Bring on the Bugs: Farming with Beneficial Insects and Pollinators

Jessa Kay Cruz
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Xerces Society – Who we are

Conservation, education, research, & advocacy to protect invertebrates and habitat

Major Programs:
• Endangered species
• Aquatic invertebrates
• Pollinator conservation & Ag biodiversity
• Pesticide program

Photos: Anne Averill; H. Ballard; Ed Ross
Xerces Society – Who we are

Xerces Pollinator Team

- Staff in CA, NC, NE, NJ, MA, MN, OR, VT, WA, WI
- Five joint Xerces / USDA-NRCS positions

Pollinator Conservation Education

- Outreach to 75,000+ farm and agency professionals since 2008
- Training events in all 50 states, Europe, Asia, Latin America

Habitat Restoration

- Supporting 250,000+ acres of habitat created in the U.S. since 2008

Photos: Brianna Borders, Xerces Society; Jolie G. Dollar; Adam Varenhorst; Jen Knutson; Eric Lee-Mäder, Xerces Society; Kelly Gill, Xerces Society
Carson City CBC Short Course

TODAY’S AGENDA: 8:30 am – 4:30 pm

1. Introduction to pollinators and CBC
2. Basic bee biology
3. Understanding and recognizing natural enemies

BREAK

4. Farm practices to support pollinators and CBC
5. Designing and restoring habitat (part 1)

LUNCH

5. Designing and restoring habitat (part 2)
6. Resources for growers
7. Case studies

BREAK

8. Breakout groups

9. Wrap up
Part 1

The Importance of Pollinators
Importance of Pollinators

More than 85 percent of flowering plants require an animal, mostly insects, to move pollen and to reproduce (make fruit, set seed)
The fruits and seeds produced as a result of pollination are a critical source of food for many mammals and birds.
Pollinators are keystone species!

Importance of Pollinators

Pollinators are valuable to our economy... and our diets!

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

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

Photo: USDA-ARS/Peggy Greb
Importance of Pollinators

Your produce choices with bees
Importance of Pollinators

Insects matter!

Your produce choices without bees

Photo: Whole Foods Market
Most crop pollination is done by the European honey bee. This leaves us reliant on a single pollinator, one that is experiencing many problems.
Crop Pollination by Bees: Wild Native Bees

Nearly 3,600 species of native bees to the U.S, many are excellent crop pollinators

Photos: Doug Walsh, Bob Hammond, Mace Vaughan, Eric Lee-Mader, Nancy Lee Adamson
Recent study of 41 crops around the globe:
• Wild pollinators improved fruit set at **twice** the rate of honey bees
• Better quality pollination relates to the ways bees interact with flowers and foraging techniques.

**Synergy between native bees and honey bees:**
• Presence of native bees increased the efficiency of honey bees

Garibaldi et al. 2013, Brittain et al. 2013, Greenleaf et al 2006
Conservation Biological Control
What is Conservation Biological Control?

‘An ecologically based pest management strategy relying on living organisms’

Beneficial Insects

- AKA
  - “Natural Enemies”
  - “Biocontrol Agents”
- Perform ecosystem services
- Regulate insect pests

Photo credit: Susan Ellis, bugwood.org
What is Conservation Biocontrol?

**Biological Control:**
Use of living organisms to provide pest control

Three Types of Biological Control:
• Classical/Introduced
• Augmentative
• Conservation (CBC)
What is Conservation Biocontrol?

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

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Parasitoid wasp attacking a mottled tortoise beetle

What is Conservation Biocontrol?

Benefits of Conservation Biological Control

• Alternative to insecticides
• Supports the natural ecosystem
• Increase farm diversity
• Reduced risks of unintended consequences
• Reduced management costs
• Value to pollinators and other wildlife
The Importance of Habitat
The amount of natural habitat in our landscapes has a direct influence on pollinator and beneficial insect diversity and abundance.
The Importance of Habitat

When natural areas are far away, bees and other beneficial insects will use resources on the farm (crops, trees, hedgerows, wildflowers, and weeds).

Study: Wildflower plantings in California

- Even in areas with little surrounding natural habitat, planting strips of natural vegetation increased pollinator populations and subsequent visitation of adjacent orchard crops
The Importance of Habitat

Wildflower Field Borders: Researchers observed 12% higher blueberry yields in fields adjacent to wildflower plantings.

Cost of establishing wildflowers is repaid in 3 to 4 years
Study: Hedgerows increase pest control in tomato fields

- Study comparing stink bug parasitism in tomato fields adjacent to hedgerows to tomato fields without habitat.
- Parasitism rate 3x as high in fields adjacent to hedgerows

Scelionidae wasps parasitize stink bug eggs

Consperse stink bug
Example: Flowering Cover Crops Enhance Pest Control in Mississippi

Buckwheat flowering cover crops near soybeans increased wasp parasitism of stink bug eggs by 2 ½ times.

The Importance of Habitat

Natural Habitat Provides:

• Food sources (pollen & nectar)
• Shelter (over-wintering and egg-laying)
• Refuge from pesticides
Tough Times for Insects
Tough Times for Insects

Unprecedented Scale of Habitat Loss

• In CA: Between 2001 and 2011, natural areas disappeared at the rate of one football field every 2.5 minutes (www.disappearingwest.org)

• 9+ Million acres of grassland/prairie converted to cropland since 2008

• *Largest conversion of habitat to cropland since just before the Dust Bowl*
Tough Times for Insects

Unprecedented Scale of Habitat Loss: Changes in Agricultural Landscapes

Removal of fencerows and hedgerows to enlarge field size reduces insect habitat from the landscape.
Tough Times for Insects

**Insecticides:** Dramatic increases in pesticide use, especially systemic and prophylactic use (neonicotinoids)
Honey Bees in Decline

Fewer honey bees available

• 70-100% decline in feral colonies since the 1990s

• Over 50% decline in number of managed hives since 1950

• Average >30% annual losses across the industry since 2006

Causes: Disease, pests, habitat loss, pesticides
Bumble bees – critical pollinators of crops and wildflowers – also in decline

- At least 25% of North American species at risk of extinction

**Causes:** Disease spread by commercial bees, *habitat loss*, *pesticide use*, global change

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

Photo: Jennifer Hopwood
Butterflies in Decline

More than 17% of North American butterfly species at risk, including habitat specialists and formerly common and widespread species.

Source: NatureServe

Photo: Mace Vaughan
Butterflies in Decline

Estimated 74% decrease in western Monarch populations since 1977.

**Causes:** Loss of breeding habitat due to decline of milkweeds, loss of overwintering sites, and extreme weather events.
Tough Times for Insects

Declines of natural enemies less studied, likely similar impacts.

Ambush bug feeding on prey

Photo: Adam Varenhorst
Beneficial Insect Declines

What does all this mean for the sustainability of pest management and crop pollination
Beneficial Insect Declines

To improve sustainability of crop pollination and stabilize natural ecosystems:

• Important to diversify the species that we depend on for pollination in agriculture

• Important to consider the role of natural enemies in pest control

• Important to strengthen habitat and pesticide protection for all beneficial insects

Photos: Toby Alexander, VT-NRCS; Bob Hammond, CSU Coop Ext
Supporting Pollinators and Beneficial Insects

Create a farming environment that supports pollinators and beneficial insects