, and Kansas

Photo: Jennifer Hopwood, Xerces Society

Monarch Initiative Programs for FY2016

EQIP ($2 million)

- Midwest: Habitat plantings (e.g. Conservation Cover, Riparian Herbaceous Cover, etc.)
- Southern Plains: Prescribed Grazing

ACEP (WRP - $2 million)

- Midwest and Southern Plains: Ongoing restoration on land currently enrolled in WRP.

CSP (no funding set aside)

- Midwest and Southern Plains: Focus on new Monarch Butterfly Habitat supplement and grazing management

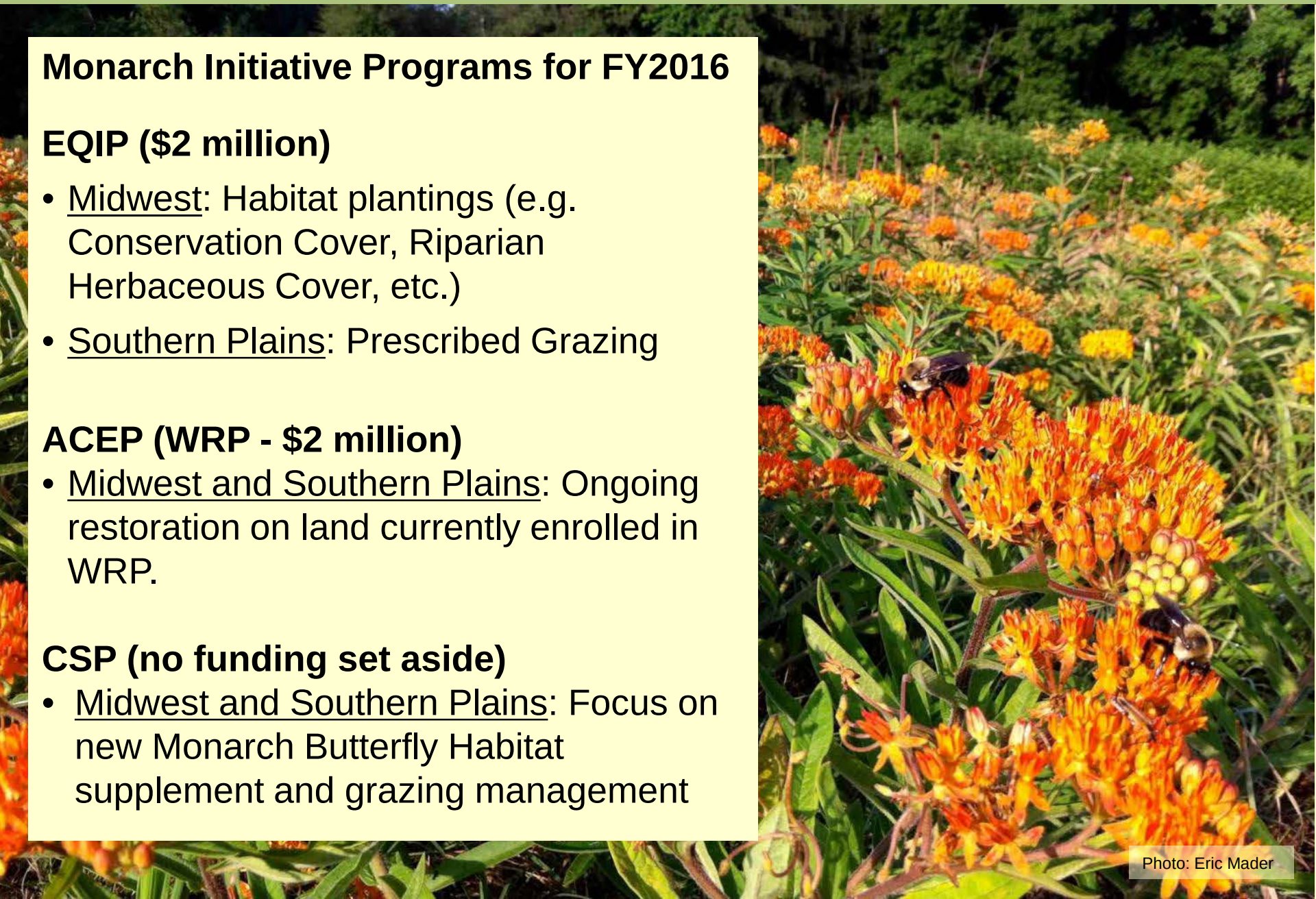


Photo: Eric Mader

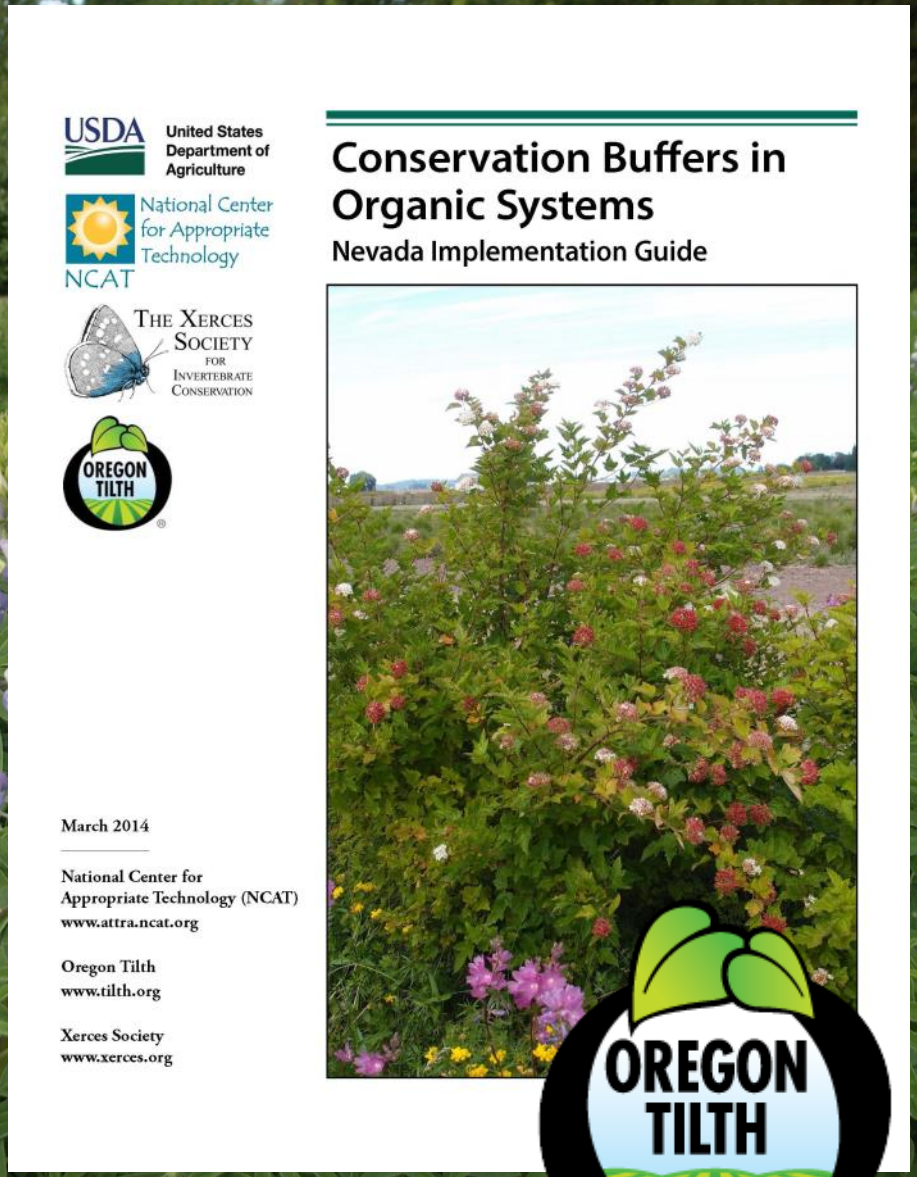
Part 6. Additional Resources

Photo: Rollin Colville

Oregon Tilth Buffer Guides

Oregon Tilth collaborated with several partners to develop a series of guides to establishing buffers in organic systems:

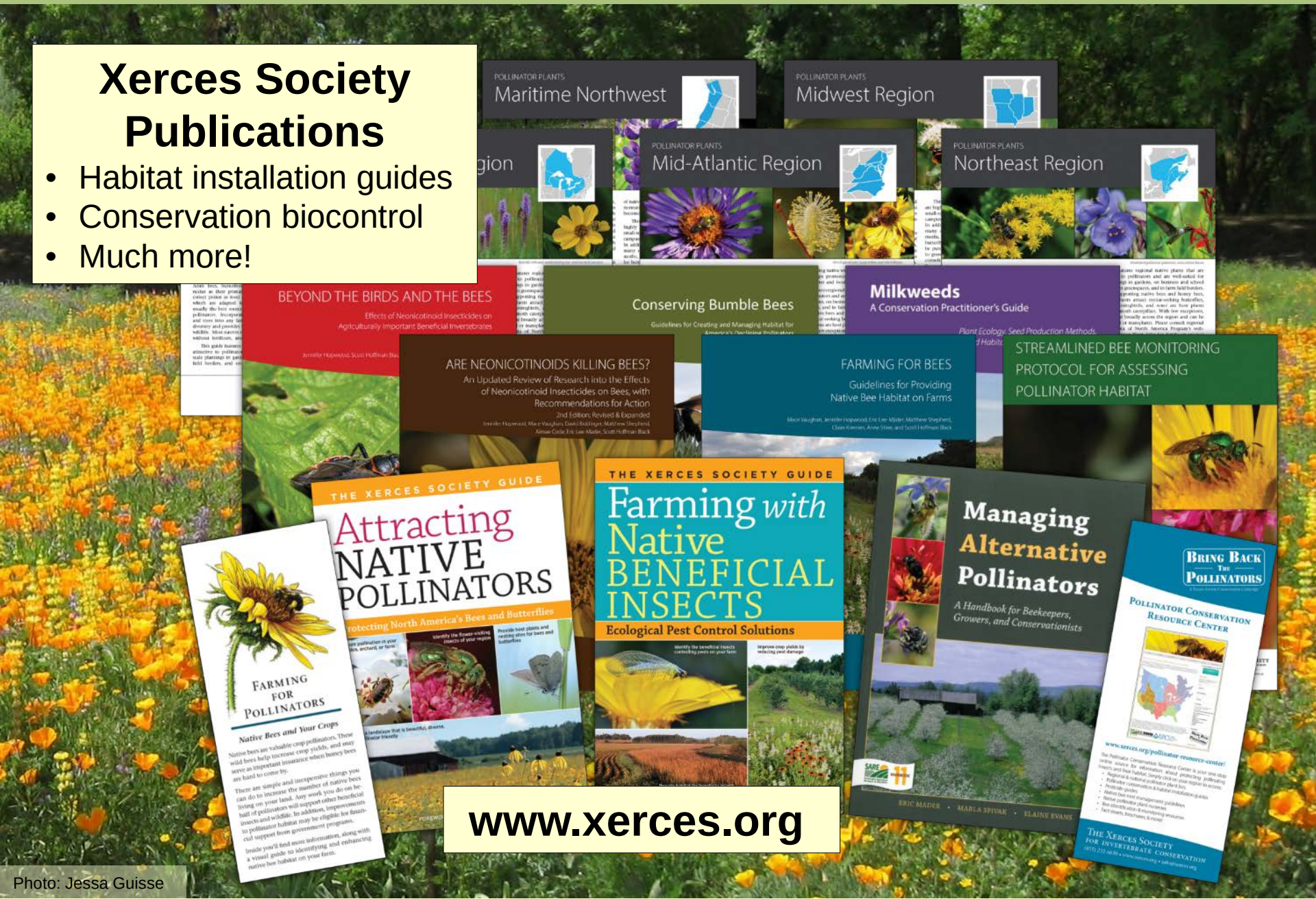
https://tilth.org/resource_topic/buffers/



Additional Resources

Xerces Society Publications

- Habitat installation guides
- Conservation biocontrol
- Much more!



www.xerces.org

Photo: Jessa Guisse

Pollinator Conservation Resource Center

Region-specific Information from Xerces, Cooperative Extension, USDA-NRCS, NGO, and other sources, including:

- Regional plant lists
- National plant lists
- Conservation guides
- Bee nest construction guides
- Pollinator identification guides
- Pesticide reduction guidelines
- Native plant nursery directory

www.xerces.org/pollinator-resource-center

Xerces Habitat Installation Guides and Seed Mix Calculators

Wildflower meadow and hedgerow installation guidelines for multiple regions of the U.S.

http://www.xerces.org/pollinator-conservation/agriculture/pollinator-habitat-installation-guides/

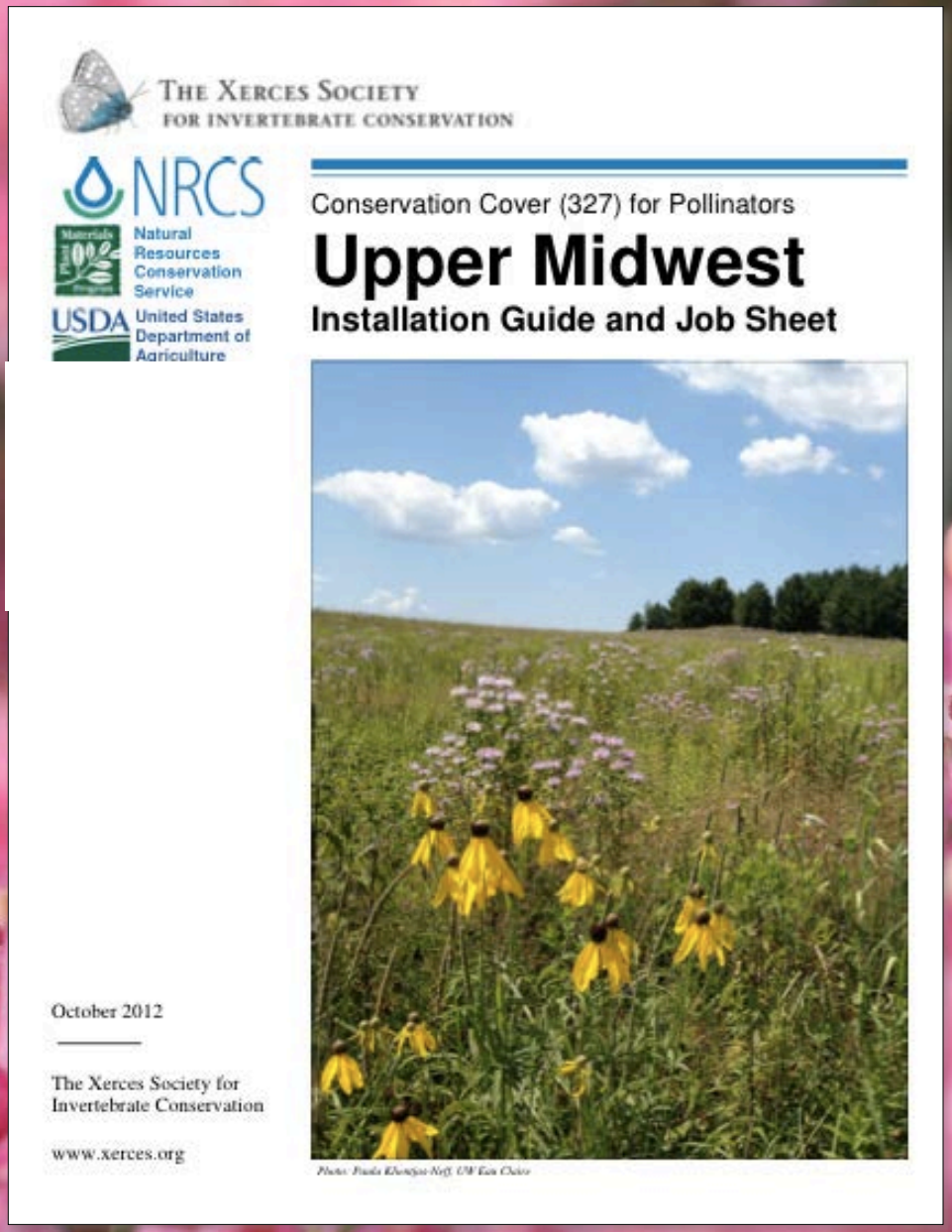


Photo: Karl Foord

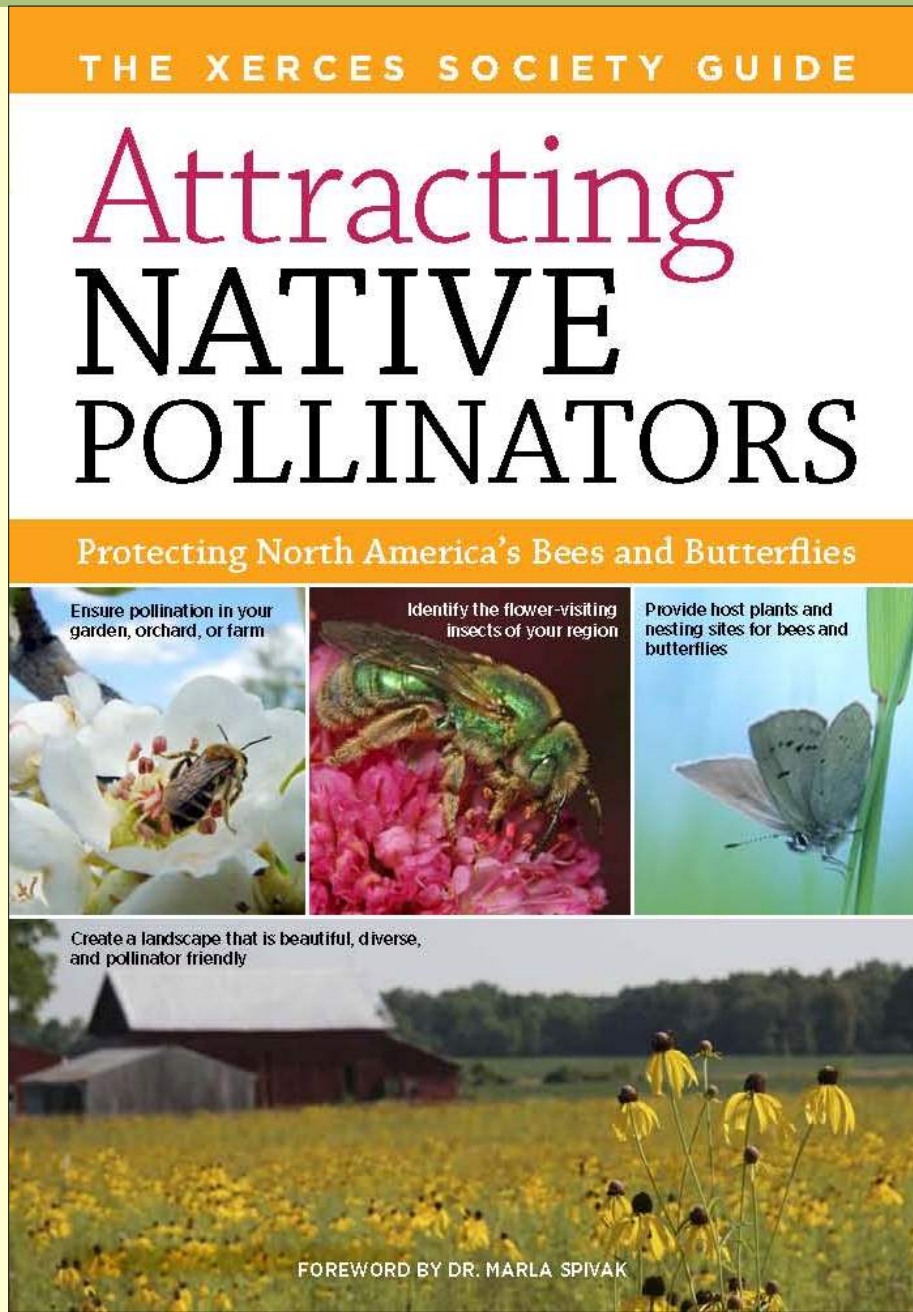
Learn more about pollinators, and how-to restore pollinator habitat in all landscapes

"*Attracting Native Pollinators* belongs on the bookshelf of everyone who values the future of the natural world."

- Douglas W. Tallamy, researcher and author of *Bringing Nature Home*

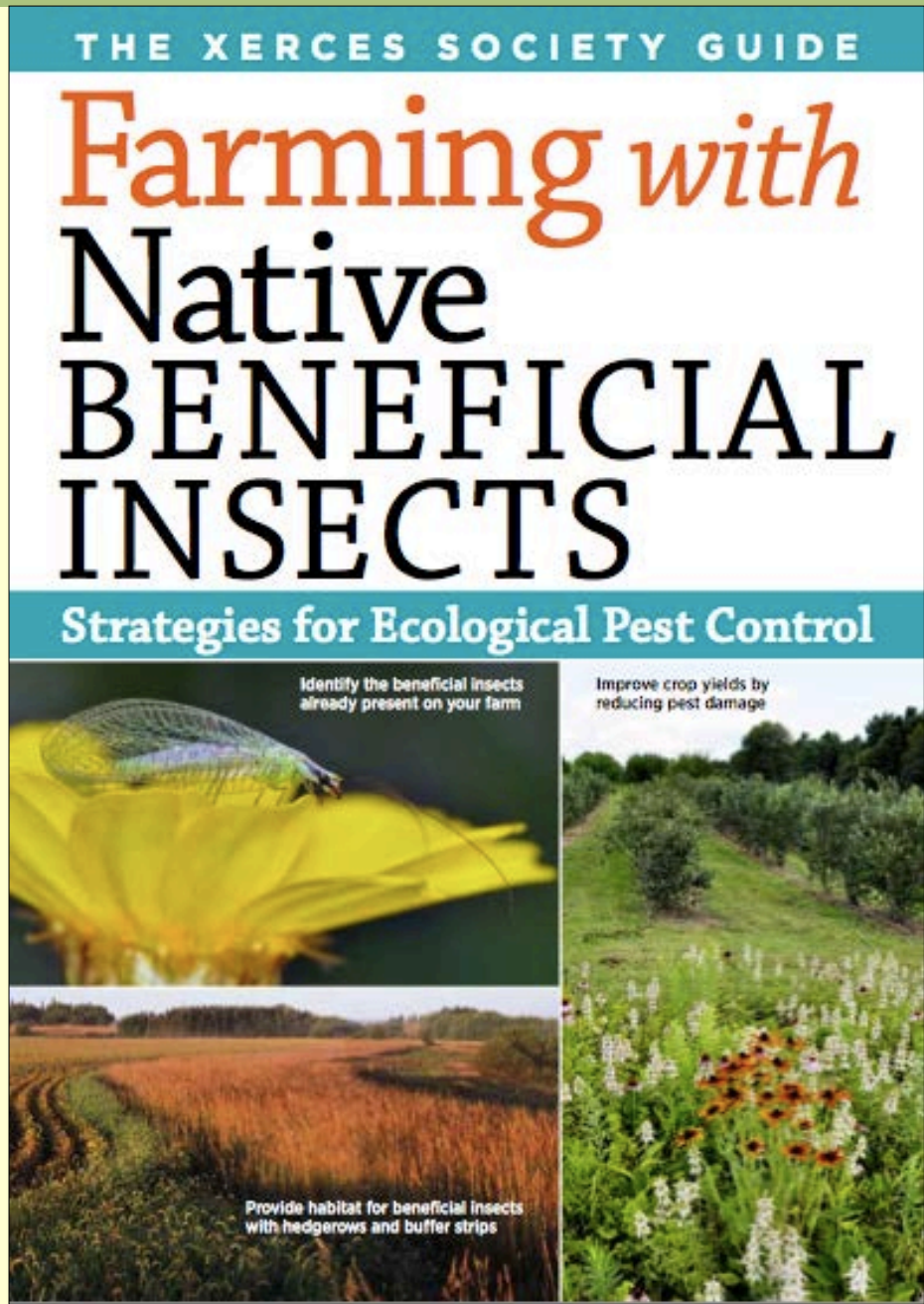
"Precise, elegant and thoughtful, the recommendations offered by the Xerces Society will become essential to advancing a healthy and diverse food production system."

- Gary Nabhan, author of *The Forgotten Pollinators* and *Renewing America's Food Traditions*



NEW ECOLOGICAL PEST MANAGEMENT BOOK

- Installation guidelines for hedgerows, beetle banks, native plant field borders, insectary strips, cover cropping, and more
- Pesticide risk mitigation guidance
- Based upon Xerces Society & UC Berkeley CIG-funded project
- Real world case studies from across the U.S.

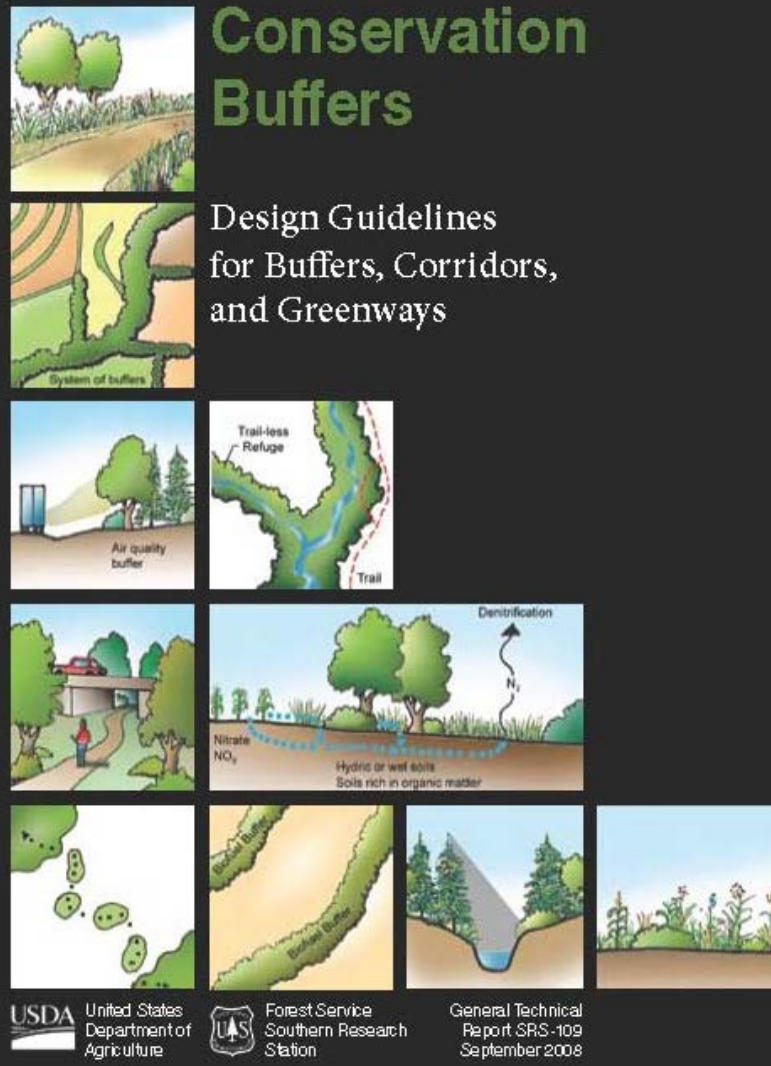


Additional Resources

National Agroforestry Center

Conservation Buffers is a fantastic design guide:

http://nac.unl.edu/buffers/index.html



Photos: Eric Mader, Xerces Society

Xerces Conservation Biocontrol Short Courses

- Rolling out in Western, Midwestern, and Northeastern states
- Basic beneficial insect ecology, habitat design, restoration, and management

http://www.xerces.org/event/

25 Years of SARE
NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

The Take Home Message

Buffers around organic farms can be designed to provide multiple services AND support new guidance on biodiversity from the NOP

Photo: Sarah Foltz-Jordan, Xerces Society

Thank You!

Ben Bowell, Oregon Tilth
Evelyn Johnson, WNTSC

Photo: Rollin Coville