Restoration to Benefit Pollinators

Plant Selection & Herbicide Impacts

Deedee Soto and Sarah Hoyle

Cal-IPC Symposium

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Photo: Stephanie McKnight/Xerces Society

What is the Xerces Society?

Major Programs

- Pollinator conservation and agricultural biodiversity

- Pesticide reduction
- Endangered species protection
- Aquatic conservation

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

Photos: Xerces Society / Sarah Foltz Jordan; Dana Ross; Justin Ross / NRCS

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Photo: Deedee Soto/Xerces Society

Native Plants & Pollinators

The Importance of Using Native Plants in Restoration

- Native Plants and Pollinators have coevolved over millennia

Recommendations for Restoration

- Use native plants as much as possible
- Consider bloom periods
- Use a diversity of plants
- Provide forage, shelter, & nesting materials
- Make sure the plants are site appropriate

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Photo: Deedee Soto/Xerces Society

Native Plants & Pollinators

Benefits of Native Plants for Pollinator Conservation

- Plants Provide:
  - Forage
  - Shelter
  - Nesting Sites
- Pollinators Provide:
  - Pollination
  - Increased Genetic Diversity
  - Increased Seed Yields
  - Pest Control

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Photo: Stephanie McKnight/Xerces Society

Monarchs & Milkweeds

Host Plant Specialists

- In their larval stage monarch caterpillars are dependent on milkweed species as their primary source of food
- Milkweeds contain toxic cardenolides/cardiac glycosides which monarchs are immune to
- Milkweeds are necessary for monarchs to complete their life cycles
- Like monarchs there are many other insect that are specialist particularly other lepidopterans

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Photo: Deedee Soto/Xerces Society

Non-native & Invasive Plants

Impacts on Pollinators

- Non-native plants can provide forage, shelter, & nesting habitat
- Non-native invasive plant species can also inversely reduce available forage and habitat for pollinators
- Displace native vegetation & reduce diversity
- Create monocultures
- Have significant impacts on insect and pollinators that are host specific
- Harbor pests and pathogens

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Photo: Deedee Soto/Xerces Society

Non-native & Invasive Plants

Impacts on Pollinators

Tropical Milkweed

- Introduced from Mexico
- Unlike native milkweeds it does not die back in the winter
- Harbors protozoan pest *Ophryocystis elektroscirrha* (OE)
- OE can cause malformations, weakness, & reduced vitality in monarchs

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Pesticides & Pollinators

Toxicity research is fairly limited for many native pollinators

- Especially for fungicides and herbicides
- Unknown effects of mixtures

Pesticide use, especially insecticides, can contribute to pollinator declines

- Sublethal impacts can reduce populations over time

Photo: Jessa Kay-Cruz/Xerces Society

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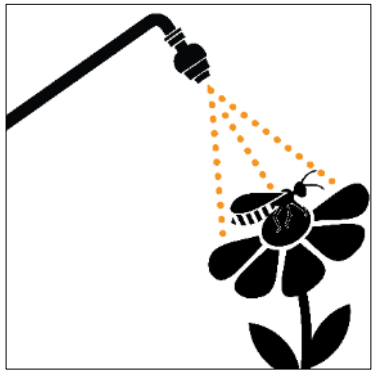
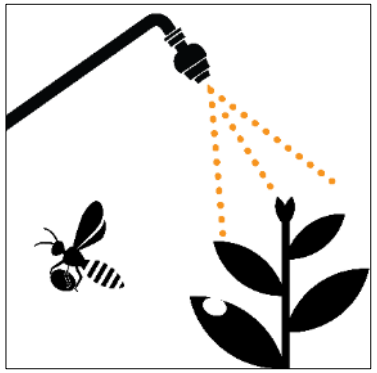
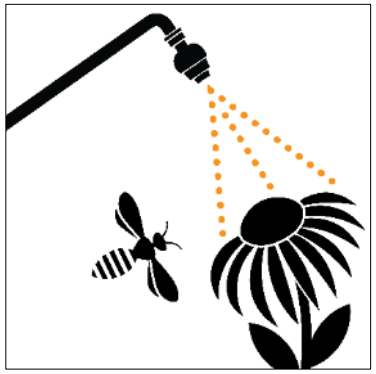
Bee Exposure Pathways



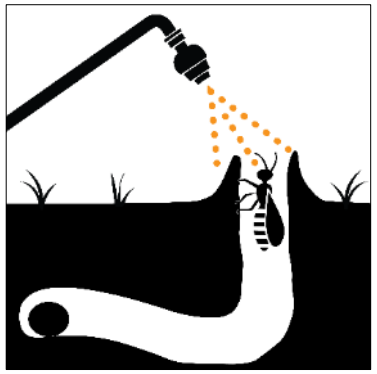
Direct Contact



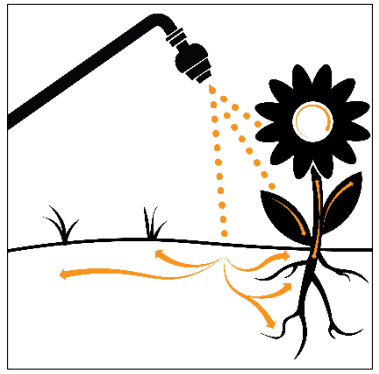
Contaminated Nest Materials



Indirect Contact



Contaminated Nest Sites



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Graphics: Xerces Society/Sara Morris

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Indirect Herbicide Impacts

Herbicides are generally associated with indirect impacts on pollinators

- Removal of habitat resources
- Reductions in plant vigor can reduce forage quality
- Example: Declines in milkweed impacting monarchs in the Midwest

Photo: Brianna Borders

Citations: Kremen et al. 2002; Tscharntke et al. 2005; Forrester et al. 2005; Russell et al. 2005; Dover et al. 2010; Hartzler 2010; Thogmartin et al. 2017

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Direct Herbicide Impacts

Some herbicides show direct toxicity to pollinators

- Rarely kill pollinators outright, but can have lasting sublethal effects
- Most studies are done at higher levels of exposure, but results are concerning for lower doses as well

Several herbicides in EPA review, will require additional pollinator studies

Photo: Brianna Borders/Xerces Society

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Direct Herbicide Impacts: Examples

Bees:

- Changes in gut microbiome
- Impaired navigational and learning abilities
- Effects on immune systems

Butterflies:

- Reduced caterpillar and pupal mass
- Reduced larval survivorship

Photo: David Cappaert/bugwood.org

Citations: Herbert et al. 2014; Balbuena et al. 2015; Motta et al. 2018; Dai et al. 2018; Vazquez et al. 2018; Blot et al. 2019; Farina et al. 2019; : Russell & Schultz 2010; Stark et al. 2012; Bohnenblust et al. 2015; Schultz et al. 2016

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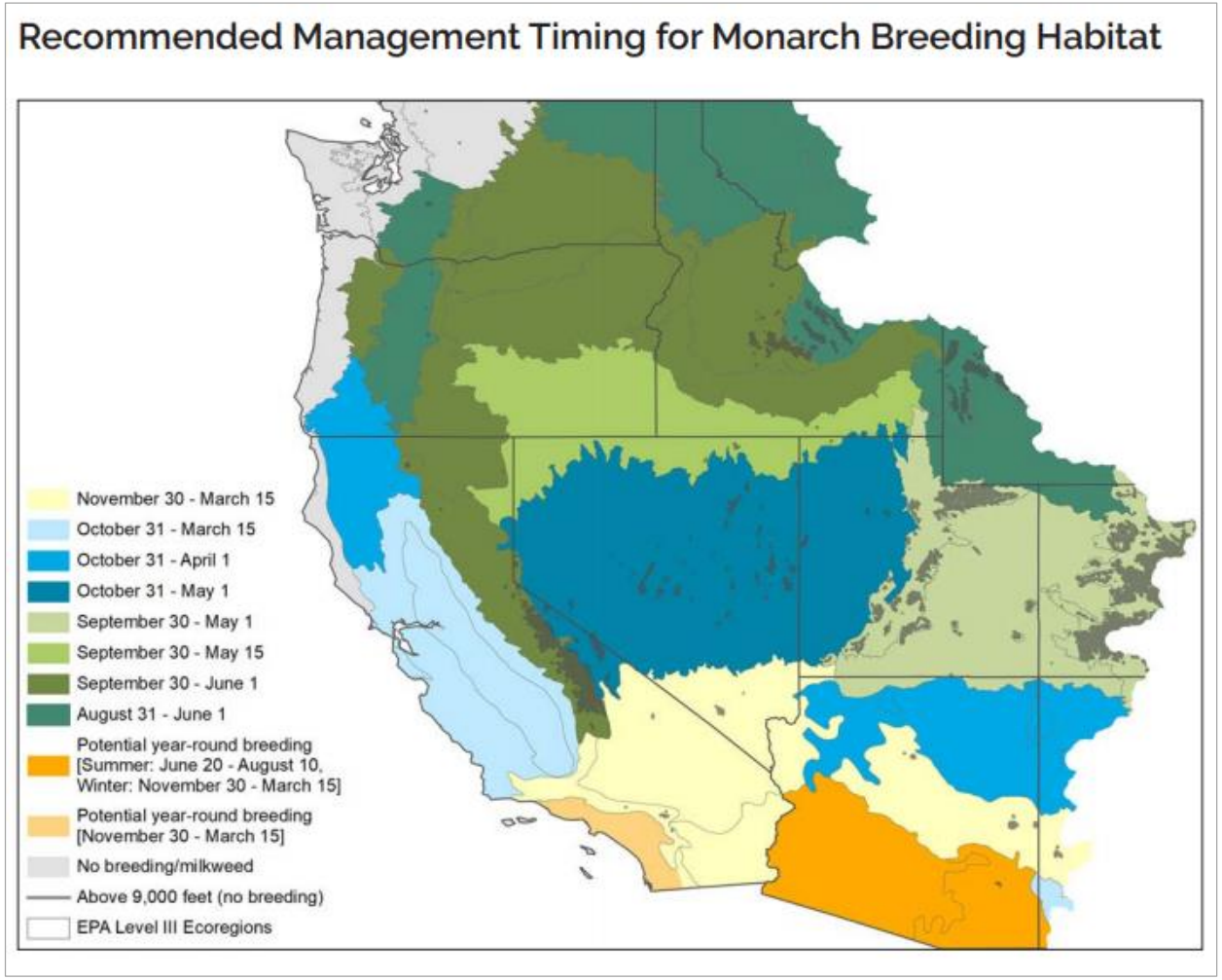
Reducing Herbicide Impacts

- Manage within an IVM plan based on prevention
- Prepare planting sites carefully to avoid needing herbicides in habitat
- Train staff in plant identification
- Time management appropriately
- Choose selective herbicides
- Use targeted applications



Map: Xerces Society

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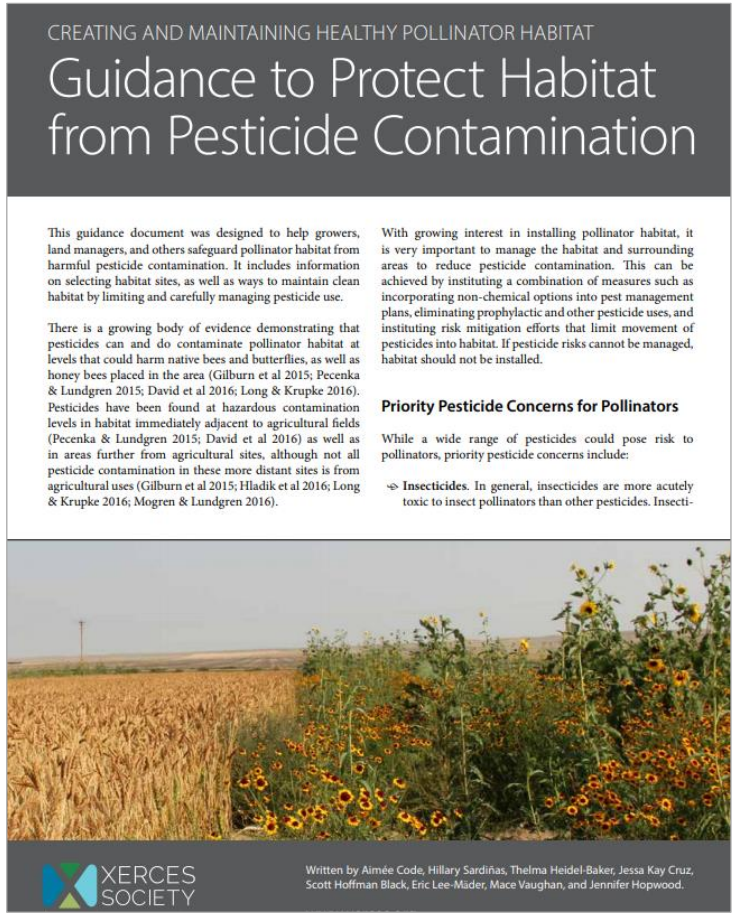
Xerces Resources



CREATING AND MAINTAINING HEALTHY POLLINATOR HABITAT

Guidance to Protect Habitat from Pesticide Contamination

This guidance document was designed to help growers, land managers, and others safeguard pollinator habitat from harmful pesticide contamination. It includes information on selecting habitat sites, as well as ways to maintain clean habitat by limiting and carefully managing pesticide use.

There is a growing body of evidence demonstrating that pesticides can and do contaminate pollinator habitat at levels that could harm native bees and butterflies, as well as honey bees placed in the area (Gilburn et al 2015; Pecenka & Lundgren 2015; David et al 2016; Long & Krupke 2016). Pesticides have been found at hazardous contamination levels in habitat immediately adjacent to agricultural fields (Pecenka & Lundgren 2015; David et al 2016) as well as in areas further from agricultural sites, although not all pesticide contamination in these more distant sites is from agricultural uses (Gilburn et al 2015; Hladik et al 2016; Long & Krupke 2016; Mogren & Lundgren 2016).

With growing interest in installing pollinator habitat, it is very important to manage the habitat and surrounding areas to reduce pesticide contamination. This can be achieved by instituting a combination of measures such as incorporating non-chemical options into pest management plans, eliminating prophylactic and other pesticide uses, and instituting risk mitigation efforts that limit movement of pesticides into habitat. If pesticide risks cannot be managed, habitat should not be installed.

Priority Pesticide Concerns for Pollinators

While a wide range of pesticides could pose risk to pollinators, priority pesticide concerns include:

- **Insecticides**. In general, insecticides are more acutely toxic to insect pollinators than other pesticides. Insecti-

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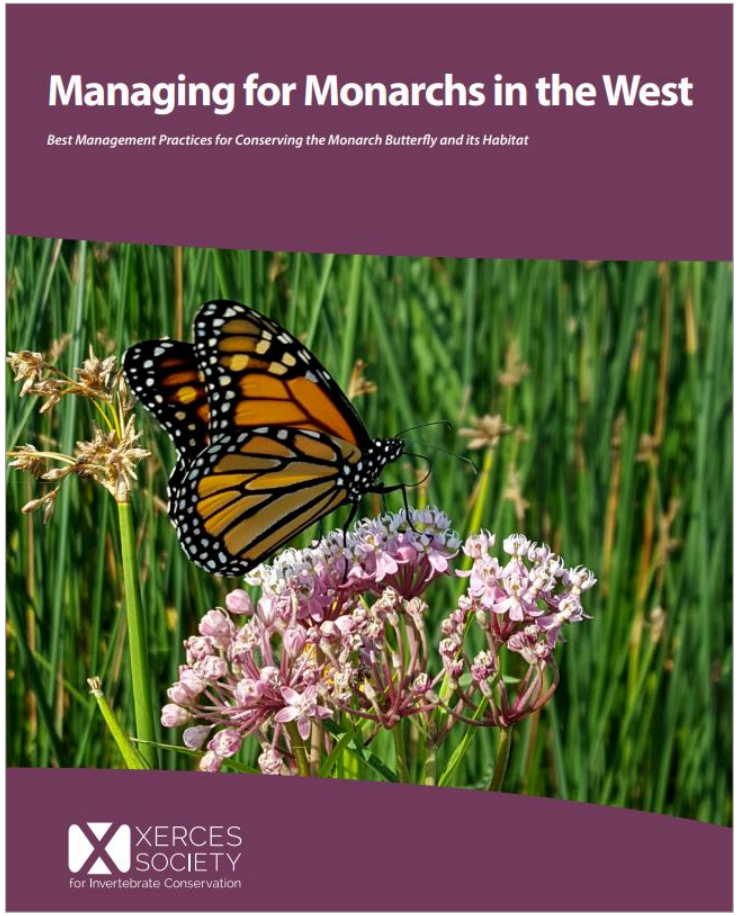
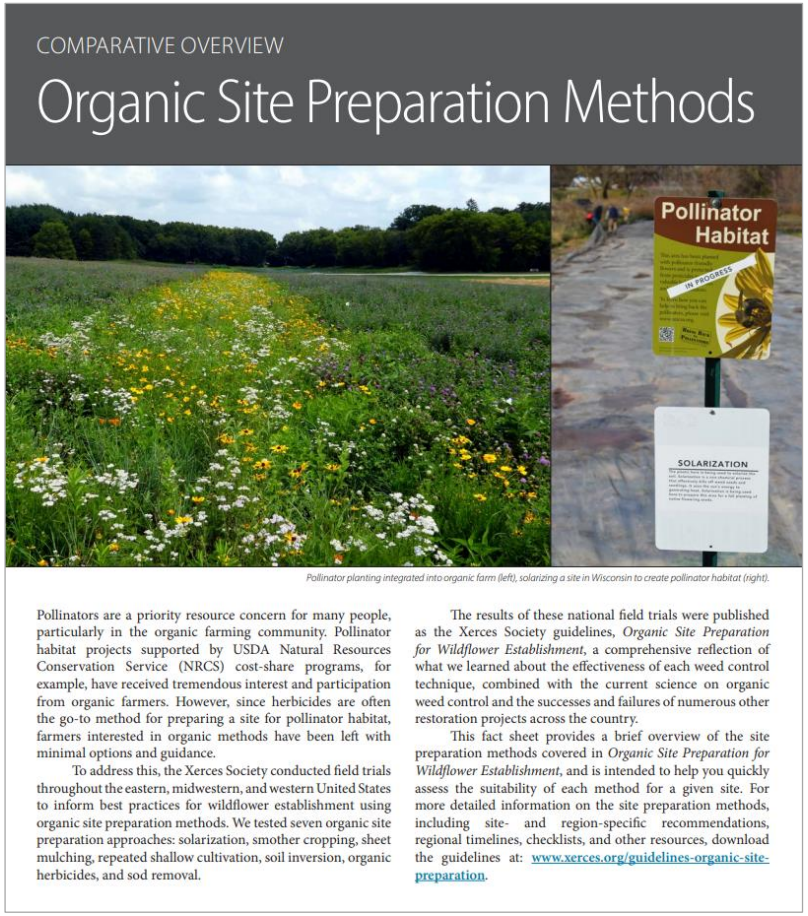


Managing for Monarchs in the West

Best Management Practices for Conserving the Monarch Butterfly and its Habitat

XERCES SOCIETY for Invertebrate Conservation



COMPARATIVE OVERVIEW

Organic Site Preparation Methods

Pollinator planting integrated into organic farm (left), solarizing a site in Wisconsin to create pollinator habitat (right).

Pollinators are a priority resource concern for many people, particularly in the organic farming community. Pollinator habitat projects supported by USDA Natural Resources Conservation Service (NRCS) cost-share programs, for example, have received tremendous interest and participation from organic farmers. However, since herbicides are often the go-to method for preparing a site for pollinator habitat, farmers interested in organic methods have been left with minimal options and guidance.

To address this, the Xerces Society conducted field trials throughout the eastern, midwestern, and western United States to inform best practices for wildflower establishment using organic site preparation methods. We tested seven organic site preparation approaches: solarization, smother cropping, sheet mulching, repeated shallow cultivation, soil inversion, organic herbicides, and sod removal.

The results of these national field trials were published as the Xerces Society guidelines, *Organic Site Preparation for Wildflower Establishment*, a comprehensive reflection of what we learned about the effectiveness of each weed control technique, combined with the current science on organic weed control and the successes and failures of numerous other restoration projects across the country.

This fact sheet provides a brief overview of the site preparation methods covered in *Organic Site Preparation for Wildflower Establishment*, and is intended to help you quickly assess the suitability of each method for a given site. For more detailed information on the site preparation methods, including site- and region-specific recommendations, regional timelines, checklists, and other resources, download the guidelines at: www.xerces.org/guidelines-organic-site-preparation.

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