Conservation and Management of Western Monarchs on DoD Lands

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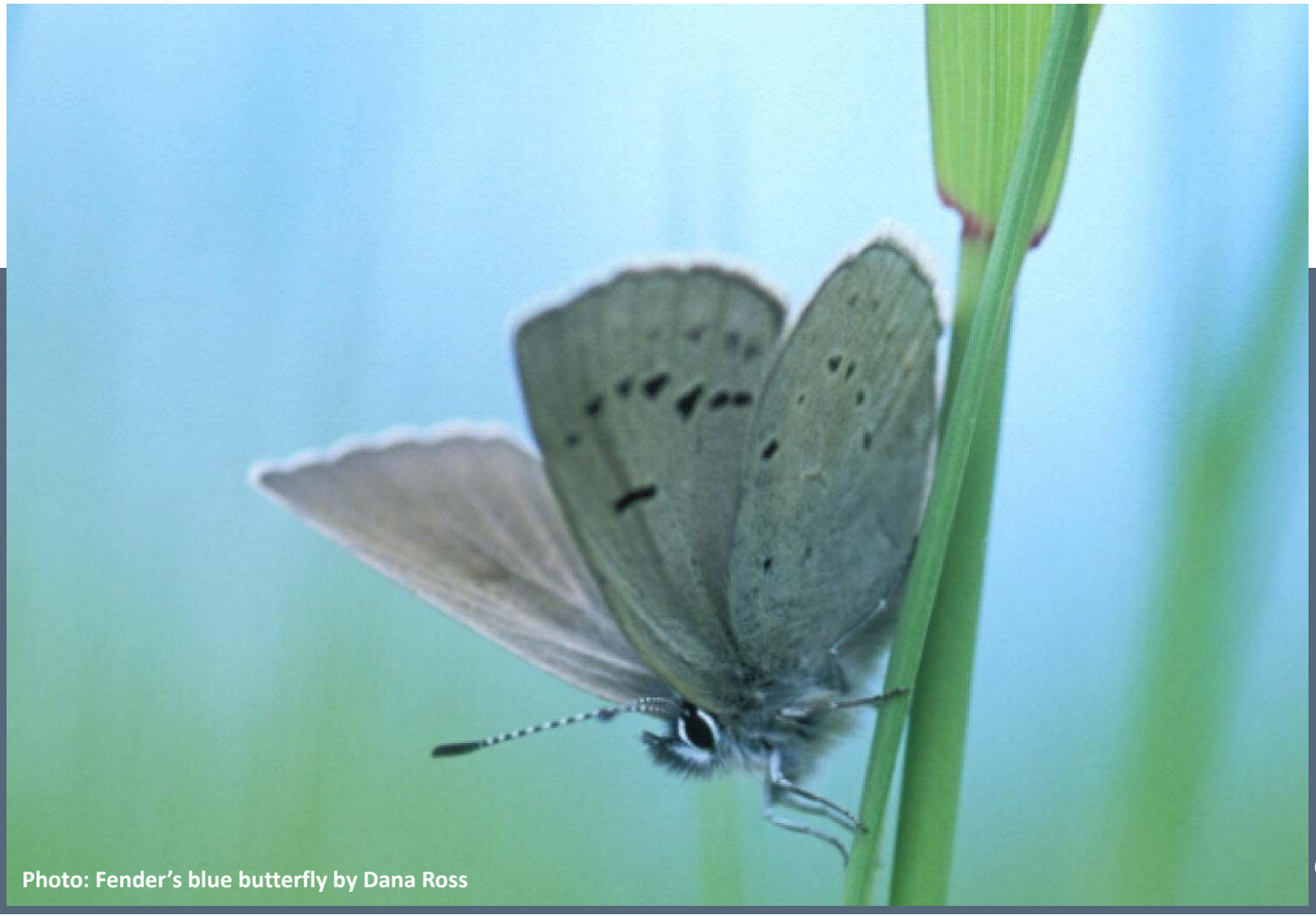

Photo: Fender's blue butterfly by Dana Ross

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

Conservation programs:

- Pollinators
- Endangered Species
- Aquatic Conservation
- Pesticides

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Our Approach to Monarch Conservation

Research & Citizen Science

- Modeling projects to understand location and timing of monarch breeding in the West
- Manage citizen science projects in western breeding and overwintering habitats to inform conservation

Policy

- Work with state wildlife agencies to include monarchs in State Wildlife Action Plans
- Work with NRCS to incentivize monarch habitat restoration on farmland

Education and Outreach

- Publications and materials
- Short Courses for land managers, agricultural practitioners, citizen scientists

Habitat Management & Restoration

- Development of Best Management Practices for western monarchs (April 2018)
- Site Management Plans for management and restoration of California overwintering sites
- More than 400,000 acres of habitat restored for pollinators, including monarch butterflies, in agricultural landscapes
- Central Valley monarch habitat restoration

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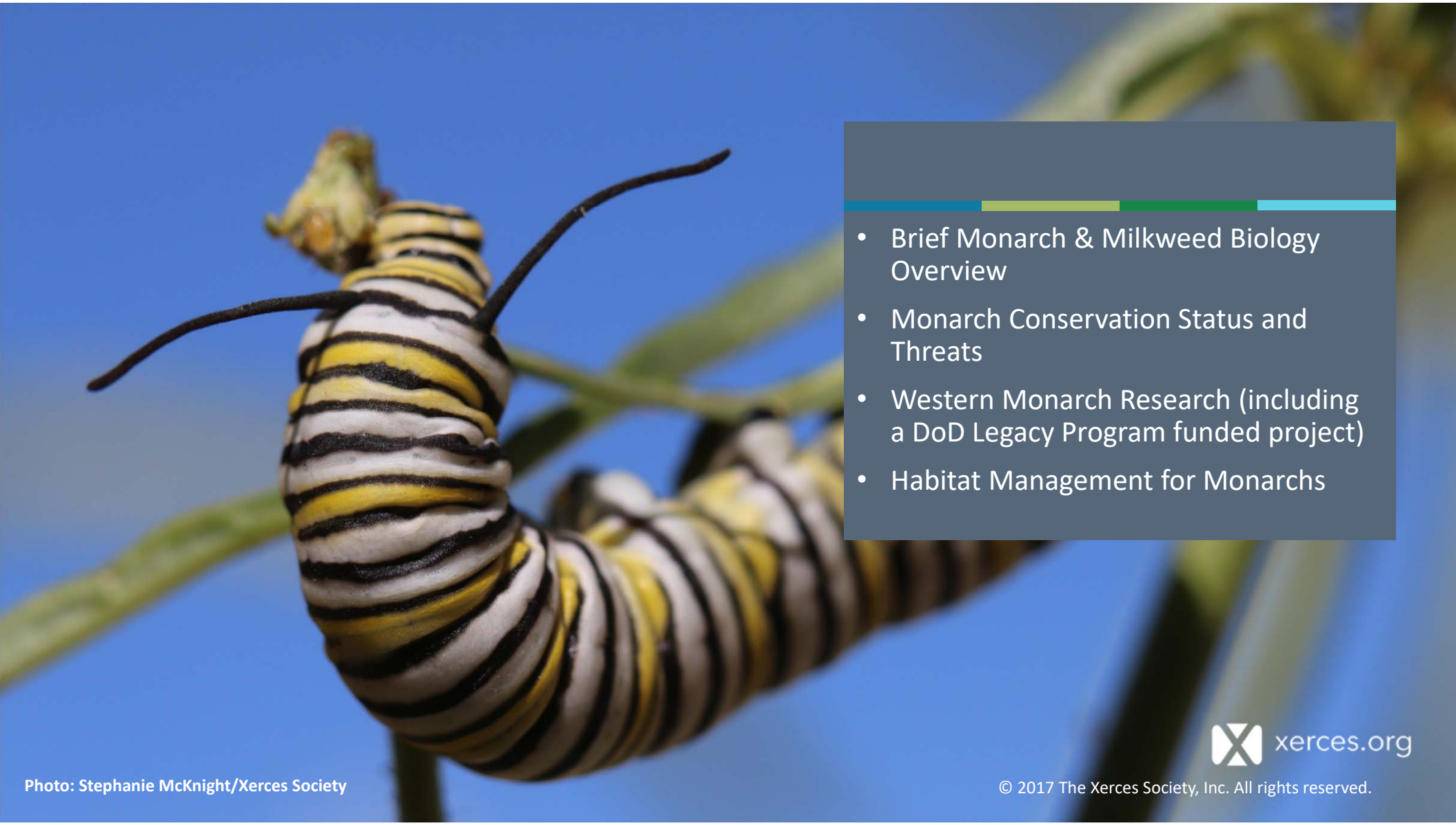

- Brief Monarch & Milkweed Biology Overview
- Monarch Conservation Status and Threats
- Western Monarch Research (including a DoD Legacy Program funded project)
- Habitat Management for Monarchs

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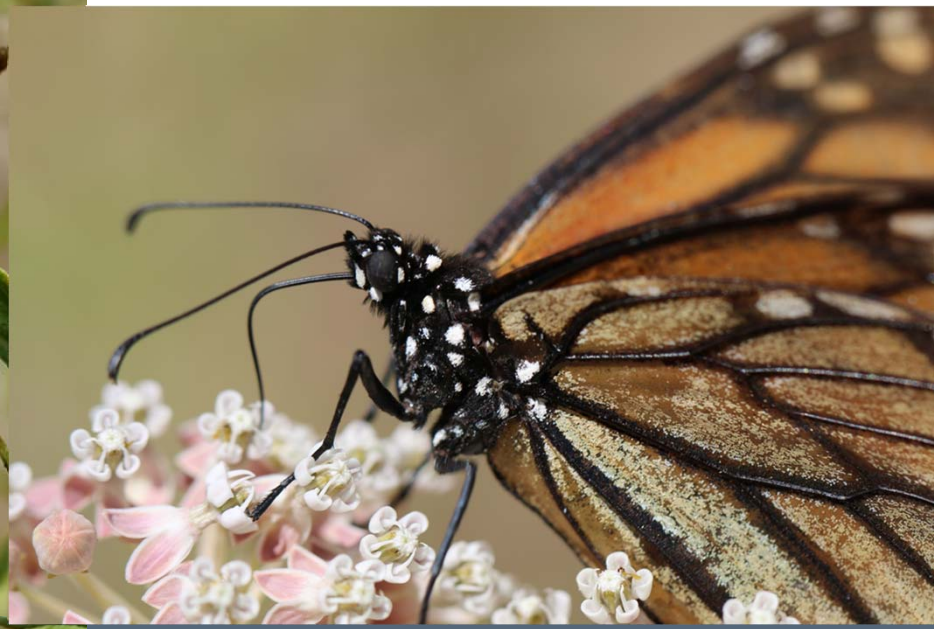
Photo: Stephanie McKnight/Xerces Society

Western Monarch & Milkweed Biology



Photos: Stephanie McKnight/Xerces Society

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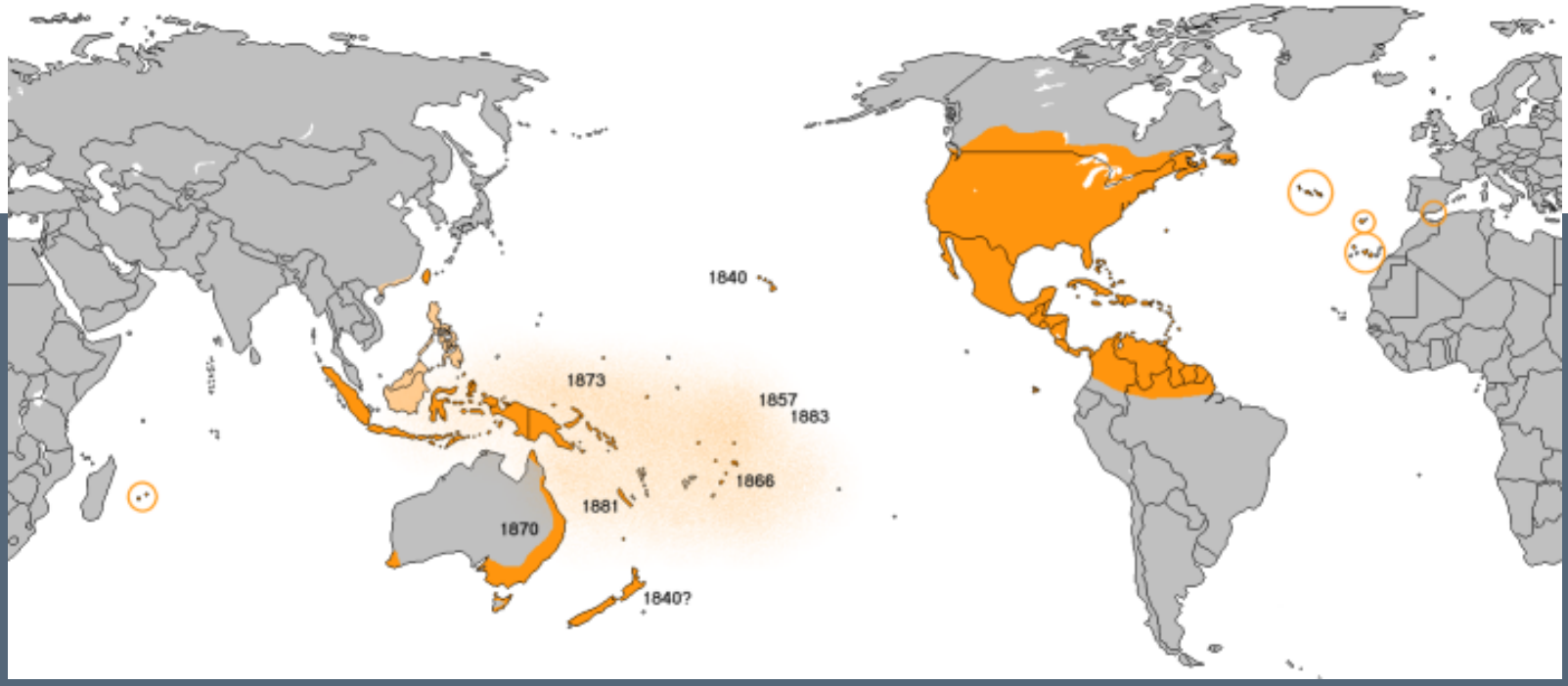
Monarch Biology, Life Cycle and Seasonal Movement



Map by CarnivoraForum.com

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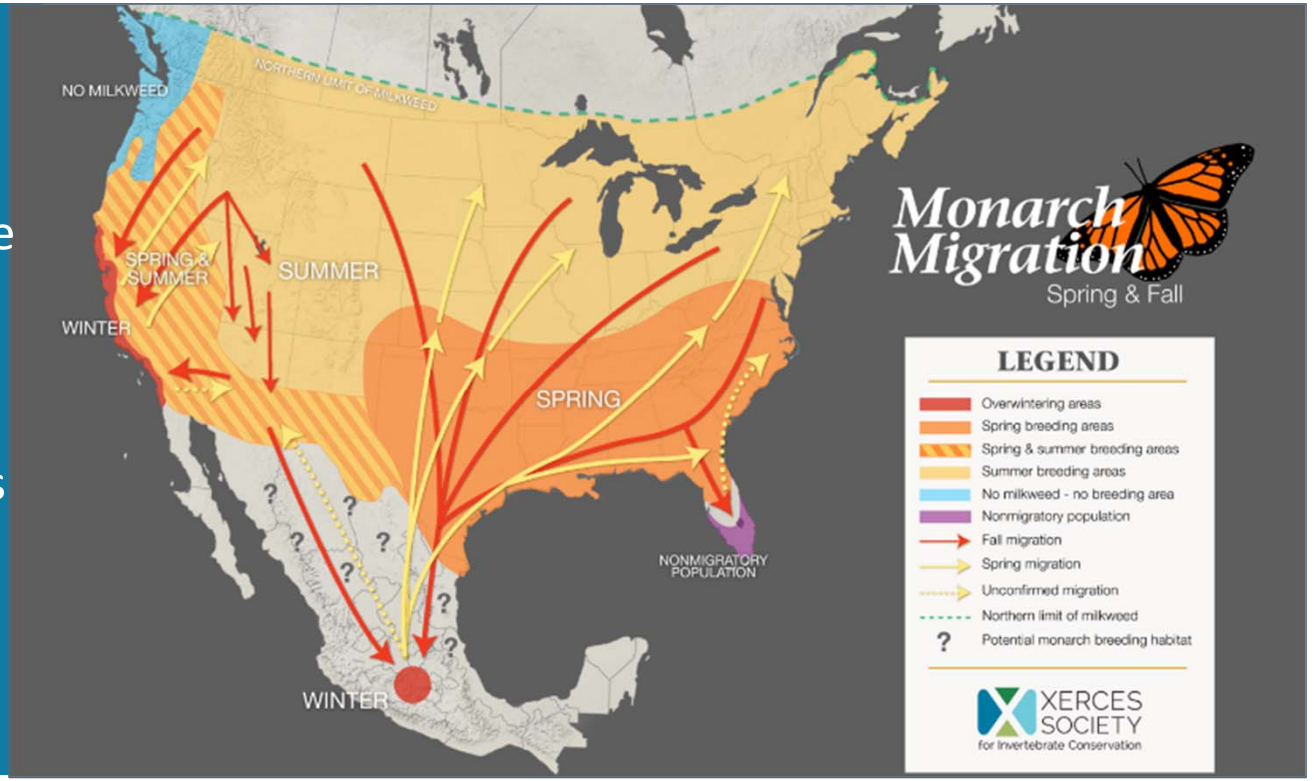
Monarch Migration

- Monarchs undergo a true long distance migration in both the Eastern US and Western US
- Internal compasses that sense the sun and the earth's magnetic field aid in their migration



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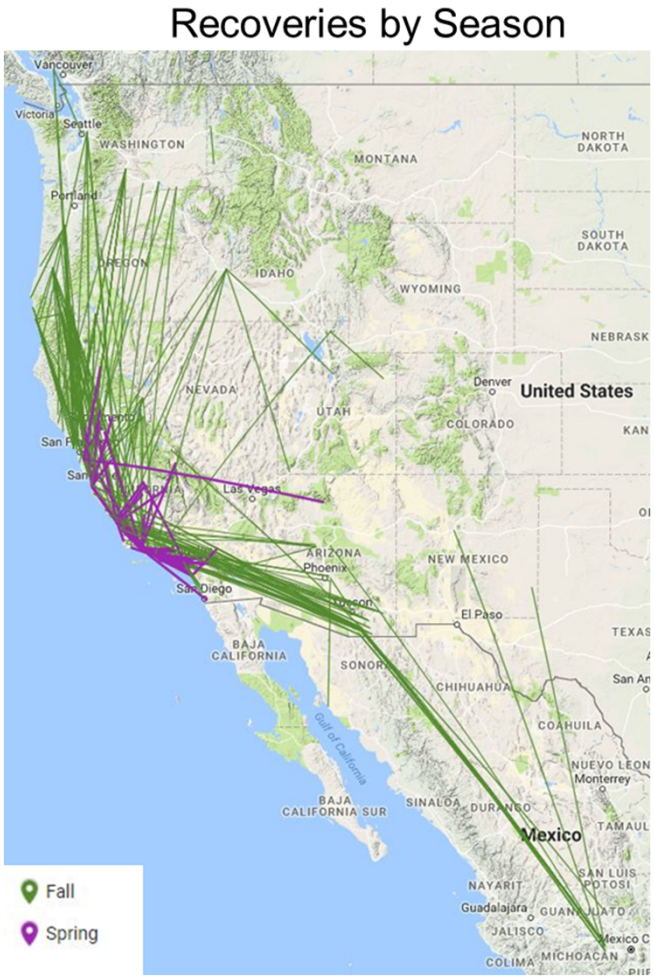
Tagging Monarchs



Map: Stephanie McKnight, Xerces Society

- Tagging led to the discovery of the aggregations in Mexico to the scientific community in 1975!
- Monarchs tagged in the Southwest have been recovered in both Mexico and California.
- Monarchs move S, SW, and SSE in the late summer/fall.
- The extent of mixing of Eastern and Western populations is unknown, but the populations are genetically indistinct.

Thank you to all the citizen scientists and tagging programs!

Data Source for Map: Southwest Monarch Study, Pacific Northwest Monarchs (WSU), Monarch Alert, Urquhart, Robert Michael Pyle, Faye Sutherland

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Western Monarch Overwintering Biology

Adult monarchs overwinter in clusters in protected microhabitats provided by groves of trees from ~October-March

Trees include native pines, cypress, and non-native eucalyptus trees, however research has found that monarchs prefer native trees.

- Monarchs are known to cluster **at over 400 locations** along the California coast from Mendocino to Baja, Mexico as well as small, inland sites in Inyo county, the Las Vegas area, and parts of Arizona
- Only ~30 sites routinely host more than 1,000 monarchs

Overwintering sites provide suitable micro-climate conditions such as

- protection from wind and freezing temperatures
- Variable light conditions (dappled sunlight)
- available nectar sources; water
- adequate humidity

Photo: Candace Fallon, the Xerces Society

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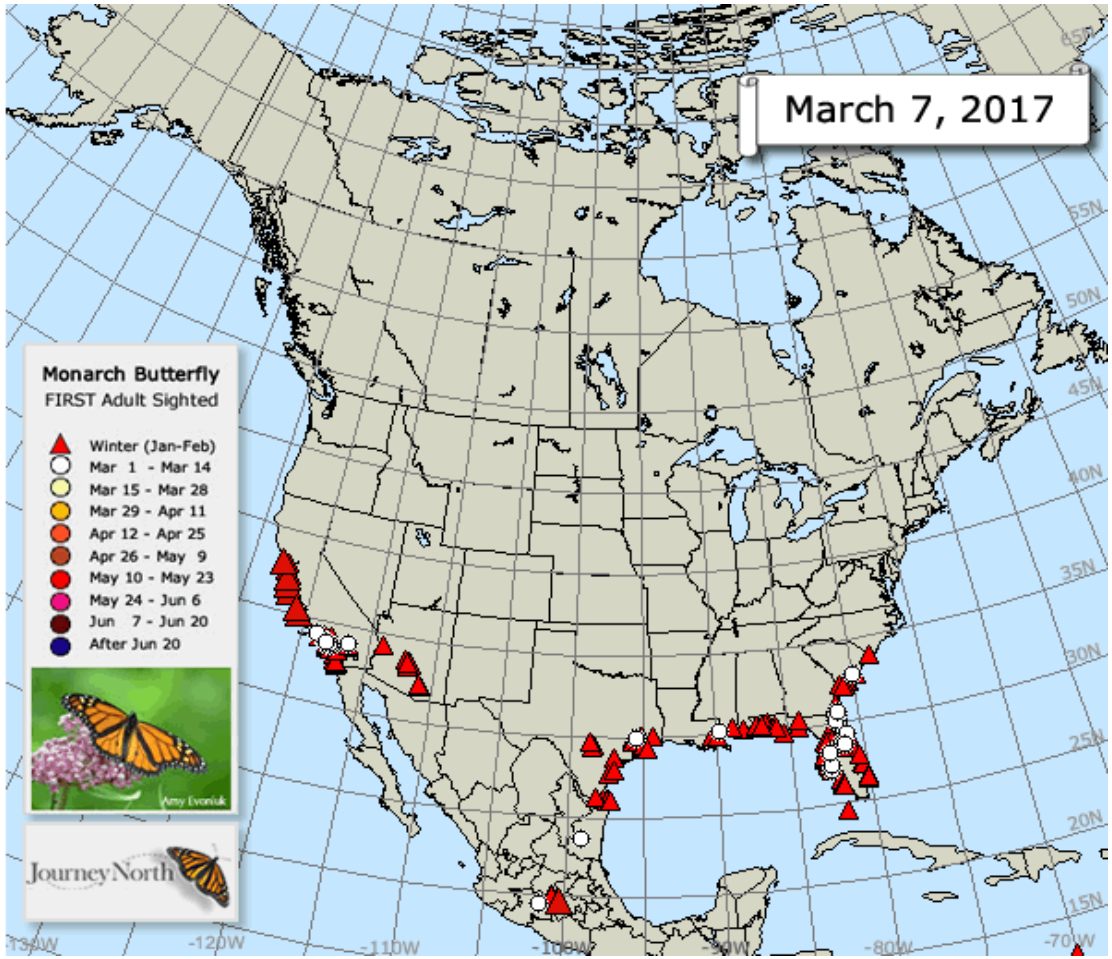
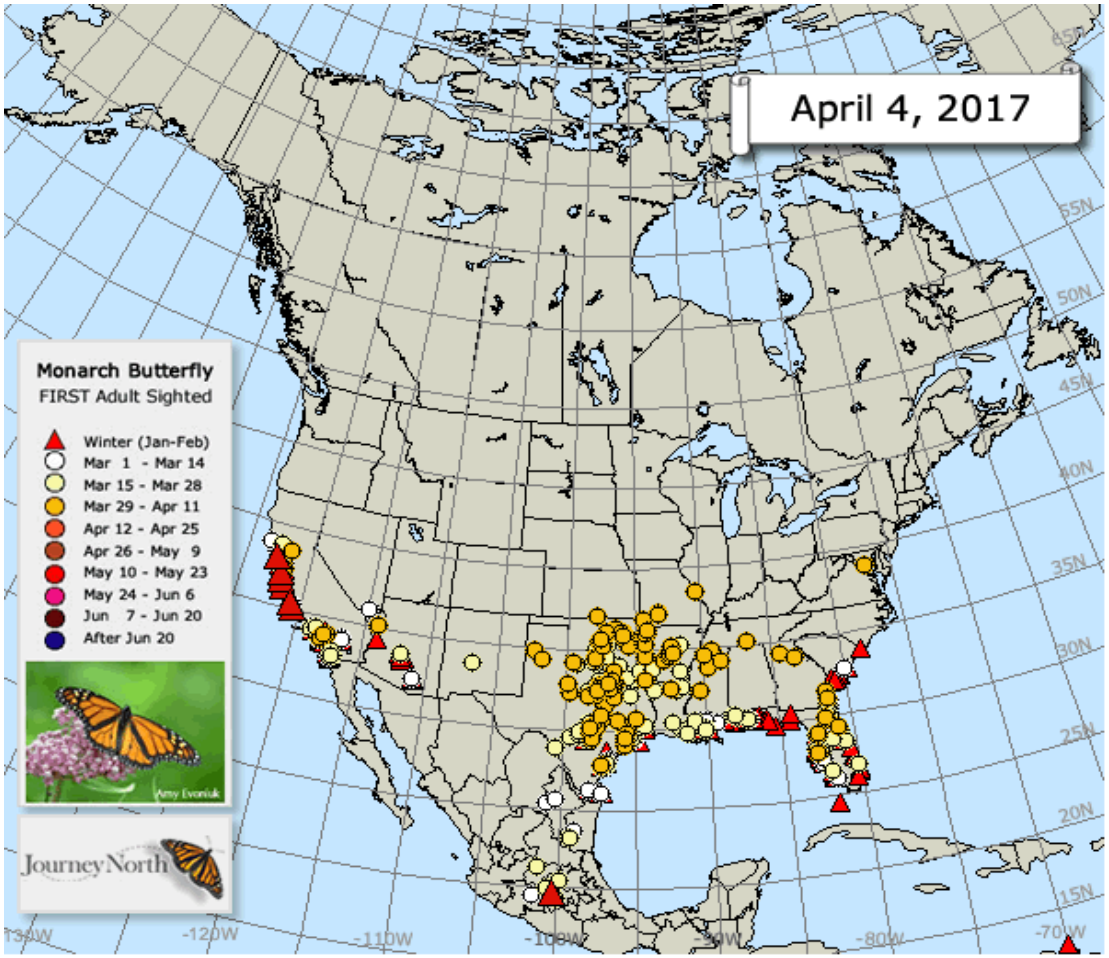
Spring Migration: March



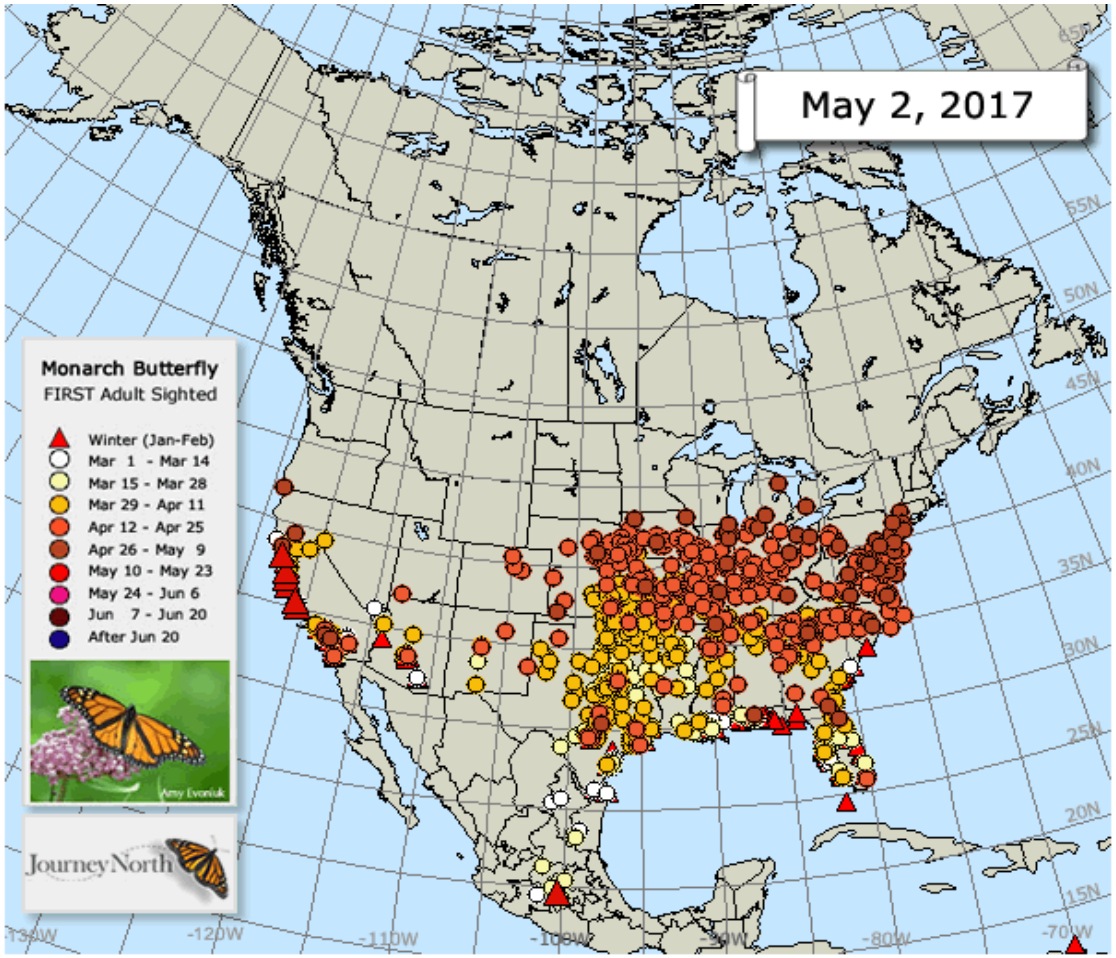
Map from **Journey North**: www.learner.org/jnorth

Spring Migration: April



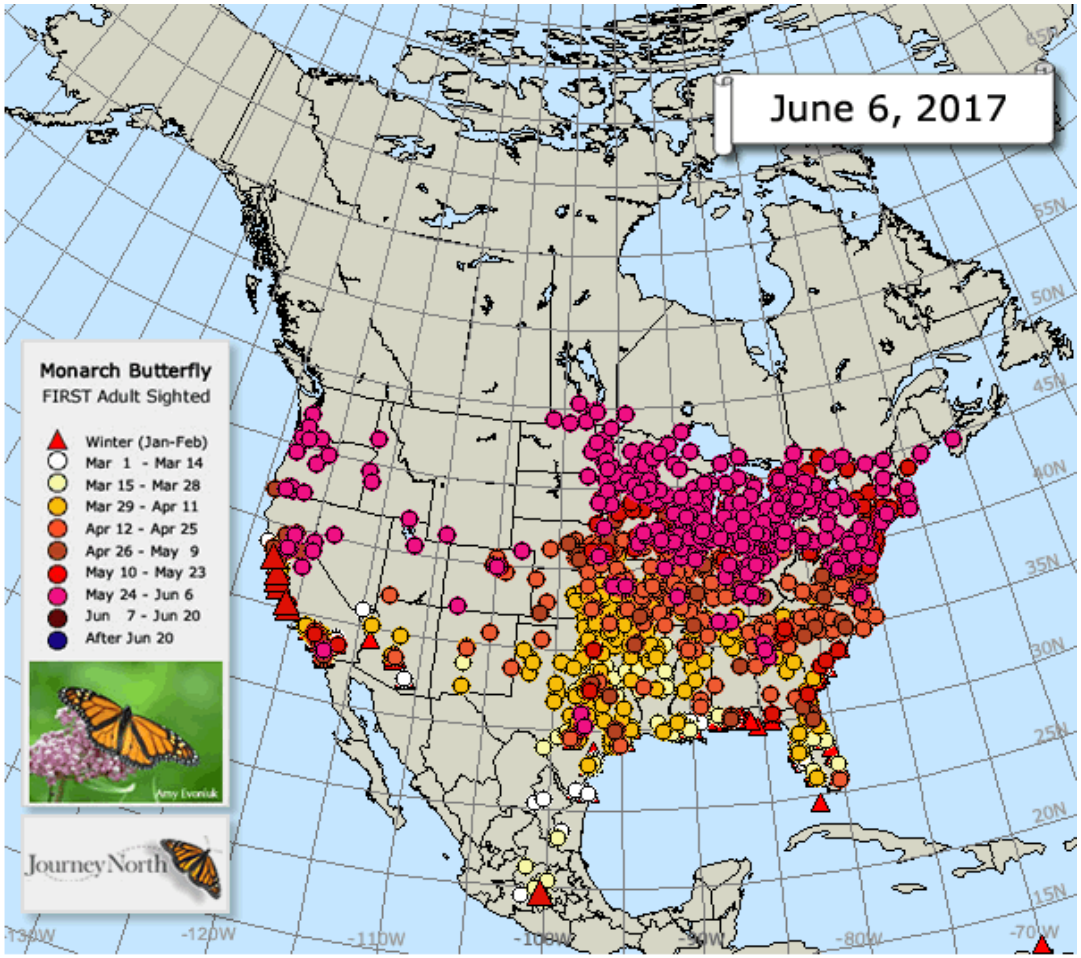
Map from **Journey North**: www.learner.org/jnorth

Spring Migration: May



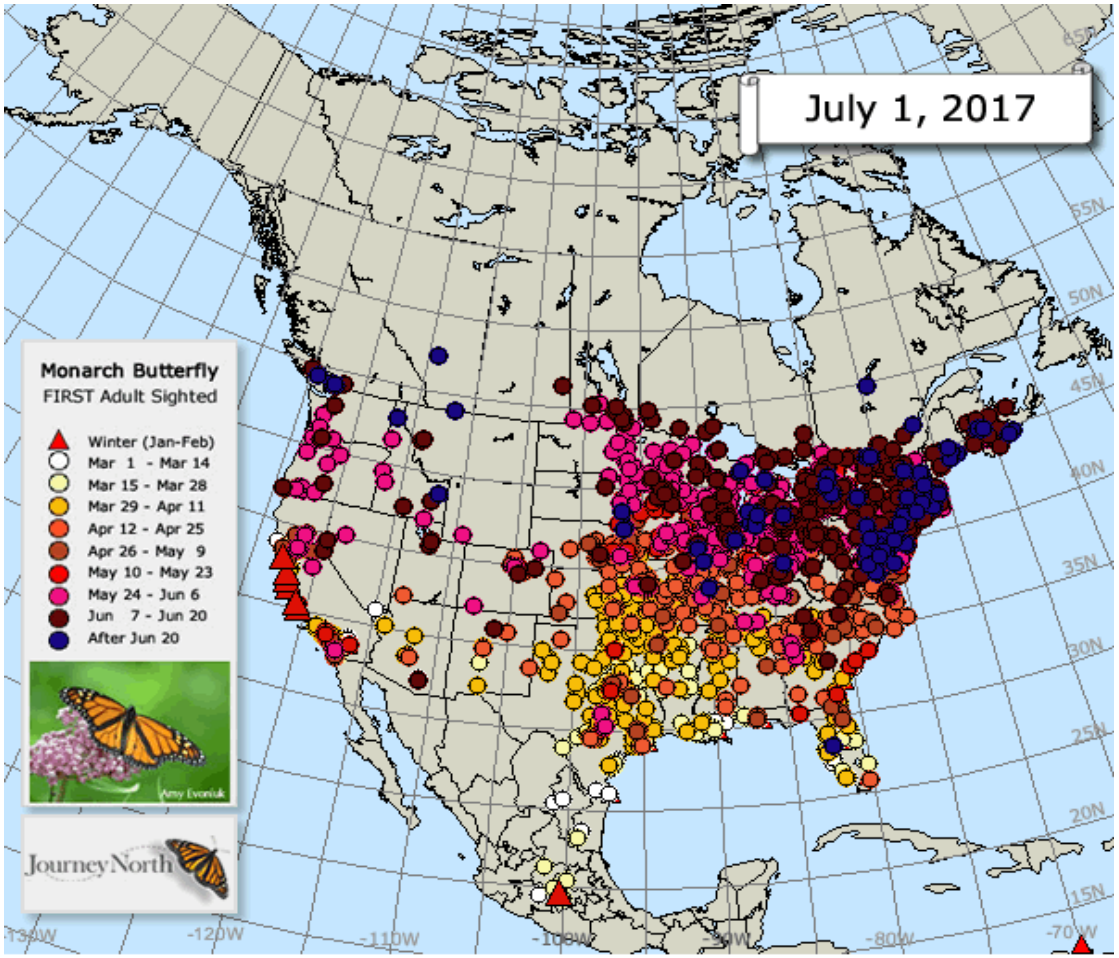
Map from **Journey North**: www.learner.org/jnorth

Spring Migration: June



Map from **Journey North**: www.learner.org/jnorth

Spring Migration: July



Map from **Journey North**: www.learner.org/jnorth

We may think of monarchs as pollinators…

Photo Credit: Stephanie McKnight/Xerces Society

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……but they are mostly important in the ecosystem as herbivores and as prey

Photo: Photo: http://talkrational.org/showthread.php?p=2214573#post2214573

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Monarch Life Cycle

Monarch larvae are specialist herbivores of plants in the family Asclepiadaceae (milkweeds).

Monarch eggs are laid individually on milkweed (*Asclepias* spp.) plants.

The eggs hatch in 3-5 days.

First instar larvae

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Monarch Life Cycle

Caterpillars go through 5 instars before forming a chrysalis.
They feed exclusively on milkweed during this time, sequestering cardenolides that make them toxic to predators.
This stage lasts 10-14 days.

Photos: Becky Hansis O'Neill; chrysalis photo: Stephanie McKnight/Xerces Society

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Monarch Life Cycle

The pupal stage lasts 10-14 days.

The time from egg to new adult is ~28 days.

Adults live for 2-5 weeks during the breeding season, and adults in the overwintering generation can live for ~8 months.

- Photos: Becky Hansis O'Neill

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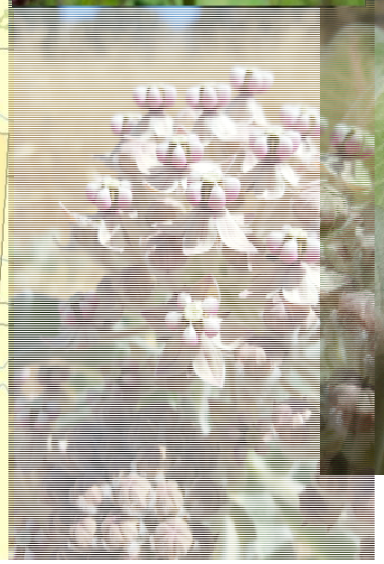
Western Milkweed Species

- There are approximately 72 milkweed species native to the U.S. and Canada (excluding ssp.)
- ~44 of these species are found in the western U.S.
- Showy milkweed (*A. speciosa*) is the most broadly distributed species in the West.
- Monarchs have been documented using ~20 of these species as larval hosts.
- Several non-native milkweed species occur in California, including tropical milkweed (*A. curassavica*)



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Milkweed Life Cycle

- Milkweeds (*Asclepias* spp.) are perennials. Most species are deciduous and usually flower between late spring and the end of summer.
- Pod-like fruits develop after flowering, splitting when mature to release the seeds.
- Following dispersal, aboveground plant growth usually dies back and the plant remains dormant through the winter.

Photo: Stephanie McKnight/Xerces Society

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Milkweeds in the Landscape

Photo: Stephanie McKnight/Xerces Society

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Importance of Milkweed to Other Species

Milkweeds are valuable to more than just monarchs!

Nectar and pollen:

- Flies
- Wasps
- Butterflies
- Hummingbirds
- Nocturnal moths
- Bees (carpenter, bumble bees, solidary bees, sweat bees, leaf cutters, etc.)

Vegetation and fruits:

- Specialist herbivores (seed bugs, long-horned beetles, leaf beetles)
- Other birds (use seed floss and stalk fibers for nesting material)

Photos: greater sage-grouse – USFWS; all other photos: Stephanie McKnight/Xerces Society

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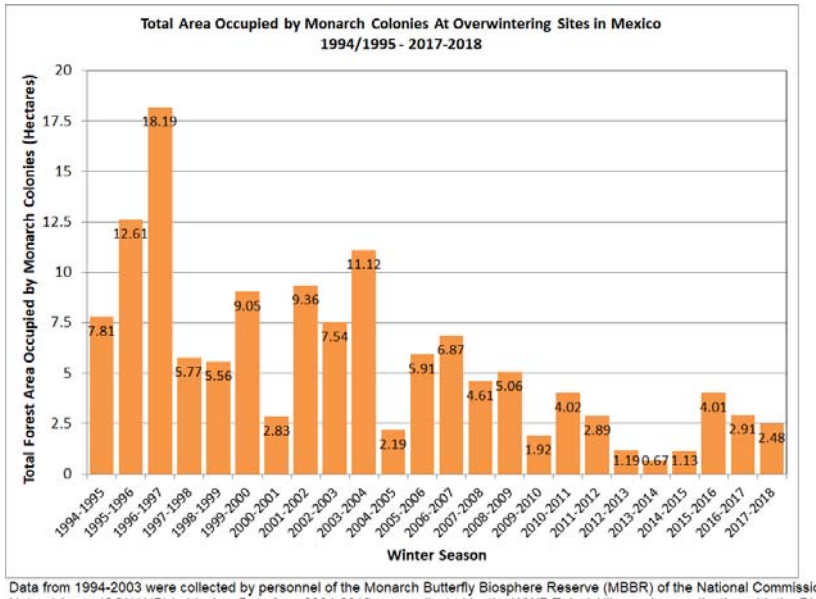
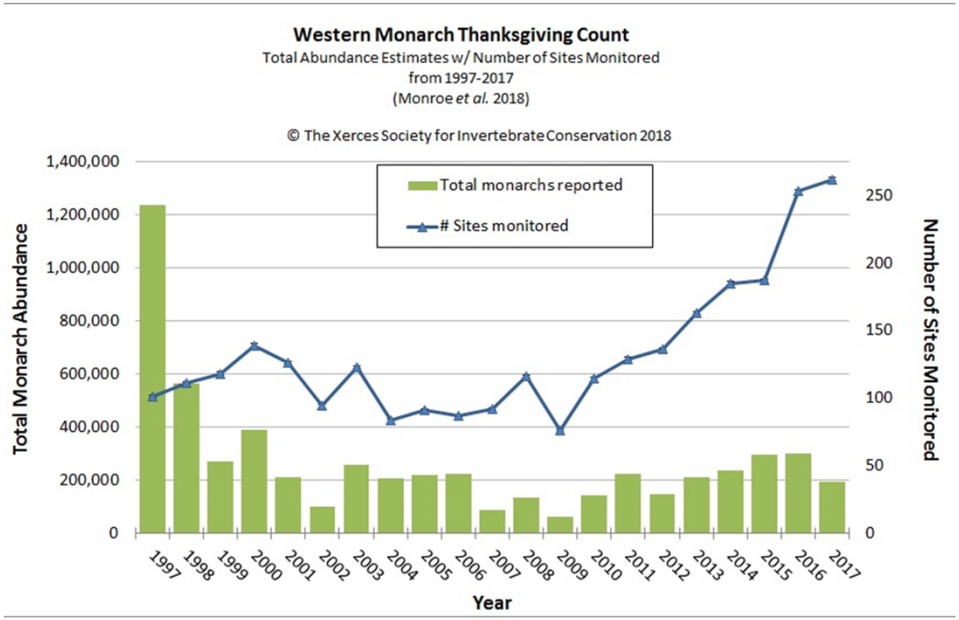
Monitoring the monarch population



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)



Mexico

population estimated in area occupied (hectares)

1990s: **400 million** monarchs

2016-17: ~60 million monarchs

California

population estimated by direct counts of individual monarchs

1980s: **10 million** monarchs

1990s: **1 million** monarchs

2017: 192,692 monarchs

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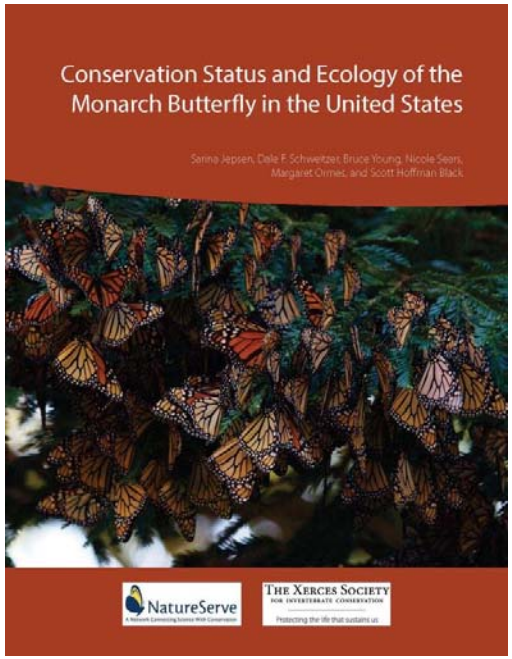
Graph: Left – Monarch Joint Venture, Right – Xerces Society Western Monarch Thanksgiving Count

Monarch Conservation Status

NatureServe Conservation Status Assessment – A standardized method to evaluate extinction risk using range extent, population trends, threats, vulnerability, and other factors

Danaus plexippus plexippus (Monarch)	**G4T3 – Vulnerable**
D. p. plexippus pop. 1 (Western Monarch - California Overwintering Population)	**G4T2T3 – Imperiled / Vulnerable**
D. p. plexippus pop. 2 (Eastern Monarch - Mexican Overwintering Population)	**G4T1 – Critically Imperiled**



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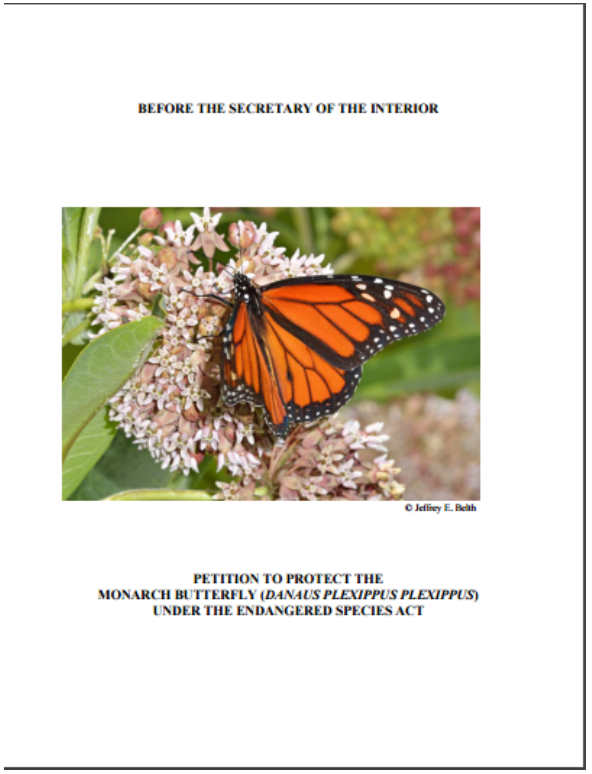
Monarchs and the Endangered Species Act

Endangered Species Act Timeline

August 2014: Petition to USFWS to list monarch as threatened with critical habitat & 4d special rule
Dec 2014: Service 90-day finding that listing may be warranted
2016: Species Status Assessment (SSA) initiated
2019: 12-month finding will be made based on SSA. Final listing decision due.


BEFORE THE SECRETARY OF THE INTERIOR

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PETITION TO PROTECT THE
MONARCH BUTTERFLY (*DANAUS PLEXIPPUS PLEXIPPUS*)
UNDER THE ENDANGERED SPECIES ACT

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Why Are Monarchs Declining?

Like many declining species, monarchs face threats from multiple stressors

Causes of monarch decline may include:

- Loss or degradation of breeding habitat (milkweed, nectar plants)
- Loss or degradation of overwintering habitat
- Pesticides
- Climate change, including drought
- Disease, parasites, and predation

Photo: Monarch larva on narrowleaf milkweed (*A. fascicularis*) Fallon Naval Air Station, Nevada -Stephanie McKnight/Xerces Society

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Herbicide and Herbicide-Resistant Crops

- Milkweed was historically abundant in agricultural fields in the Midwest.
- Pleasants and Oberhauser (2012) estimated a 58% decline of milkweed from the Midwest agricultural landscape between 1999 and 2010, largely due to conversion to herbicide-resistant corn & soy crops and increased glyphosate use

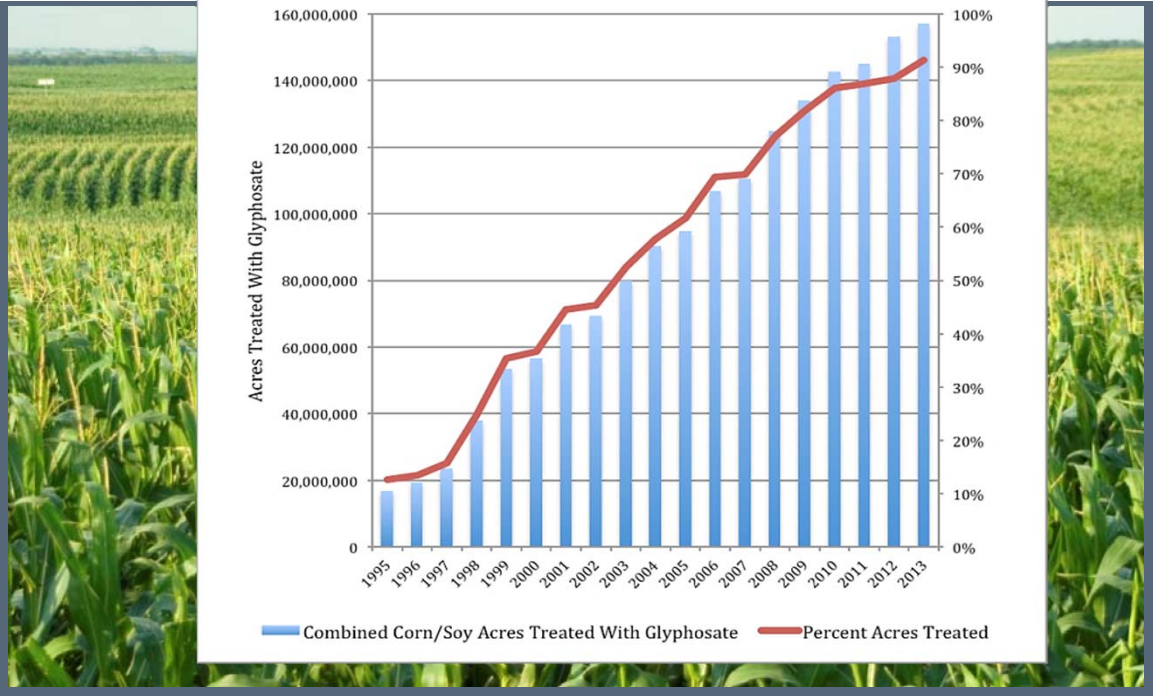

Photo: (c) iStockphoto.com/DHuss

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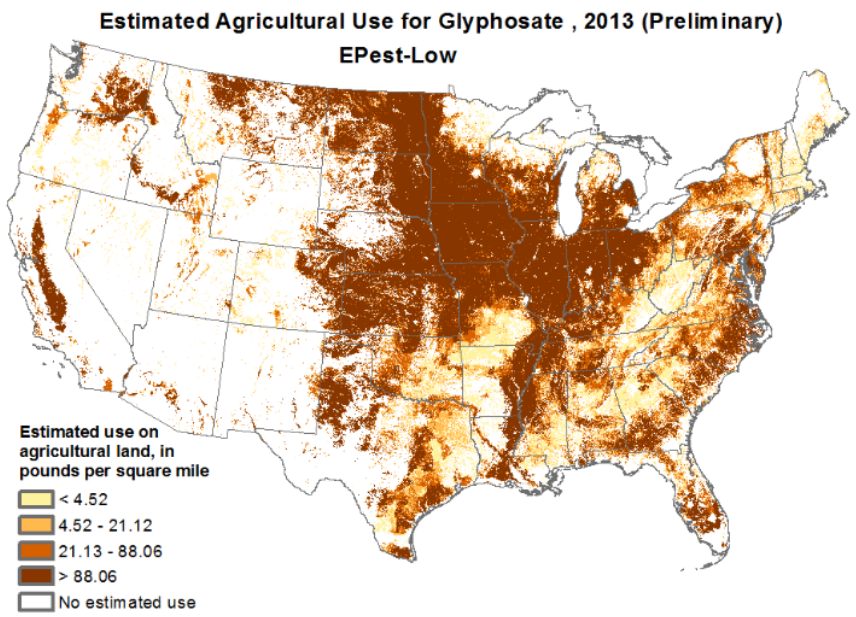
Loss of Milkweed in the West



- Milkweed loss due to herbicides and herbicide-resistant crops is considered a main driver of monarch declines in the East
- The evidence is less clear in the West
- High herbicide use in Central Valley of CA, Eastern Washington, Snake River Plain of Idaho, but less elsewhere
- Anecdotal reports of targeted eradication on rangelands
- General use herbicides on railways, roadsides, irrigation ditches, etc. to remove weeds

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Insecticides

While herbicides which indirectly harm monarchs by removing milkweed and nectar plants, many insecticides – such as the systemic neonicotinoids – can have both lethal and sublethal effects on monarchs and other pollinators

Photo: Rich Hatfield, Xerces Society

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Climate Change

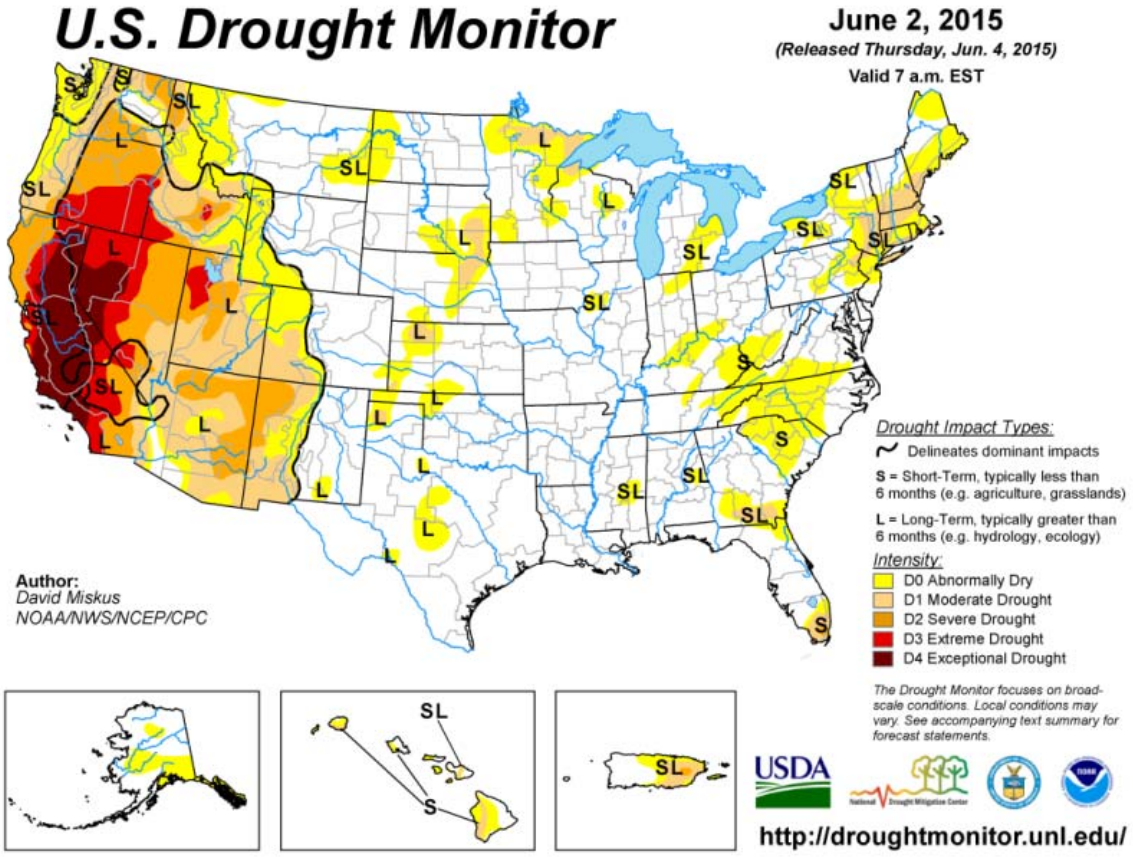

Figure: droughtmonitor.unl.edu

In the West, climate change is expected to lead to earlier spring snowmelt, reduced snowpack, and long term drought, and extreme weather events are projected to become more common: storms, floods, large forest fires, and prolonged heat waves (Wuebbles et al. 2017).

Drought

- Associated with lower abundance of overwintering monarchs (Stevens & Frey 2010)
- Many trees at overwintering sites are dead or dying as a result of the multi-year drought
- Milkweed: early senescence, increased duration of dormancy, reduced palatability to monarch larvae
- Nectar: decreased availability

Extreme weather events

- Winter storms along the California coast may have increased monarch mortality

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Overwintering Habitat Loss and Degradation

California

- More than 50 overwintering sites have been lost due to housing developments
- Continue to lose sites
- Senescence of groves and lack of active management

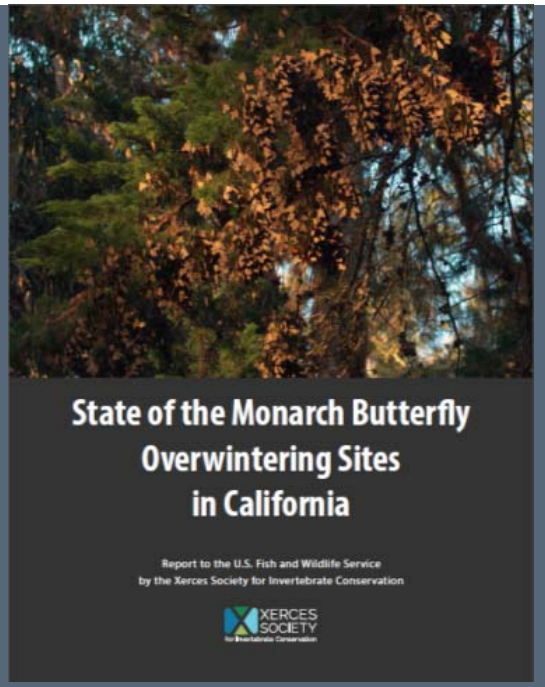

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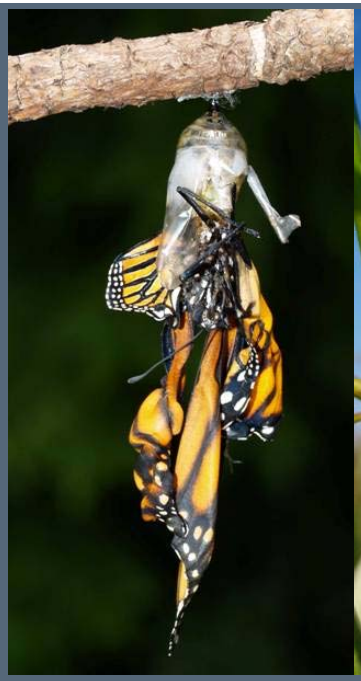
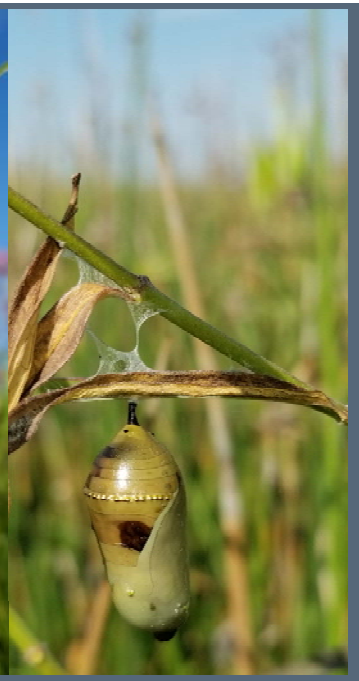
Photo: Carly Voight, Xerces Society

Disease, Parasites, and Predation

- Naturally, only <1-10% of monarch eggs and caterpillars survive to become adults.
- Predators: Birds, tachinid flies, preying mantids, etc.
- Well-studied parasite: OE (*Ophryocystis elektroscirrha*)
  - Reduces migration success
  - Severe infestations of OE can slow development, cripple adults and reduce reproductive fitness
  - Very high levels in low/non-migratory populations (FL, Gulf States, southern CA)





Photos: Left - Courtesy of Dara Satterfield, Project Monarch Health,

Right – Stephanie McKnight/Xerces Society

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Disease, Parasites, and Predation

Tropical milkweed and OE

- Due to its evergreen nature, tropical milkweed is associated with winter breeding monarchs along the coast
- Winter breeding monarch populations in California are 9x as likely to have high OE levels compared to overwintering monarchs (Satterfield, Villablanca, et al. 2016)

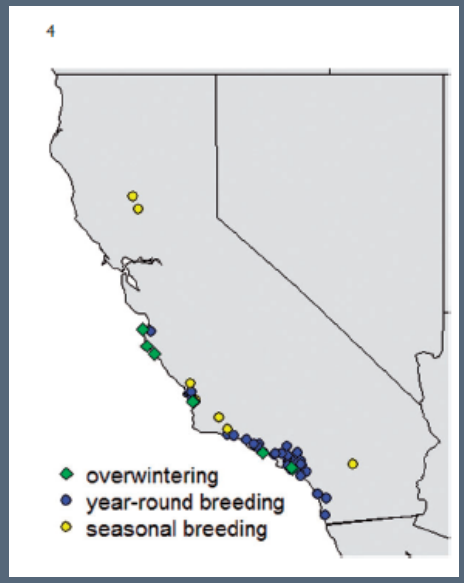

Photo: Adam Rodriguez, Desert Botanical Garden, Flickr; Map: Satterfield et al. 2016

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Xerces Western Monarch Thanksgiving Count

Coordinated by the Xerces Society and Mia Monroe
with regional coordinators

Monarch Counts

- **Thanksgiving Counts** (since 1997)**:** Three weeks centered around Thanksgiving
- **New Year's Counts** (since 2017)

Data collected: # of monarchs, # of clusters, tags, weather, cluster tree species

Habitat Assessments (since 2011)

www.westernmonarchcount.org

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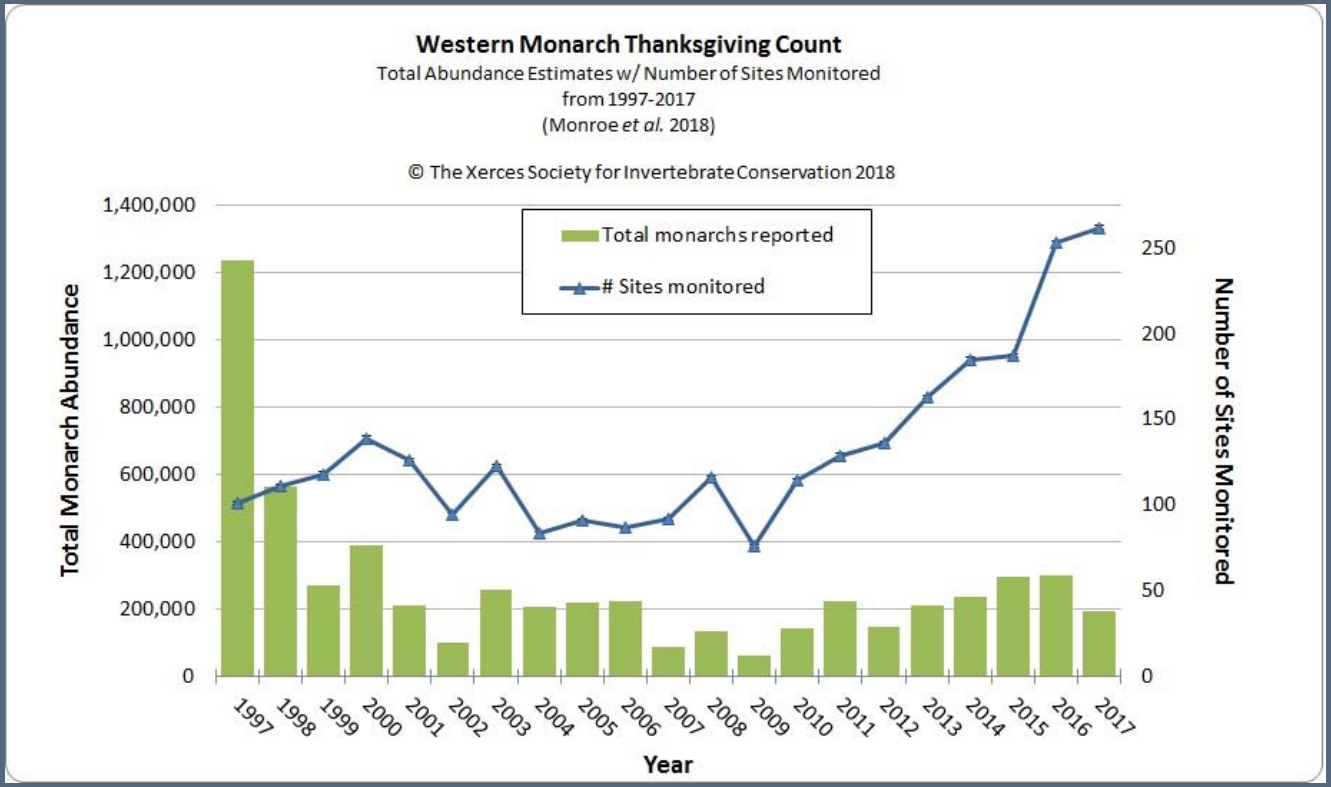
Steep population decline as volunteer effort increases



- 2017: 192,629 monarchs at 262 sites
- Counts down at 11 of the 15 sites continuously monitored
- Major sites down ~50% from last year
- A recent, if not all time low

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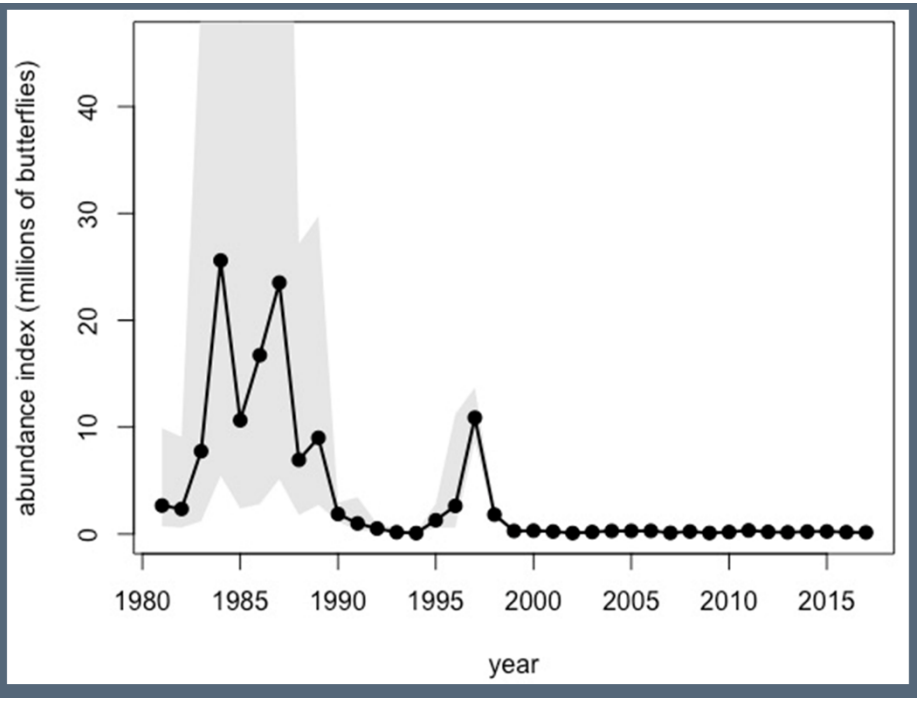
Population Viability Analysis of Western Monarchs

Western Monarch Abundance at California Overwintering Sites 1981-2017



The western monarch population has declined by **more than 95%** since the 1980s and has a **72 percent probability of quasi-extinction** over the next 20 years

Schultz, C. B., L. M. Brown, E. Pelton, and E. E. Crone. 2017. Citizen science monitoring demonstrates dramatic declines of monarch butterflies in western North America. Biological Conservation DOI 10.1016/j.biocon.2017.08.019.

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Identifying Monarch Breeding Habitats

In 2013, the Xerces Society initiated a milkweed and monarch breeding survey to ask land managers, monarch and native plant enthusiasts, and others to record their observations of milkweeds, monarch eggs, caterpillars, and chrysalises.

Over the next four years, this grew into a West-wide effort, partnering with the U.S. Fish and Wildlife Service, Idaho Dept. Fish & Game, Washington Dept. Fish & Wildlife, and the University of Nevada Reno.

- Extensive crowd-sourcing of data (e.g., existing datasets, flickr, herbaria records)
- On-the-ground surveys in 9 Western states

Photos: Stephanie McKnight/Xerces Society

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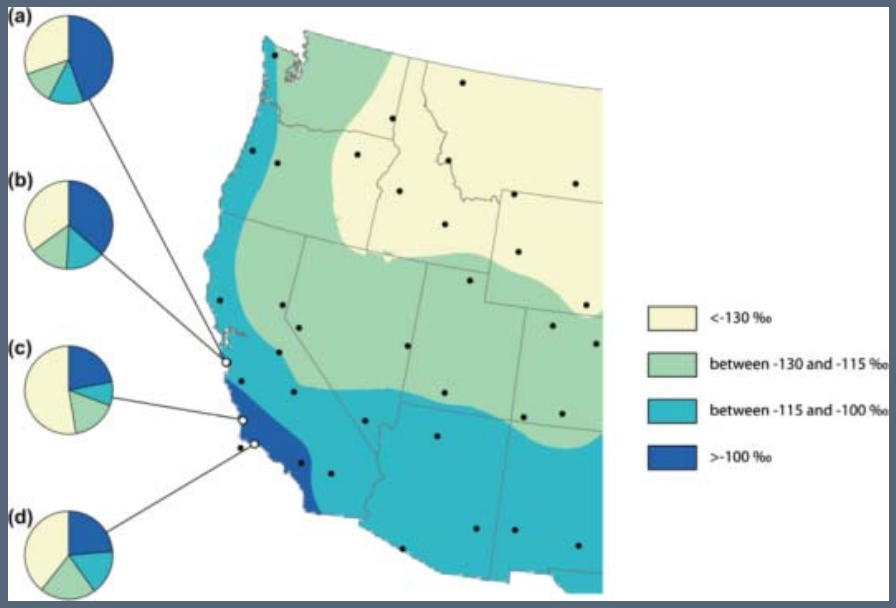
Important breeding habitat and migratory corridors

Studies have revealed some general regional patterns of monarch natal origins

Source: Stephens and Frey 2010



Source: Yang et al. 2015

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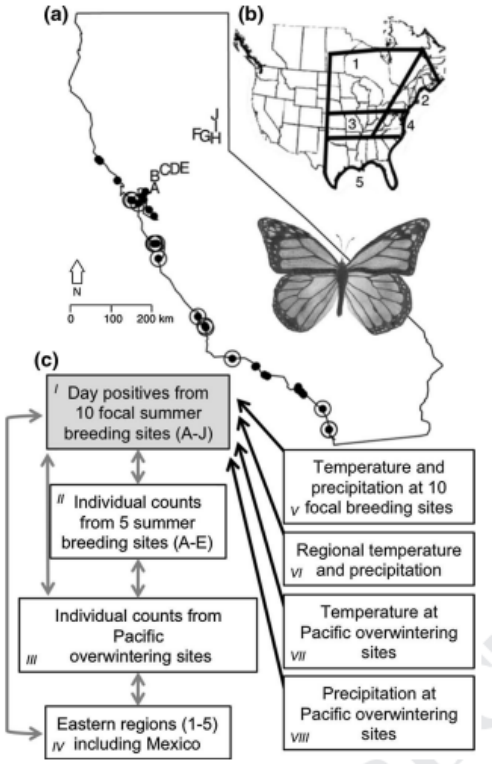
Declines in the Western breeding range



Analyses over 40 years of monarch numbers at ten sites across northern California by Espeset et al. (2016)

- Based on data including 1) 40 years of summer flight records of butterflies across a gradient in northern CA
  2) Thanksgiving data (subset)

- Results: Negative population trend over time. Fewer monarchs early in the breeding season.

- Conclusions: Suggests higher mortality may be occurring either during spring migration or overwintering phases.

Espeset, A.E., Harrison, J.G., Shapiro, A.M., Nice, C.C., Thorne, J.H., Waetjen, D.P., Fordyce, J.A. and Forister, M.L., 2016. Understanding a migratory species in a changing world: climatic effects and demographic declines in the western monarch revealed by four decades of intensive monitoring. *Oecologia*, *181*(3), pp.819-830.

Source: Espeset et al. 2016, University of Nevada Reno

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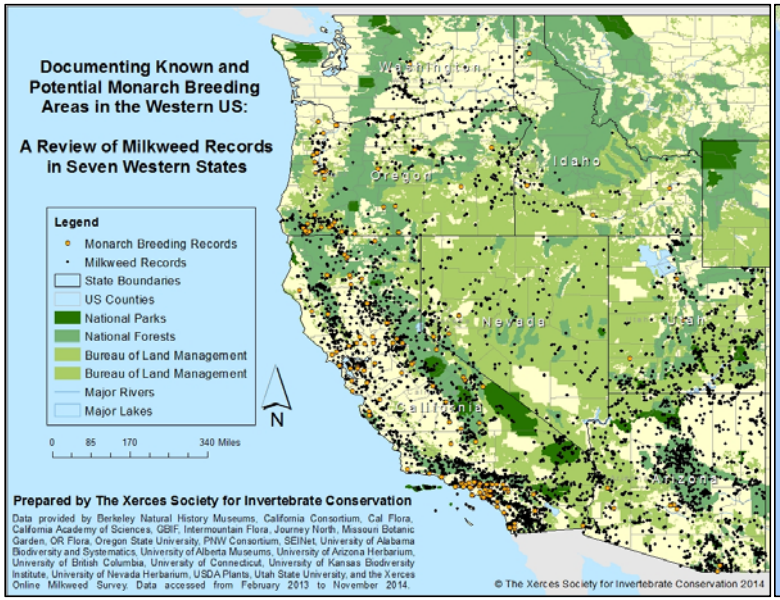
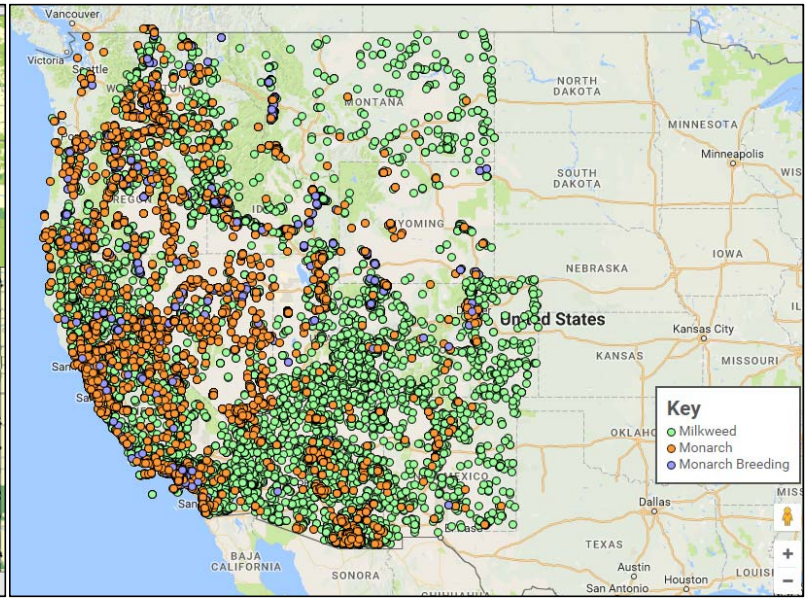
Monarch Breeding Habitat





2014

2017

We continue to need more current, highly accurate records!

To better understand where monarchs reproduce in the West, Xerces and partners have been collecting occurrence data for monarchs and milkweeds since 2011.

We now have more than 40,000 occurrence records which are being used to develop habitat suitability models for milkweeds and monarchs

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Maps: The Xerces Society and the Western Monarch Milkweed Mapper

Western Monarch Habitat Suitability Assessment Project (2015-2017)

A collaboration between USFWS, Xerces Society, and University of Nevada-Reno

- Goal: Identify high priority monarch breeding areas to inform restoration and management
- Approach: Using data gathered through the Western Monarch Milkweed Mapper project, develop species distribution models for multiple milkweed species and breeding monarchs

Photo: Ashley Taylor, Xerces / USFWS, Minidoka National Wildlife Refuge

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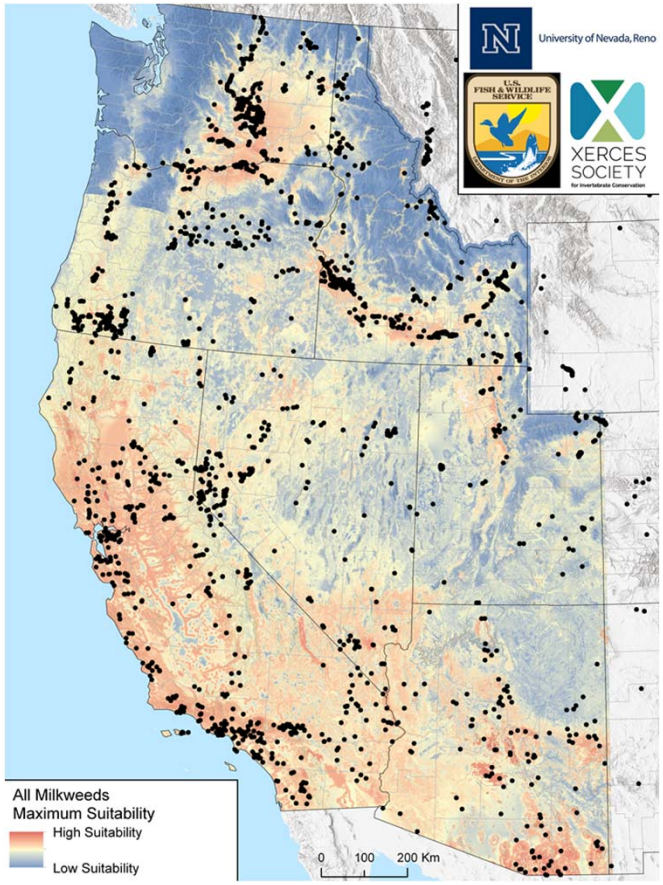
Habitat Suitability Model



Map: Dilts et al., in prep.

Western Monarch Butterfly and Milkweed Habitat Suitability Modeling Project

- Suitable habitat is widespread in the western states, in particular in the Central Valley of California, southern Idaho and eastern Washington. Smaller areas of highly suitable habitat are evident across northern Nevada, southern Arizona and other areas.
- Areas of relatively high habitat suitability for breeding monarchs can be prioritized for monarch habitat protection and management.

Red = best (most relatively suitable) monarch breeding habitat
Blue = worst (least relatively suitable) monarch breeding habitat

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Western Monarch Milkweed Mapper

To better understand where milkweed occurs and where monarchs reproduce in the West, we have launched the Western Monarch Milkweed Mapper.

Platform to collect and share milkweed & monarch observations across the West

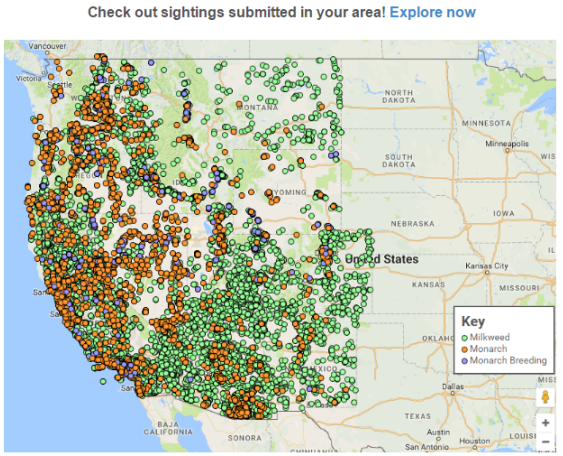
1) Computer: online survey
2) Smartphone: Monarch SOS app

Publicly accessible data---maps, detailed data, and full database download option

Milkweed profiles & identification tool for the many Western milkweed species

Learn more & participate at www.monarchmilkweedmapper.org

WESTERN MONARCH MILKWEED MAPPER



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Knowledge Gaps

A number of knowledge gaps hinder monarch conservation. Many of these gaps are being filled by citizen scientists and researchers:

- Where are the most important breeding areas in the West?
- Are there migration pathways, and if so, where?
- To what extent to monarchs move between overwintering sites?
- How many generations do western monarchs have annually?
- What is the breeding window for different regions of the West?
- What is the survival rate of monarch eggs and caterpillars? What are the primary predators?
- How common is OE?

Photo: Stephanie McKnight/Xerces Society

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Photo: Douglas Mills, Flickr.

Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

Cheryl Schultz[1], Stephanie McKnight[2], Cameron C. Thomas[1], Emma Pelton[2], Sarina Jepsen[2], David James[1], Leone Brown[3], and Elizabeth Crone[3]

[1]Washington State University, [2]Xerces Society for Invertebrate Conservation, [3]Tufts University

Purpose:

- To develop solutions for wide-scale management challenges
- To maintain military training land, air and/or water capacity
- To provide more cost-effective management capacity
- To maintain unrestricted access to training and testing areas

Objective of the Project:

To determine seasonal timing of location of monarch butterflies across the West, and to use this information to increase the efficiency and effectiveness of managing habitat for monarchs on DoD lands. This will help DoD land managers maximize the use of these lands for training while considering the needs of a widespread at-risk species. Our work will contribute to key aspects of DoD land management plans, such as INRMPs (Integrated Natural Resources Management Plans) at each installation, by focusing efforts on the temporal windows with greatest importance to breeding monarchs throughout their range.

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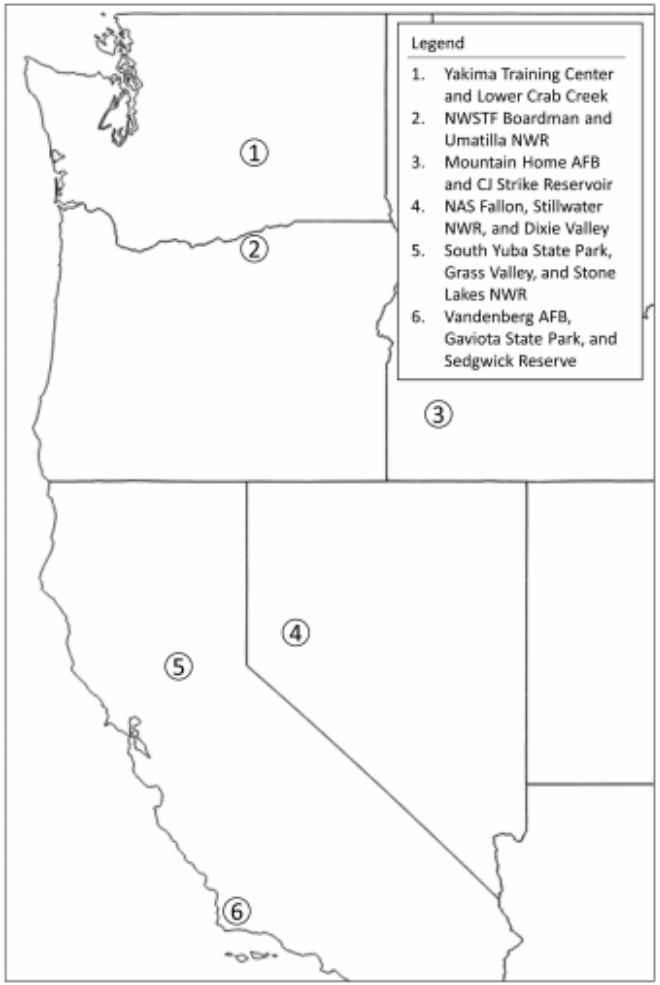
Research Approach and Field Sites



Summary of Approach: research combines monthly systematic surveys with statistical models to determine seasonal timing of monarch breeding across the West.

- Study sites in 5 Western states: Vandenberg AFB in California, NWSTF Boardman in Oregon, JBLM Yakima Training Center in Washington, NAS Fallon in Nevada, and Mountain Home AFB in Idaho. In addition, we worked with US Army Corps of Engineers, Stone Lakes National Wildlife Refuge, and California State Parks in northern California, and Sedgwick Reserve - University of California Santa Barbara Natural Reserve System in Southern California. Thank you to all of the agency and university partners for participating in this research, and allowing access to field sites!

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Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

Systematic monthly surveys (about the time it takes for monarchs to complete 1 generation, temperature dependent) throughout the expected breeding season at five installations in the West.

Document abundance of monarch life stages (eggs, larvae, pupae and newly emerged adults) as evidence of site-based breeding.

Documented milkweed abundance and phenology (flowering, fruiting).

Photo: Stephanie McKnight/Xerces Society

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Preliminary Results from Year One

- Adult detections in all regions except Southern California peaked between mid-July and mid-August.
- The highest number of immature stage detections in most regions occurred one month prior in early to mid-June.
- High numbers of immature stages were also detected in early August in Northern California, Nevada, and Oregon, and increased again in September and October in Southern California.

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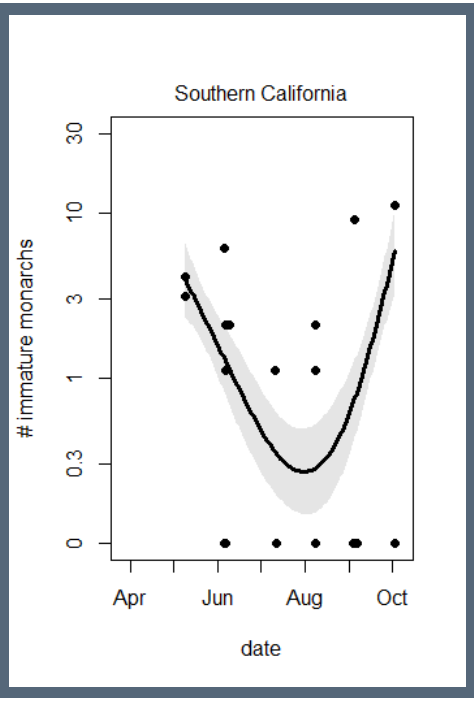
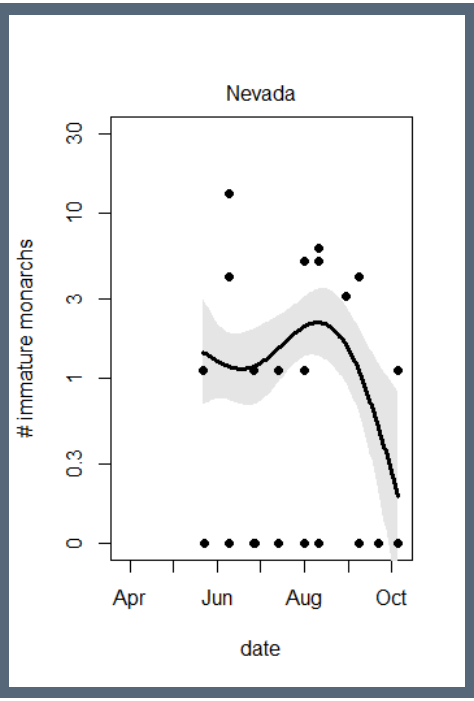
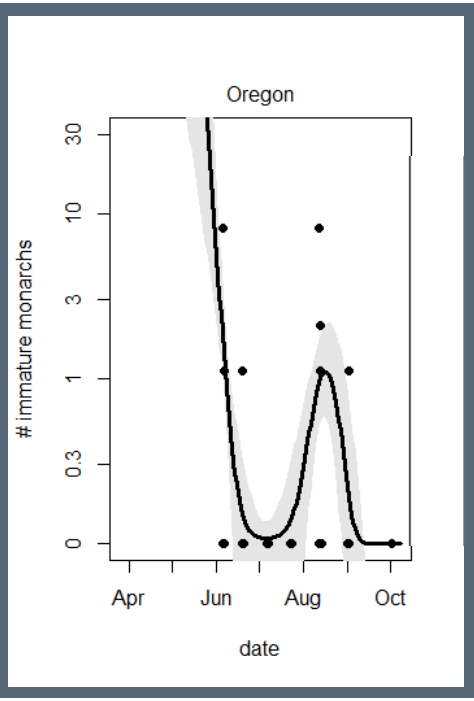
Photos: Stephanie McKnight/Xerces Society

Western Monarch Phenology

Preliminary Results from Year 1







Figures: Elizabeth Crone, unpublished data, Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

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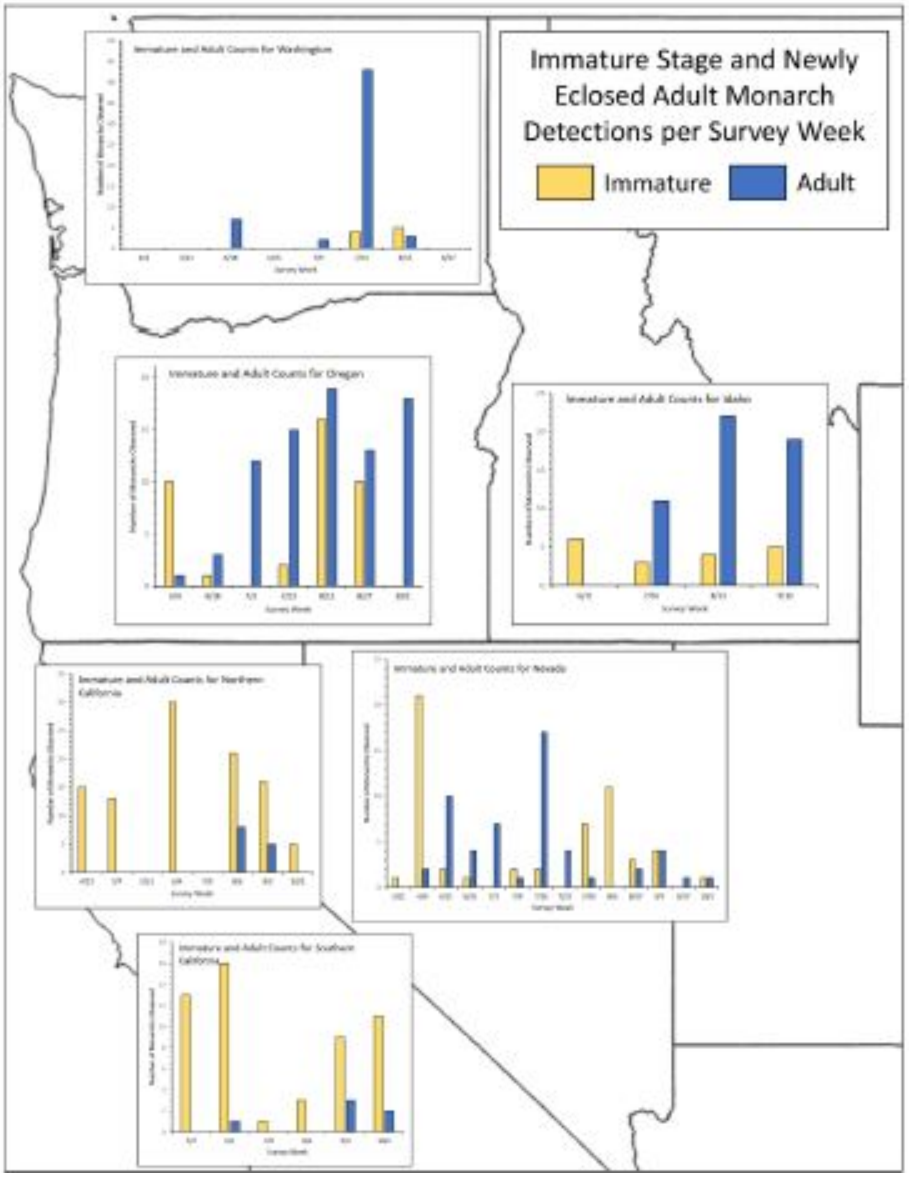
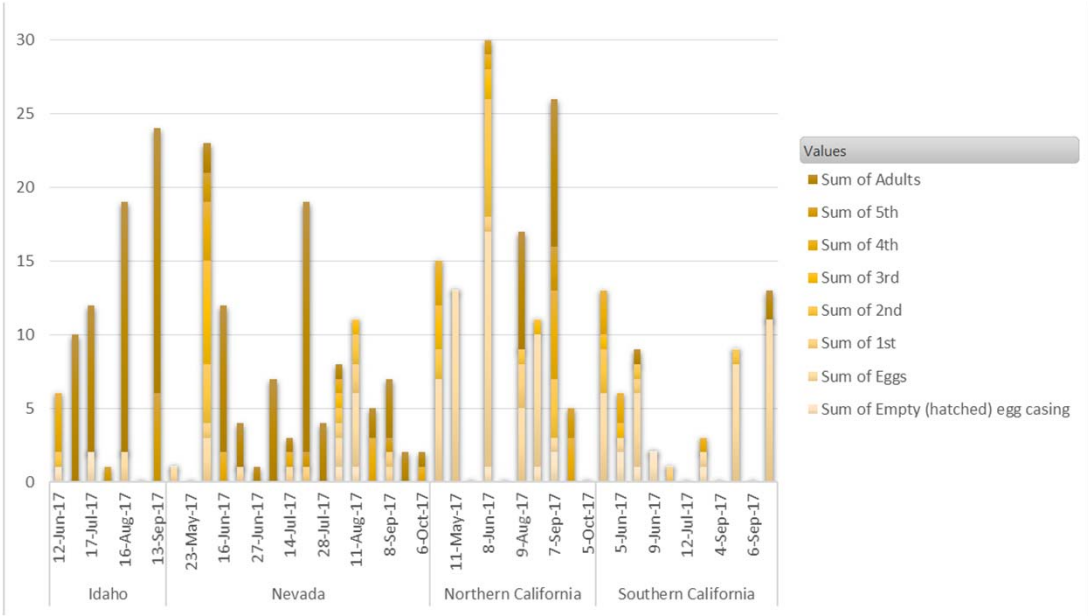


Western Monarch Phenology

Year One Raw Data

- Raw count data of immature and adult monarchs.
- More or less continuous breeding throughout the season in all locations.



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Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

Next Steps

- A second year of data will allow us to develop more region and habitat specific guidance for managing monarch habitat on DoD land in the West.
- Monarch BMPs specific to DoD lands, with specific guidance for each installation participating in the research project (expected 2019).

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Monarch and Milkweed Management BMPs – April 2018

Best Management Practices to Sustain Monarchs and Milkweeds in Public Lands of the Western U.S. **(2016-2018)**

In partnership with the National Fish & Wildlife Foundation, USFS, BLM, USFWS, and Matt Forister (University of NV Reno)

- Conducted milkweed and monarch breeding surveys in the Great Basin (2016)
- Survey land managers in western states to better understand how land management practices affect monarch habitat, especially on rangelands (2017)
- Develop BMPs to improve monarch habitat on western public lands (Winter-Spring 2018)
  - Informed by research: Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

Photo: Stephanie McKnight, The Xerces Society

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Monarch Habitat Requirements

Throughout their life cycle, monarchs need safe places to breed, migrate, and overwinter:

- Milkweed host plants
- Diverse nectar sources
- Roosting sites along migratory routes and breeding sites
- Overwintering habitat
- Access to water

Photo: Stephanie McKnight/Xerces Society

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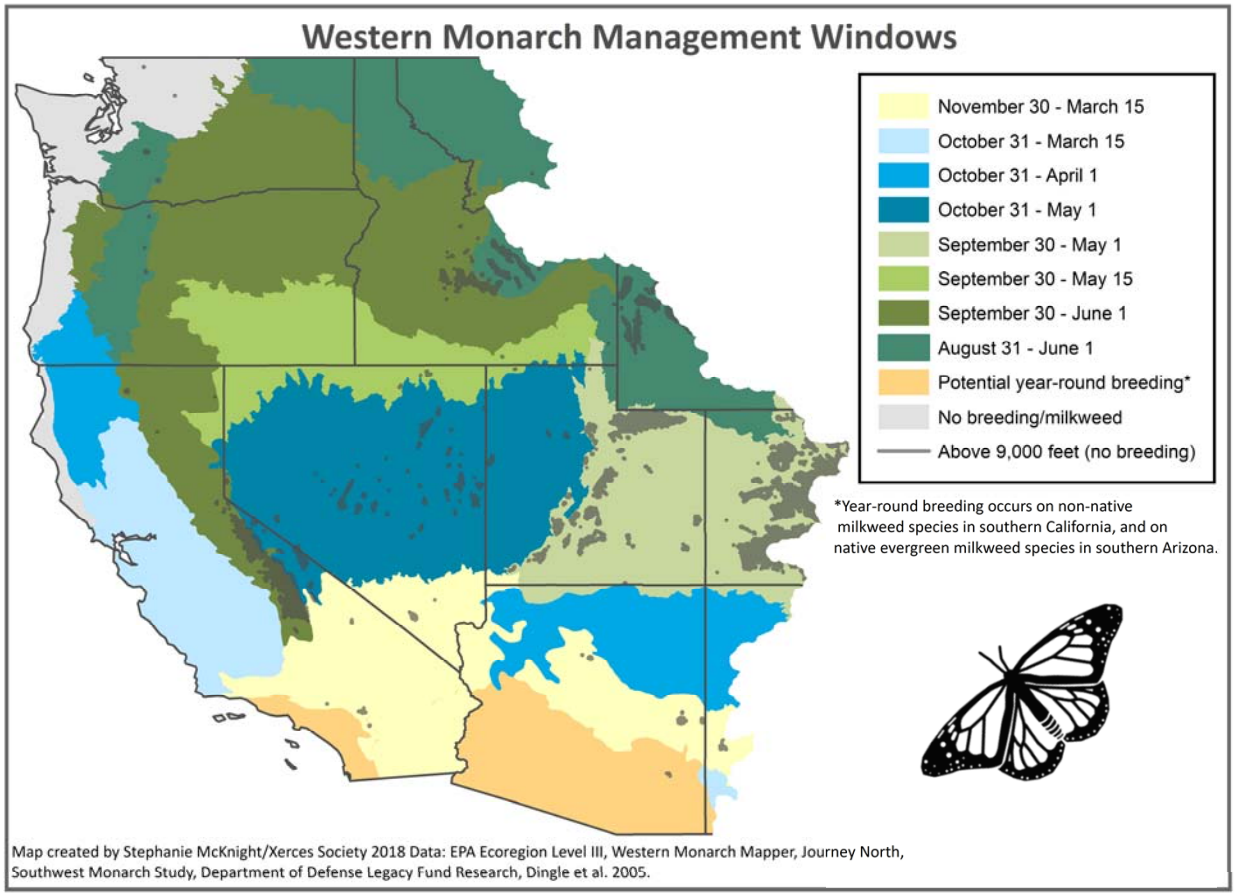
Best Management Practices for Monarchs



- Management such as mowing, grazing, or prescribed fire during the breeding season could result in mortality of immature monarchs and reduce the availability of milkweed or nectar plants.
- Map is a product of research efforts including the Western Monarch Milkweed Mapper, Habitat Suitability Modeling, and the DOD Legacy project, as well as expert opinion.
- Broad management recommendations based on the best available data for monarch breeding activity in the West.
- There is still more to learn about when and where monarchs breed in the West.
- Timing of monarch breeding may vary from year to year.

Map:Xerces Society/Stephanie McKnight

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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

Photo: Liz West/Flickr

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Monarch Nectar Plant Guides

Bloom		Common Name	Scientific Name	Flower Color	Max. Height	Water Needs	Notes
		Forbs			(Feet)	Low, Medium, or High	All species perennials, unless otherwise noted. Monarchs can be found year-round in California.
Spring to Summer	1	Cobwebby thistle	*Cirsium occidentale*	Pink/white/purple	4	L	Biennial plant.
	2	Heartleaf milkweed	*Asclepias cordifolia*	Pink/purple	3	L	Monarch caterpillar host plant.
	3	Nettleleaf giant hyssop	*Agastache urticifolia*	Purple/red	2	L	Establishes better from transplant than seed. Tolerates clay soil and wet conditions.
Spring to Fall	4	Slender sunflower	*Helianthus gracilentus*	Yellow	1	L	Excellent butterfly nectar plant.
	5	Western vervain	*Verbena lasiostachys*	Purple	3	L	Good butterfly plant. Tolerates seasonal flooding, sand and clay. Can be used for erosion control.
Summer	6	Common sunflower	*Helianthus annuus*	Yellow	5	M	Annual plant.
	7	Coyote mint	*Monardella villosa*	Pink/purple	2	L	Requires good drainage.
	8	Mountain monardella	*Monardella odoratissima*	White/purple	1	L	Does best at mid to high elevations. Attracts many species of butterflies.
	9	Pacific aster	*Symphyotrichum chilense*	Yellow/violet	4	L	Tolerates clay soils and wet or dry conditions.
	10	Showy milkweed	*Asclepias speciosa*	Pink/green/purple	3	M	Monarch caterpillar host plant.
Summer to Fall	11	California goldenrod	*Solidago velutina* ssp. *californica*	Yellow	3	L	Important late-season forage for bees, butterflies, wasps, beetles, and more.
	12	Narrow-leaved milkweed	*Asclepias fascicularis*	Pink/white	3	M	Monarch caterpillar host plant. Tolerates clay soils and wet or dry conditions.
	13	Smooth beggartick	*Bidens laevis*	Yellow	3	H	Prefers wet areas and can be used in bioswales. Attracts beneficial insects and butterflies in the fall.
	14	Sulphur-flower buckwheat	*Eriogonum umbellatum*	Yellow	2	L	Attracts many species of bees and butterflies.
Winter to Spring	15	Bluedicks	*Dichelostemma capitatum*	Purple	3	L	Attracts other bees, butterflies, and hummingbirds. An early spring bloomer.

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Milkweed Species Selection

Monarch BMPs April 2018

Species	Common Name	J	F	M	A	M	J	J	A	S	O	N	D	Documented as Monarch Larval Host	Commercially Available Seed/plants	Suitability for Restoration (X=yes, U=uncommon, R=rare)	Species Distribution in State	Habitat Type
Oregon																		
Asclepias cordifolia	heartleaf milkweed					x	x	x						Yes		X	SW	Dry, rocky areas in woodlands, chaparral, and evergreen forest in the North Coast F
Asclepias cryptoceras	pallid milkweed				x	x	x							Yes		R	E	Dry, open, barren places such as washes, slopes, and hillsides, in pinyon-juniper wo
Asclepias fascicularis	narrowleaf milkweed					x	x	x	x	x	x			Yes	Yes	X	Most Counties	Valley grasslands, wetland-riparian areas, foothill woodlands, and chaparral, and cl
Asclepias speciosa	showy milkweed					x	x	x	x	x				Yes	Yes	X	Most Counties	Dry to moist soil in open, sunny areas and occurs in many plant communities includ
Washington																		
Asclepias cryptoceras	pallid milkweed				x	x	x							Yes		R	SE	Dry, open, barren places such as washes, slopes, and hillsides, in pinyon-juniper wo
Asclepias fascicularis	narrowleaf milkweed					x	x	x	x	x	x			Yes		X	E	Valley grasslands, wetland-riparian areas, foothill woodlands, and chaparral, and cl
Asclepias speciosa	showy milkweed					x	x	x	x	x				Yes		X	E	Dry to moist soil in open, sunny areas and occurs in many plant communities includ
Idaho																		
Asclepias asperula	spider milkweed			x	x	x	x	x	x	x	x			Yes		U	SE	Well-drained rocky or sandy soils of prairies, roadsides, pastures, plains, hillsides, b
						x	x							Yes		R	S	Dry, open, barren places such as washes, slopes, and hillsides, in pinyon-juniper wo
						x	x	x	x	x	x			Yes		U	S	Valley grasslands, wetland-riparian areas, foothill woodlands, and chaparral, and cl
							x	x	x					Yes		X	S	Wet, flat, grassy meadows as well as streams and ditch-banks, marshes, and moist
						x	x	x	x	x				Yes		X	Most counties	Dry to moist soil in open, sunny areas and occurs in many plant communities includ
California																		
														Yes		X	SE	Dry rocky places in deserts, including desert flats, slopes, and creosote bush scrub
						x	x	x	x	x	x			Yes		U	SE	Well-drained rocky or sandy soils of prairies, roadsides, pastures, plains, hillsides, b
						x	x	x						Yes		X	W	Flats and grassy or brushy slopes in many plant communities, including valley grass
						x	x	x						Yes	Yes	X	N, E	Dry, rocky areas in woodlands, chaparral, and evergreen forest in the North Coast F
						x	x	x	x	x	x			Yes	Yes	X	W	Dry, rocky areas in many plant communities, including valley grassland, chaparral, a

https://xerces.org/milkweed-seed-finder/

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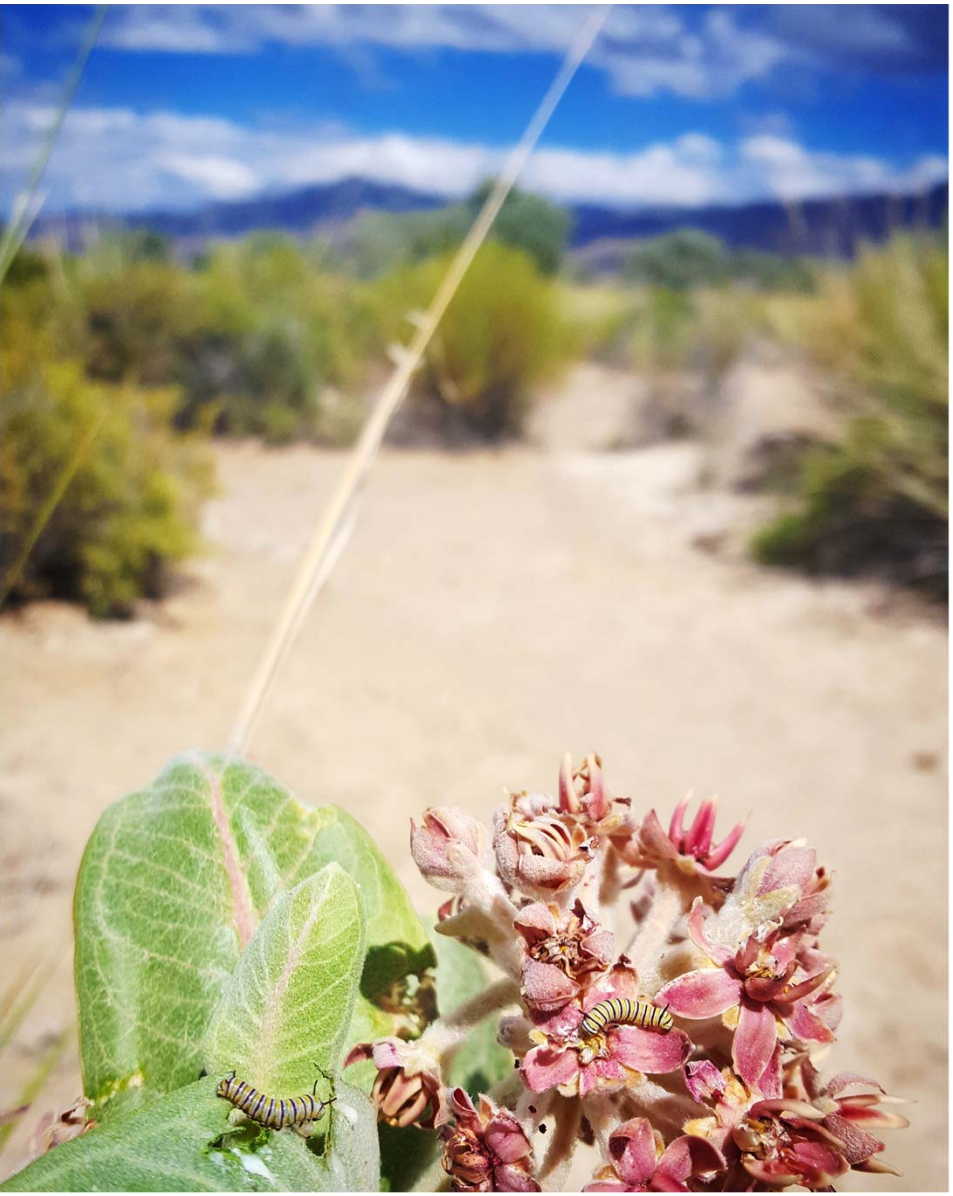

Photo: Stephanie McKnight – monarch larva on showy milkweed, Fallon NAS

Restoration: Milkweed Patch Size

- Monarchs prefer to lay eggs in small isolated milkweed patches. Possibly to minimize predation & competition risks for their offspring
- There are also risks: a single plant may not provide sufficient food for a caterpillar's entire development
- Plant varying densities of milkweed - smaller, less dense patches are likely better compared to isolated plants or large, dense stands of milkweed

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Mowing

There are millions of acres of roadside habitat that are mowed in the West.

Mowing can kill pollinators – including monarch larvae - and remove nectar resources.

Excessive mowing reduces wildflower abundance and diversity over time.

Photo: Stephanie McKnight/Xerces Society

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Sources: Thomas 1984; Wynhoff 1998; Di Giulio et al. 2001; Humbert et al. 2010; Hatfield et al. 2012; Kayser 2014

Mowing BMPs

- Leave unmowed strips (flag and avoid milkweed patches)
- Delay mowing until fall (avoid mowing during the monarch breeding season for your region) if milkweed is present along roadsides
- Adjust mowing height. (10-12 inches)

Photo: Ron Klataske

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Grazing BMPs

In general, as grazing intensity increases, pollinator abundance and diversity decreases, especially at high grazing intensities.

However, grazing can also be an important management tool to maintain forb-dominated grasslands which can benefit specific pollinator species.

General recommendations for pollinators:

- 40% max utilization rate
- Move livestock frequently: rotational grazing; HDSD; or low AUMs
- Limit access to riparian areas & butterfly host plants
- Fall and winter grazing = fewer impacts

Photo: Xerces Society / Sarina Jepsen

Source: Morris 1967; Hutchinson & King 1980; Sugden 1985; Dana 1997; Balmer & Erhardt 2000; Cagnolo et al. 2002; Carvell 2002; Kruess & Tscharntke 2002; Pöyry et al. 2006; Kuussaari et al. 2007; Sjödin 2007; Yoshihara et al. 2008; Littlewood 2008; Börschig et al. 2013; Jerrentrup et al. 2014; Elwell et al. 2016; van Klink et al. 2016

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Is Milkweed Compatible with Grazing?

Monarch caterpillars require milkweed

But it is toxic to livestock when consumed in large quantities…

Photo: Xerces Society / Brianna Borders

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Sources: Fulton 1972; Pfister et al. 2002; Borders and Lee-Mader 2014; Fleming and Fleming 1920.

Yes! If you follow milkweed BMPs

- Ensure enough forage is available and use appropriate stocking rates
- Keep fields which will be used as hay free from milkweed
- Avoid planting Western whorled milkweed and narrow leaf milkweed

Asclepias subverticillata (whorled milkweed)

A. speciosa (showy milkweed)

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Photos: Xerces Society / Scott Hoffman Black

Fire

Burning can kill adult and immature stages of butterflies

However, fire can be necessary to maintain open, early-stage habitats rich in nectar and host plants for many butterflies

Some milkweed species respond positively to fire (increase in abundance/sexual reproduction) – more research is needed to determine optimal timing of fire to promote western milkweed species.

Photo: Jeff Vanuga, NRCS

Sources: Baum and Sharber 2012; Smallidge & Leopold 1997; Harper et al. 2000; Ne'eman et al. 2000; Moretti et al. 2006; Cane & Neff 2011; Pryke & Samways 2012; Scandurra et al. 2014

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Fire BMPs

- Leave at least 1/3 of an area unburned
- Burn during the dormant season (when monarchs aren't breeding in your region, and the majority of other pollinators are dormant): ~October-February
- Include monarch nectar plants in post-fire seeding (regional monarch nectar guides)
- If burning during the monarch breeding season, consider flagging and avoiding milkweed plants and giving the plants sufficient buffer to avoid causing mortality to immature stages.

Photo: Robert Parks/National Park Service

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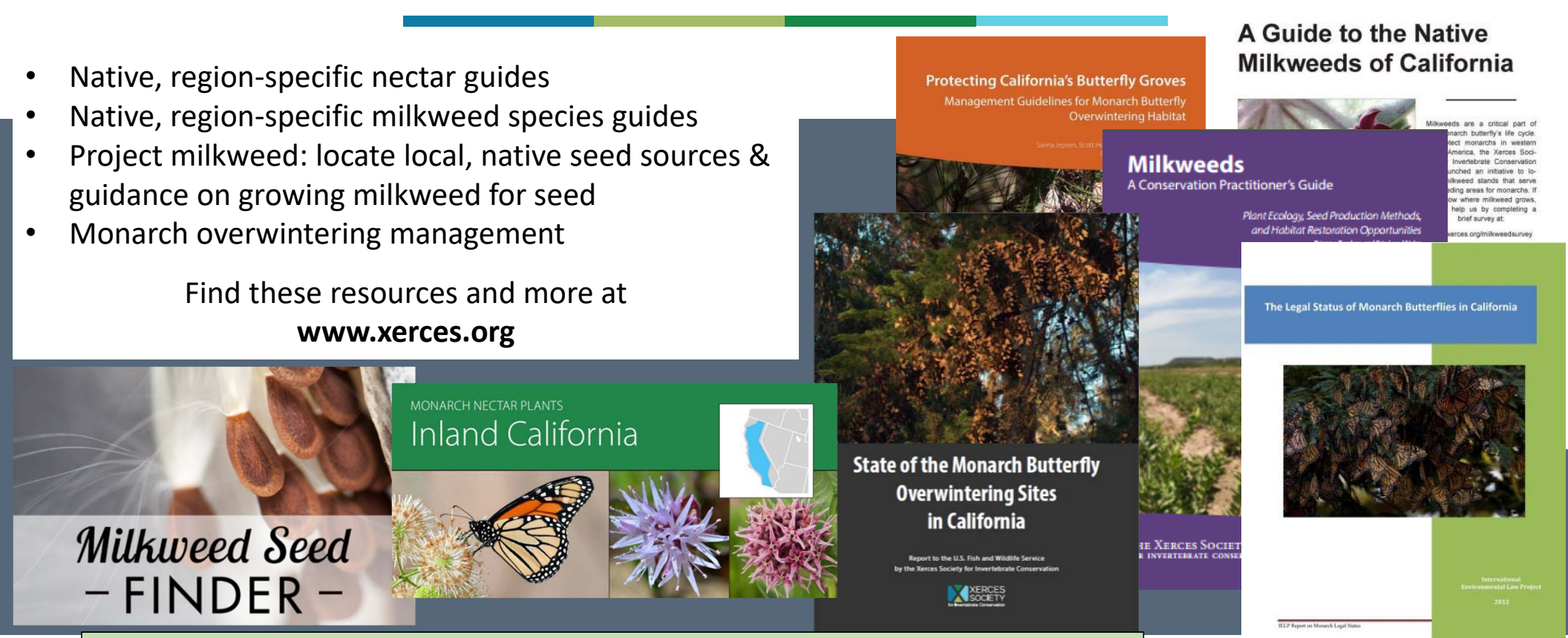
Xerces Monarch Conservation Resources

- Native, region-specific nectar guides
- Native, region-specific milkweed species guides
- Project milkweed: locate local, native seed sources & guidance on growing milkweed for seed
- Monarch overwintering management

Find these resources and more at
www.xerces.org



Coming soon: "Best Management Practices for Monarchs in the West"

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Ways to Support and Advance Monarch Conservation in the West

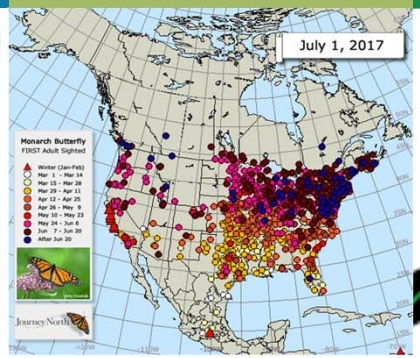
Citizen Science Monitoring Programs for Monarchs

Western Monarch Milkweed Mapper

Where are the most important breeding areas in the West? Regional breeding phenology?

Journey North, Tagging Programs

Are there migration pathways, and if so, where? To what extent do monarchs move between OW sites?



Monarch Larva Monitoring Project

How many generations do western monarchs have annually? What is the survivial rate of eggs/larvae?

Project Monarch Health

How common is OE in the West?

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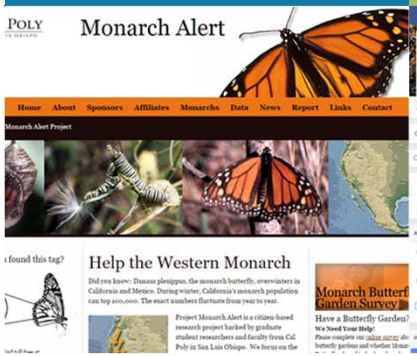
Identifying Western Monarch Migration Pathways

Western Tagging Programs

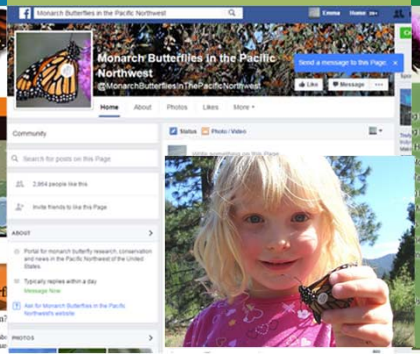
California

Monarch Alert at Cal-Poly



Northwest

Pacific Northwest Monarch Butterflies



Southwest

Southwest Monarch Study

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Supporters

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Field Work Support: Vandenberg AFB in California, NWSTF Boardman in Oregon, JBLM Yakima Training Center in Washington, NAS Fallon in Nevada, and Mountain Home AFB in Idaho. In addition, we worked with US Army Corps of Engineers, Stone Lakes National Wildlife Refuge, and California State Parks in northern California, and Sedgwick Reserve - University of California Santa Barbara Natural Reserve System in Southern California.

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