Merging Roadside Management and Pollinator Conservation

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Photo: John Anderson

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The Xerces Society for Invertebrate Conservation

The Xerces Society is a science based nonprofit organization that engages in education, outreach, applied research, policy, and restoration to protect invertebrates and their habitats.

Main Office: Portland, Oregon
Regional Offices: California, Connecticut, Iowa, Maine, Minnesota, Nebraska, New Jersey, New York, North Carolina, North Dakota, Oklahoma, Washington, Wisconsin

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

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

Today’s talk…

• Importance and status of pollinators
• Best Management Practices
• NCHRP monarch project overview
• Where to go for more information

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

Ollerton et al. 2011
### 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 |

Photos: Wildreturn, Flickr; Ron Nichols, NRCS; Xerces Society / Matthew Shepherd; Karen Ward, NPS.
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
• One in three mouthfuls of food and drink we consume

Morse and Calderone 2000; Klein et al. 2007; Eilers et al. 2011; IPBES, 2016
Bees: The most efficient pollinators

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

Photo: Rollin Coville
Status of Pollinators

Evidence of managed and wild pollinators in decline

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

Evidence of managed and wild pollinators in decline

Patterns of widespread decline in North American bumble bees

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

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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
Bumble Bees in Decline

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

Photo: Bombus fraternus, by Jennifer Hopwood
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
Pollinator Declines

- Rusty patched bumble bee (Bombus affinis) officially listed as an endangered species on March 21, 2017.

Source: IPBES 2016
Butterflies in decline

More than 17% of North American butterfly species at risk
This includes both habitat specialists and formerly common and widespread species

Source: NatureServe
Decline of Butterflies: Monarchs

Photo: Bryan E. Reynolds
Butterflies in Decline: Monarchs

- Monitored in hectares of forest occupied
- 84% decline from population high in 1996
- 6 hectares is the goal for a stable population
Butterfly Declines

Western Monarchs

- Declined by more than 95% since the 1980s
- About 10 million monarchs overwintered in CA in the 1980s, fewer than 300,000 monarchs have been counted

Source: Schultz et al. 2017
Status of Monarchs

Currently under evaluation for ESA listing as Threatened

Monarch listing decision due in 2019

Potential consequences of listing

All hands on deck approach: Roadsides alone cannot provide enough habitat
Transportation Bill Language for Pollinator Habitat

Section 1415: Administrative Provisions to Encourage Pollinator Habitat and Forage on Transportation Rights-of-Way

- Encourages IRVM, including reduced mowing
- Encourages the development of pollinator habitat on roadsides through planting native forbs and grasses

Photo: Idaho Transportation Department

2015 Fixing America’s Surface Transportation (FAST) Act:
Roadsides as pollinator habitat: Summary of the science

Roadsides provide pollinators with habitat:

Food
- Plants that provide nectar and pollen
- Host plants for caterpillars

Shelter
- Nests
- Overwintering sites

Connectivity to other habitat
- Corridors, stepping stones
- Expanded ranges

17+ million acres of roadsides in the U.S.

BMP 1: Protect and manage remnant and existing habitat

Protect and manage remnant habitat and existing stands of native vegetation

• Conduct inventories of roadside vegetation

• Develop and implement site-appropriate management plans that maintain plant diversity

Photo: Texas DOT
Case Study: Washington DOT Inventories Inform IVRM

Identify invasive weed issues, existing habitat, opportunities for managed succession

Conduct management, Evaluate management result

Determine changes to IRVM plan

Update IRVM plans

Conduct crew trainings on plan changes
Case study: Encouraging wildflowers in Florida

Florida DOT focuses on protecting existing wildflower stands

- Florida DOT Wildflower and Natural Areas Program
- Additionally, 31 of Florida’s 67 counties have adopted roadside wildflower resolutions. Citizens take the lead, work with county commissioners to draft resolutions tailored to their county.

Photo: Jeff Norcini
BMPs 2: Adjust Mowing Practices to Benefit Pollinators

Reduce the frequency of mowing beyond the clear zone

Example: Limit mowing to no more than twice a growing season

Consider the timing of mowing

Balance management needs with resource needs of pollinators

Adopt techniques that reduce impacts to pollinators

Example: Mow at height of 10” or more to allow vegetation to recover quicker

Case Studies: Reduced Mowing

Illinois reduced mowing strategies
Mowing only 15 feet along the roadway (one pass of mower), with final mow in fall
• Saw increased milkweed stems and more wildflowers

Kansas budget cuts
Mow fence to fence every 2-4 years on a rotational basis, wildflowers flourished

Photo: Ron Klataske
Reduced Mowing: The Business Case

Florida I-10 reduced mowing pilot study
Typically mowed 7x/yr, reduced mowing to 1x/yr in the fall: Saved $1000 per mile and increased wildflower abundance and diversity

Oklahoma DOT saved $1.5 million in summer and fall of 2016 due to reduced mowing of some roadsides

Source: Norcini 2015

Photo: Jeff Norcini
Emerging Research

Mowing stimulating Milkweeds

In some regions, a July mowing may stimulate milkweed regrowth, which is preferred by monarchs for egg laying in late season.

Different timing for different regions is likely needed

Baum and Mueller 2014; Fischer et al. 2014

Photo: Jennifer Hopwood
BMPs 3: Reduce the Impacts of Herbicides on Pollinators

Use herbicides efficiently and effectively:
- Use selective herbicides or use nonselective herbicides selectively
- Time applications for vulnerability of weeds

Avoid damage to nontarget plants:
- Recognize weeds (avoid native plants)
- Target applications
- Manage drift

Photo: Jennifer Hopwood

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Case Study: Reducing herbicides on Oregon’s roadsides

2010 Internal Oregon DOT directive to reduce amount used by 25%

- Replaced older application equipment
- Moved to spot spraying for noxious weeds
- Avoided routine sprays

By 2015, herbicide use reduced by nearly 50%

Photo: Matthew Shepherd/Xerces Society
Incorporate landscape design elements that benefit pollinators

• Prioritize ecoregional native plants
• Increase flowering plant diversity and abundance
  – Wildflowers, Shrubs, Trees
• Include flowering plants with sequential overlapping bloom times throughout the growing season
• Include butterfly host plants
Case Study: Living Snow Fences

New York State Department of Transportation

Shrubs as living snow fences

- Willows trap snow, reduce maintenance costs and increase driver safety
- Willows and other native flowering shrubs used in living snow fences are an important food source for pollinators in early spring
Case Study: Ecoregional seed mixes

California Department of Transportation

California has extraordinary botanical diversity and 19 ecoregions, ranging from coast to desert to mountains

- Caltrans uses TransPLANT, a tool that helps landscape architects select regionally appropriate native plant species
- Enter in a project’s location -> get a list of potential species based on ecoregional classifications, project site parameters, and seed availability.
BMPs 5: Plant your site effectively, enhance establishment

Prioritize locations
Focus first on sites with lower weed pressure, visible to public (if that is a goal), won’t be sprayed out by adjacent land

Thoughtful site planning and implementation
Select suitable species, time of planting, type of planting, conduct site preparation, effective planting techniques, provide weed control during establishment

Find high quality plant material
Prioritize local ecotypes

Build revegetation expertise within your agency
Conduct trainings, build partnerships, develop standard operating procedures

Photo: Idaho Transportation Department
Case study: Native seed industry in Iowa

Iowa has lost 99.9% of prairie and wetlands

1989 legislation supported Integrated Roadside Vegetation Management:

• Use of native plants, locally sourced
• Judicious mowing, herbicide use, prescribed burning
• Iowa DOT cooperated with state and federal agencies and private nurseries to build a native seed industry
  • Foundation seed sourced from three regions of Iowa
Case Study: Planning ahead in Arizona

Advance planning reduces weeds, aids plant establishment

- Increases production and availability by consistently committing to use of locally sourced plant material
- Use 15-25 species of native plants, usually over 50% forbs
- Plan 3-5 years in advance with plant providers
- Write weed control into construction specifications so that new plantings have a better chance to establish
BMPs 6: Raising public awareness

Engaging and informing the public can significantly help to build public support.

- Spread educational information through a number of avenues
- Produce effective restorations that can serve as examples of success
Case study: Establishing wildflowers in Ohio

District 9 Pollinator Plantings

- Site Selection:
  - Visible location, plenty of floral resources for pollinators, wide ROW, near apiary
- Outreach to local community
- Working with partners to gain restoration knowledge

Photo: Dianne Kahal-Berman, Ohio DOT
BMPs 7: Training Your Staff

Training can include:

- Background knowledge about pollinators and the role of roadsides in pollinator conservation
- Management techniques and design elements that benefit pollinators
- Information about long-term economic and ecological value of native plants

Native plant identification training with the Tallgrass Prairie Center in Iowa

Photo: Iowa DOT
Evaluating the Suitability of Roadway Corridors for Use by Monarch Butterflies

Funded by the National Cooperative Highway Research Program
Project coordinated by Monarch Joint Venture

Photo: Jennifer Hopwood
Four Components

- GIS Priority Habitat Model
- Rapid Field Assessment
- Habitat Calculator
- Best Management Practices
GIS Prioritization Model

• Revegetation following Construction
• Where to Invest
• Rank Roadsides

  • Wider
  • By Natural Lands (fewer chemicals, weeds)

  • Traffic Volume (collisions and salt, zinc, phosphorus, nitrogen)

Priority Area for Habitat

- High
- Low
Rapid Field Assessment for Monarch Habitat

• ~10 minutes
• Walk 150 ft
• Zig zag across ROW
• Record number of milkweeds, types of flowers, prevalence of noxious weeds
• Width habitat, mowed
• Protocol compared well to Integrated Monarch Monitoring Protocol
• Results so far: Monarch breeding on 35% of sites with milkweed
Monarch Habitat Assessment: Calculator

- Rapid Field Assessment
- Calculate habitat score
- Identify exemplary sites or opportunities to improve
- Connect to BMP’s
Best Management Practices

- Mobile friendly website with regional, context-dependent BMP’s
- Case studies, existing resources
- Tools for communication
  - With public:
    - FAQs
  - With staff:
    - Training module
    - Regional milkweed ID guides
- What other tools do you need?
NCHRP Project: Roadsides as Habitat for Monarch Butterflies

https://monarchjointventure.org/our-work/partner-projects/roadsides-as-habitat-for-monarch-butterflies

For more information or to get involved, please contact Alison Cariveau
acarivea@umn.edu
FHWA Revegetation Manual

Available in 2018: Updated classic 2007 manual

- Has a national scope, with regional case studies
- Updated revegetation recommendations, resource library
- Is peer-reviewed
- Includes information about pollinators, including:
  - Habitat needs (pollen, nectar, host plants, nesting, overwintering)
  - Objectives for pollinators during project design, including plant selection
  - Vegetation management and pollinators
  - Monitoring of habitat and pollinators

Available at www.nativerevegetation.org
FHWA’s Ecoregional Revegetation Application Tool

- Search for native plants by ecoregion
- Filter plants by attributes (soil, moisture, value to pollinators, salt tolerance, more)
- Workhorse species for revegetation

http://www.nativerevegetation.org/era/
FHWA’s Ecoregional Revegetation Application Tool

- Search for native plants by ecoregion
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- Workhorse species for revegetation

http://www.nativerevegetation.org/era/
Bee and Butterfly Monitoring Protocols

These tools include:

- Introduction to bee and butterfly identification
- Detailed monitoring protocol
- Data sheets

They can be used to assess:

- Pollinator habitat quality
- How pollinator communities change through time

Provide a metric that is more accessible than collecting specimens and is scientifically rigorous
Guidance for planting and maintaining pollinator habitat
Regional Monarch Nectar Plant Guides

Nectar guides include information on species which are
- Native & attractive to monarchs (documented visitation)
- Commercially available
- Hardy and appropriate for large-scale restoration
- In bloom during the time period when monarchs are in a particular region
Milkweed Seed Finder

Native milkweeds (Asclepias spp.) are essential for monarch butterflies (Danaus plexippus) caterpillars and support a diversity of pollinators with their abundant nectar. By including milkweeds in gardens, landscaping, wildlife habitat restoration projects, and native revegetation efforts, you can provide breeding habitat for monarchs and a valuable nectar source for butterflies, bees, and other beneficial insects. As part of our Project Milkweed, we have created this comprehensive national directory of milkweed seed vendors to help you find sources of seed. To learn more about monarch butterflies and how you can participate in conservation efforts, please visit the Xerces Society’s Monarch Butterfly and Western Monarch Conservation Campaign pages or the Monarch Joint Venture webpage.

Please use the drop-down menus below to search for seed sources by species and/or state. Below the search function, you can read more about finding and selecting the milkweed seed that is right for your area.

Before using the Seed Finder, please note that:
- Milkweed seed is currently unavailable in several areas of the country. If you do not receive any results when you search by state, we have not listed any milkweed vendors located there.
- Please search other states in your region for vendors who may carry local varieties that are appropriate for planting in your area.
- A seed vendor’s physical address does not always reflect the origin of the seed that they carry. Please always ask vendors for information about seed origin and try to plant seed that is as locally sourced as possible.
- Some of the vendors listed are wholesale only and require a minimum order amount.
- In most parts of the country, it is best to plant milkweed seed in the fall, however, spring planting is possible in some areas. Please ask your regional seed vendor for planting recommendations.

Search for Native Milkweed Seed

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<th>Plant Species</th>
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Milkweed Availability and the Nursery Industry

At present, approximately 20 milkweed species are available as seed to varying degrees, although availability varies widely by region. Through Project Milkweed, we have been working to change this in several states, but notable gains in availability remain.

In addition to seed, several nurseries also sell milkweed transplants (“plugs”). Please ask your regional vendors about availability. For regional lists of native plant nurseries, visit our Pollinator Conservation Resource Center.

Species Selection

We encourage you to only plant milkweed species that are native to your area. The Biota of North America Program’s (BONAP) web-based North American Plant Atlas provides county-level distribution information for all Asclepias species in the lower 48 states (milkweeds are not native to Alaska and Hawaii). Please refer to BONAP’s map color key for detailed information, and note that dark green indicates that the species is present within the state, while bright green shows that the species is documented to occur in that specific county. However, these maps do not convey the

https://xerces.org/milkweed-seed-finder/
Final Thoughts: Roadsides and ecosystem health

The benefits of native plants on roadsides extend beyond unique regional beauty

“I want Texas to look like Texas and Vermont to look like Vermont and every state to look like itself.”

– Lady Bird Johnson

Photo: Jeff Norcini
Final thoughts: Multiple functions of roadsides

Photos: Ken Graeve, Minnesota DOT
Thank you!!

Photo: Rollin Coville

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Roadsides as habitat: Pollinator mortality along roads

- Roads cause pollinator mortality but typically less than 10% of roadside population.
- Mortality rates influenced by:
  - Species traits
  - Traffic volume
  - Road width
  - Roadside width
  - Roadside vegetation management
    - Mowing frequency increases butterfly kills
    - Roadside plant diversity reduces butterfly kills

Sources: Munguira and Thomas 1992; McKenna et al. 2001; Ries et al. 2001; Skorka et al. 2013
BMPs: Native Plants as Management Tools

Benefits of native plants on roadsides:

• Stabilize soil, reduce runoff, capture snow drift
• Locally adapted, require fewer inputs
• Robust native plant communities can resist invasive plant encroachment
• Reduced maintenance, long-term cost savings
• Wildflowers are preferred over turf ROW by drivers, can benefit tourism

BMPs: Reduced mowing and safety

- Reduced mowing does not increase rates of deer-vehicle crashes.
- Mowing can increase plant palatability.
- Maintain a regularly mown clear zone adjacent to the pavement to help maintain driver visibility.
- Avoid planting known palatable species, especially those that are forage at times when other food sources are scarce (e.g. cool season legumes).

Sources: Mastro et al. 2008; Barnum and Alt 2013; Guyton et al. 2014
BMPs 2: Adjust Mowing: Consider timing of mowing

Management windows for mowing to support monarchs

These recommendations are based primarily on monarch breeding and migration activity.

Options listed in [ ] are recommended only if necessary. These summer mowing intervals may still cause some mortality.
Value could be doubled with designation of wildflower areas and adoption of reduced mowing.