DoD Natural Resources Program

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Conservation and Management of Western Monarchs on DoD Lands

June 25, 2019

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Conservation and Management of Western Monarchs on DoD Lands

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The Xerces Society

Conservation programs:

- Pollinators
- Endangered Species
- Aquatic Conservation
- Pesticides

Photo: ©The Florida Museum

Photo: Matthew Shepherd/Xerces Society

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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

Advocacy & 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

- Best Management Practices for western monarchs
- Regional Monarch Nectar Plant Guides
- 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 – getting climate resilient monarch friendly breeding habitat on the ground

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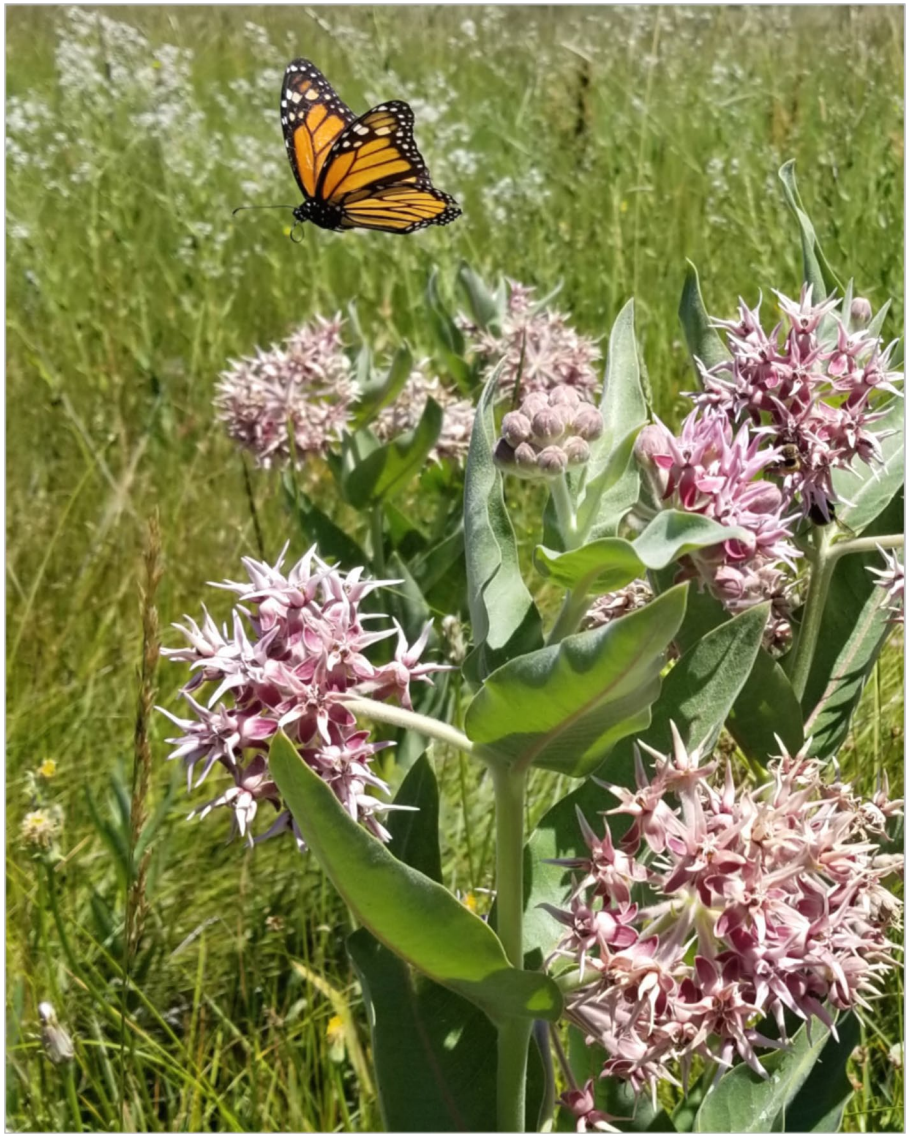

Photo: Stephanie McKnight, Xerces Society

Presentation Overview

I. Brief introduction to western monarchs

II. Conservation Status and Causes of Decline

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

IV. Western Monarch Call to Action with Recommended Conservation Actions for the West

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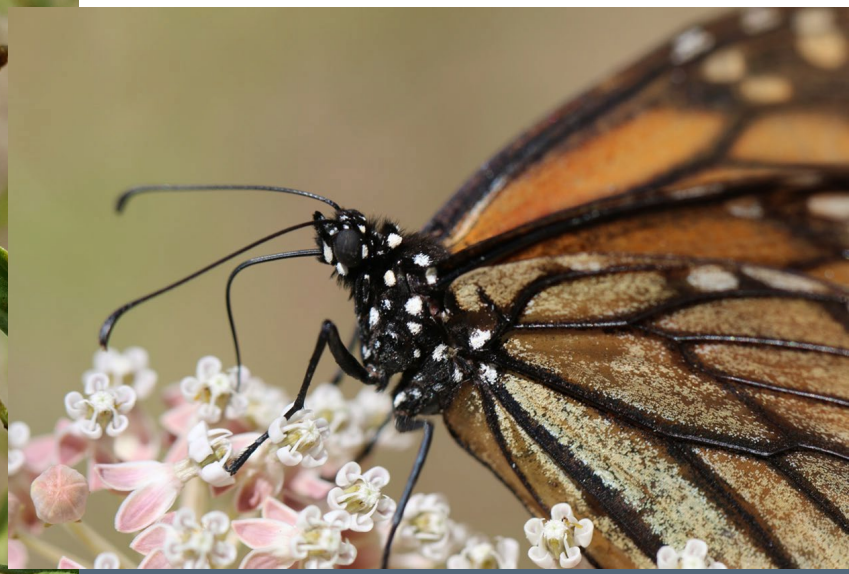
Western Monarch & Milkweed Biology



Photos: Stephanie McKnight/Xerces Society

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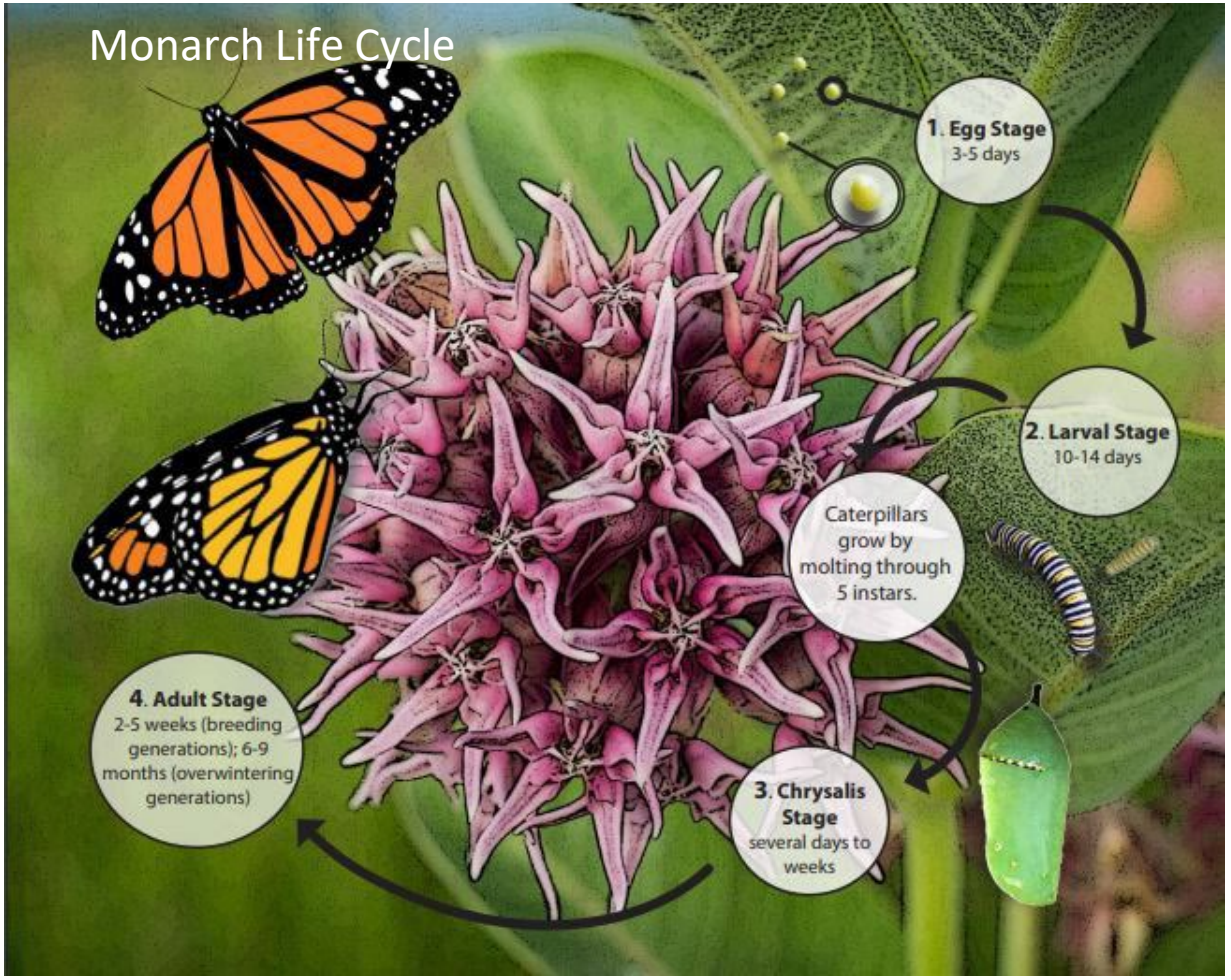
Monarch Life Cycle



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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

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Monarch Life Cycle

- The pupal stage also lasts 10-14 days.
- At eclosure, the abdomen contains most body fluids and wings are shrunken. The adult hangs upside-down and pumps fluids into wings until they expand and stiffen, then flies and feeds on nectar plants (often milkweed).

Photos: Becky Hansis O'Neill

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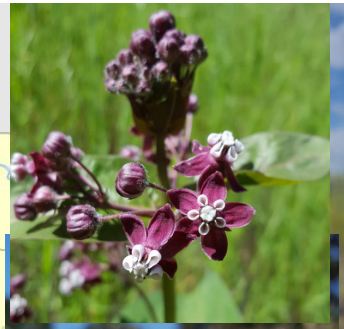
Western Milkweed Species

- 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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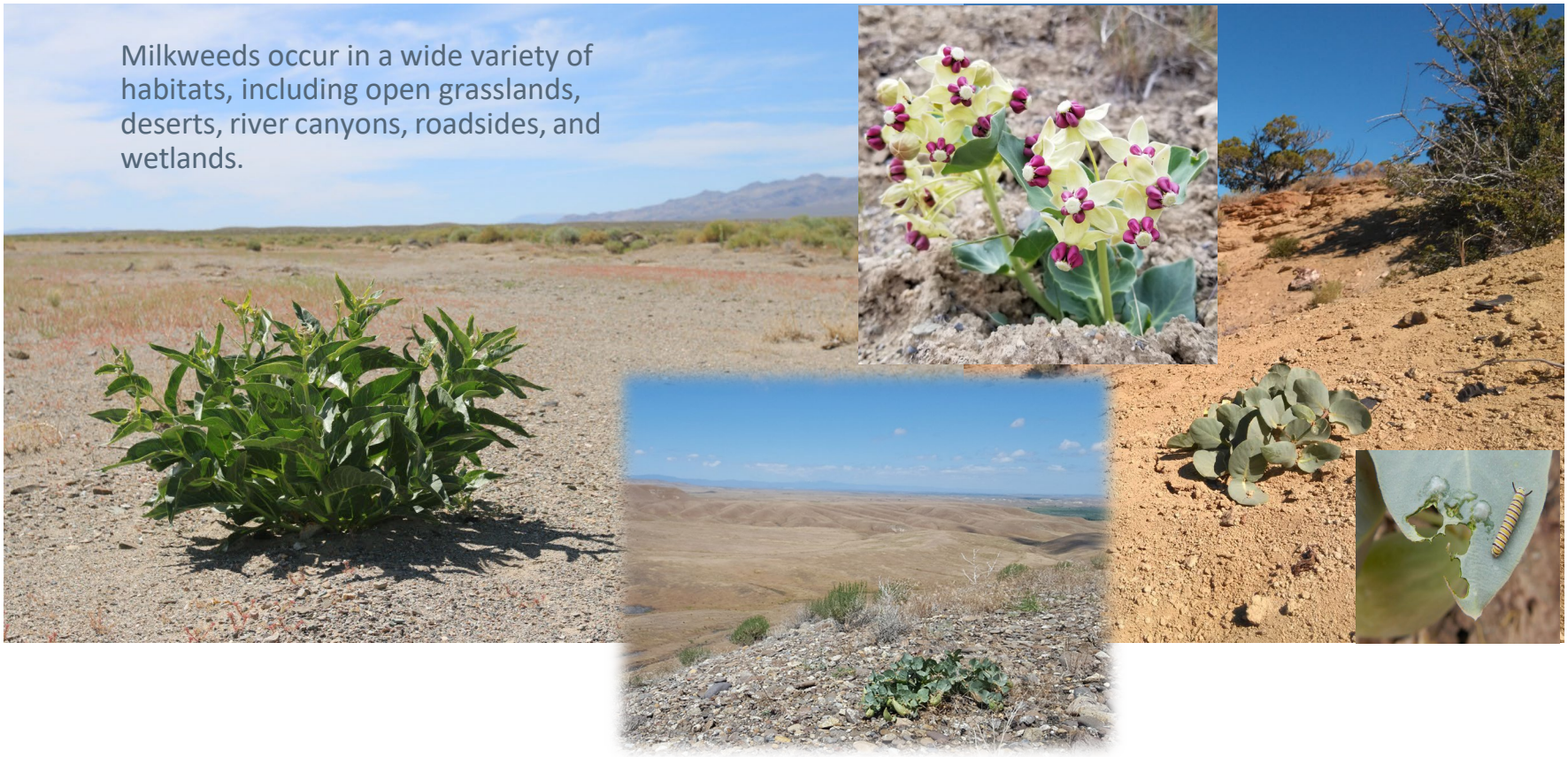
Milkweeds in the Landscape



Photos: Stephanie McKnight/Xerces Society

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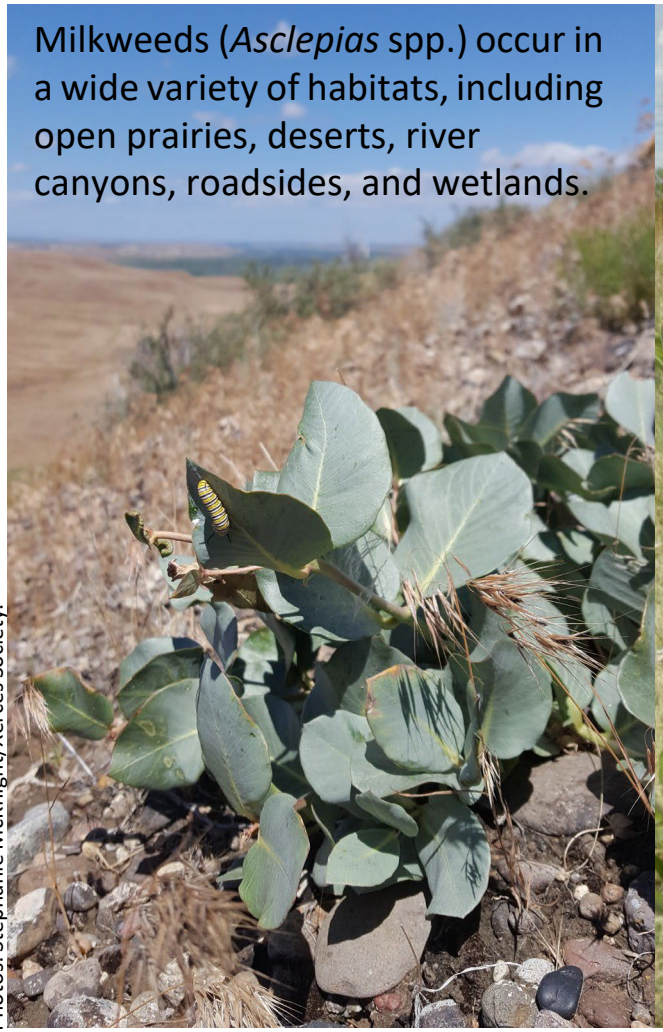
Milkweeds (*Asclepias* spp.) occur in a wide variety of habitats, including open prairies, deserts, river canyons, roadsides, and wetlands.



Photos: Stephanie McKnight/Xerces Society.

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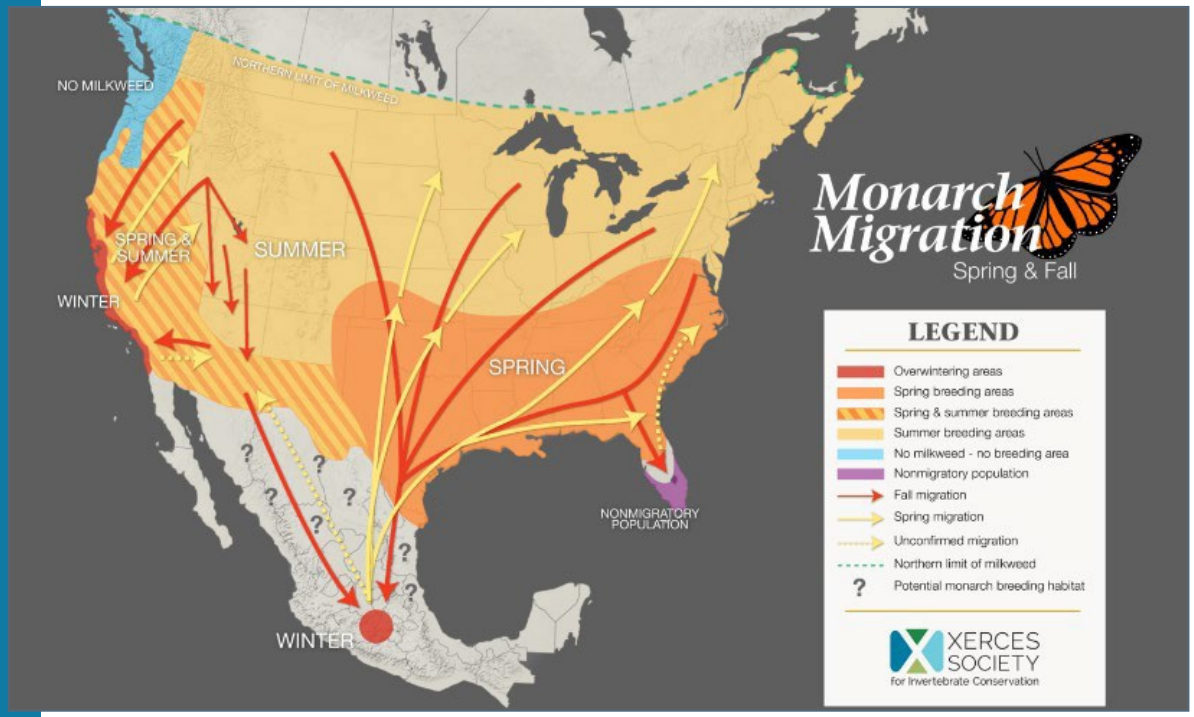
Monarch Migration

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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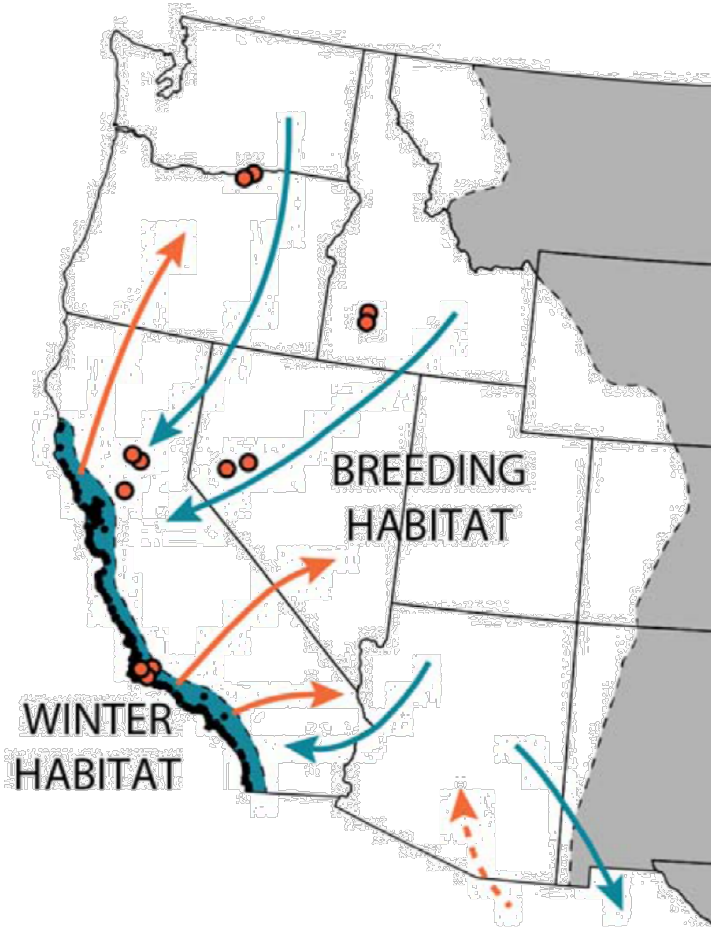
Western Monarch Migration



Map by Elizabeth Crone and Cheryl Schultz

Seasonal monarch movements in the West

- Monarchs typically overwinter from mid-Oct to mid-February
- Monarchs reach interior West in early summer
- Phenology in the West has been poorly understood.
  - Spring Dispersal - overwintering generation oviposits on milkweed in California to start first breeding generation: March-April
  - Summer Breeding and Range Expansion: May-September
  - Fall Migration: September-October
  - Overwintering: November-February

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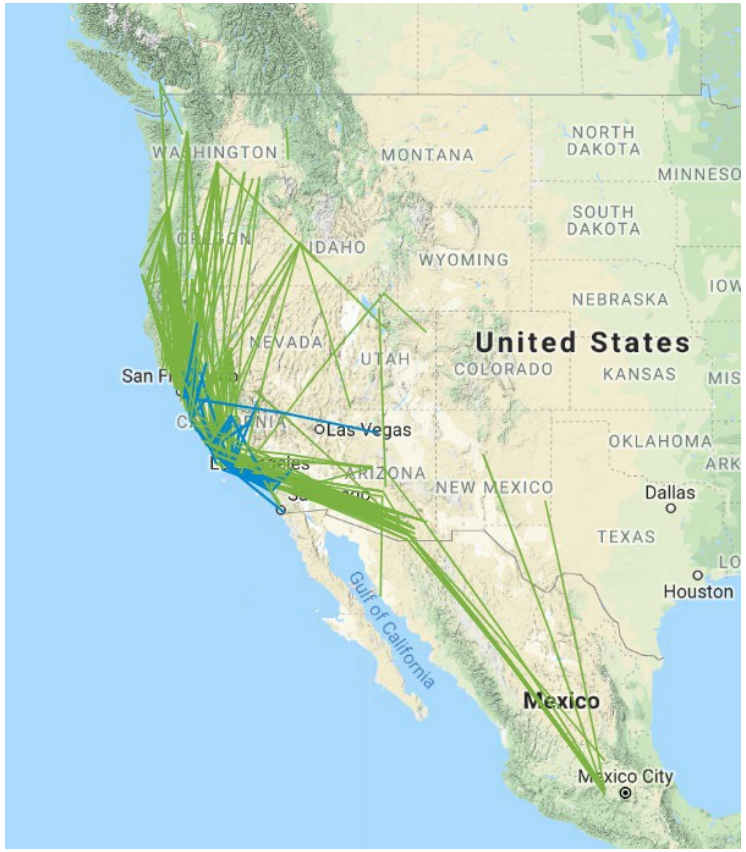
Western Monarch Migration



Map by Stephanie McKnight, The Xerces Society; Tagging recoveries reported from Southwest Monarch Study, David James (PNW Monarchs), Monarch Alert, Robert M. Pyle, and others.

Recoveries of tagged monarchs 1958-2019

- Tagged monarchs from Washington, Idaho, Oregon, Utah, Nevada, Arizona, and California have all been recovered at California overwintering sites
- Tagged monarchs from Arizona have been recovered at both California and Mexico overwintering sites

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Western Monarch Overwintering Biology

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

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, Map by the Xerces Society

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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 winter 2016-2017)

Volunteers visit 250+ sites and collect data on: # of monarchs, # of clusters, tags, weather, cluster tree species, other habitat data

Habitat Assessments (since 2011)

www.westernmonarchcount.org

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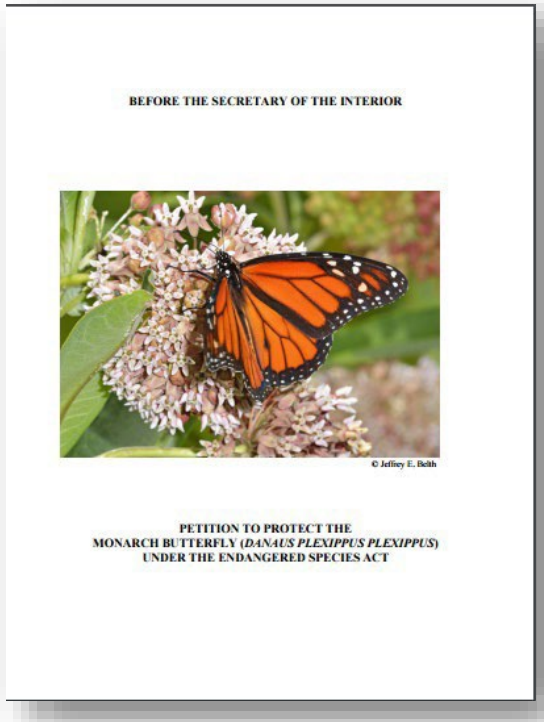
Monarchs and the Endangered Species Act

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 due.
May 2019: Deadline for Decision on Protected Status was Extended to December 15, 2020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PETITION TO PROTECT THE
MONARCH BUTTERFLY (*DANAUS PLEXIPPUS PLEXIPPUS*)
UNDER THE ENDANGERED SPECIES ACT

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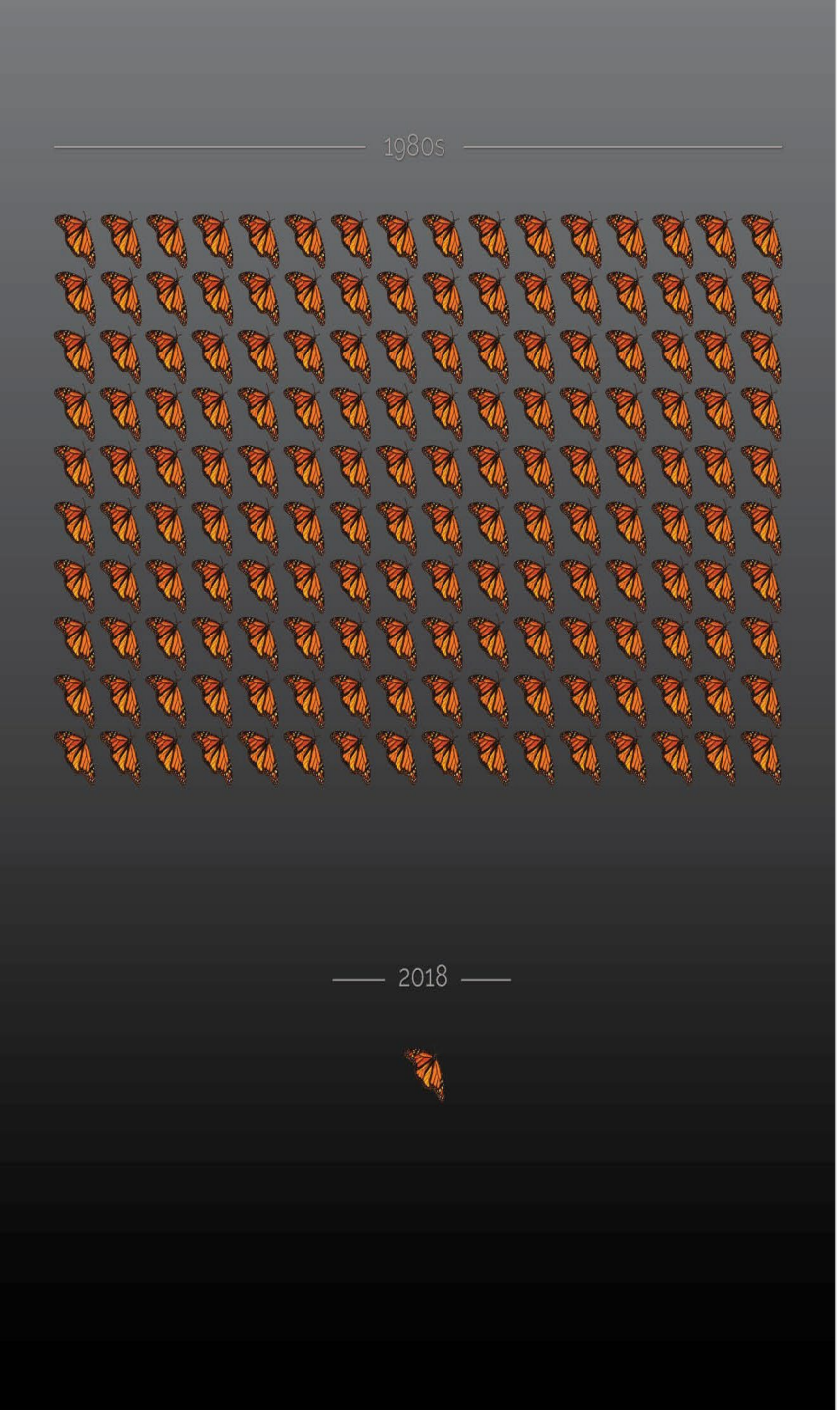

Western Monarch Population

- In 2018, only 28,429 monarchs were counted in the Western Monarch Thanksgiving Count
- 2018 Thanksgiving population represents 0.6% of 1980s population
- For every 160 monarchs that existed in the 1980s, there is now only one

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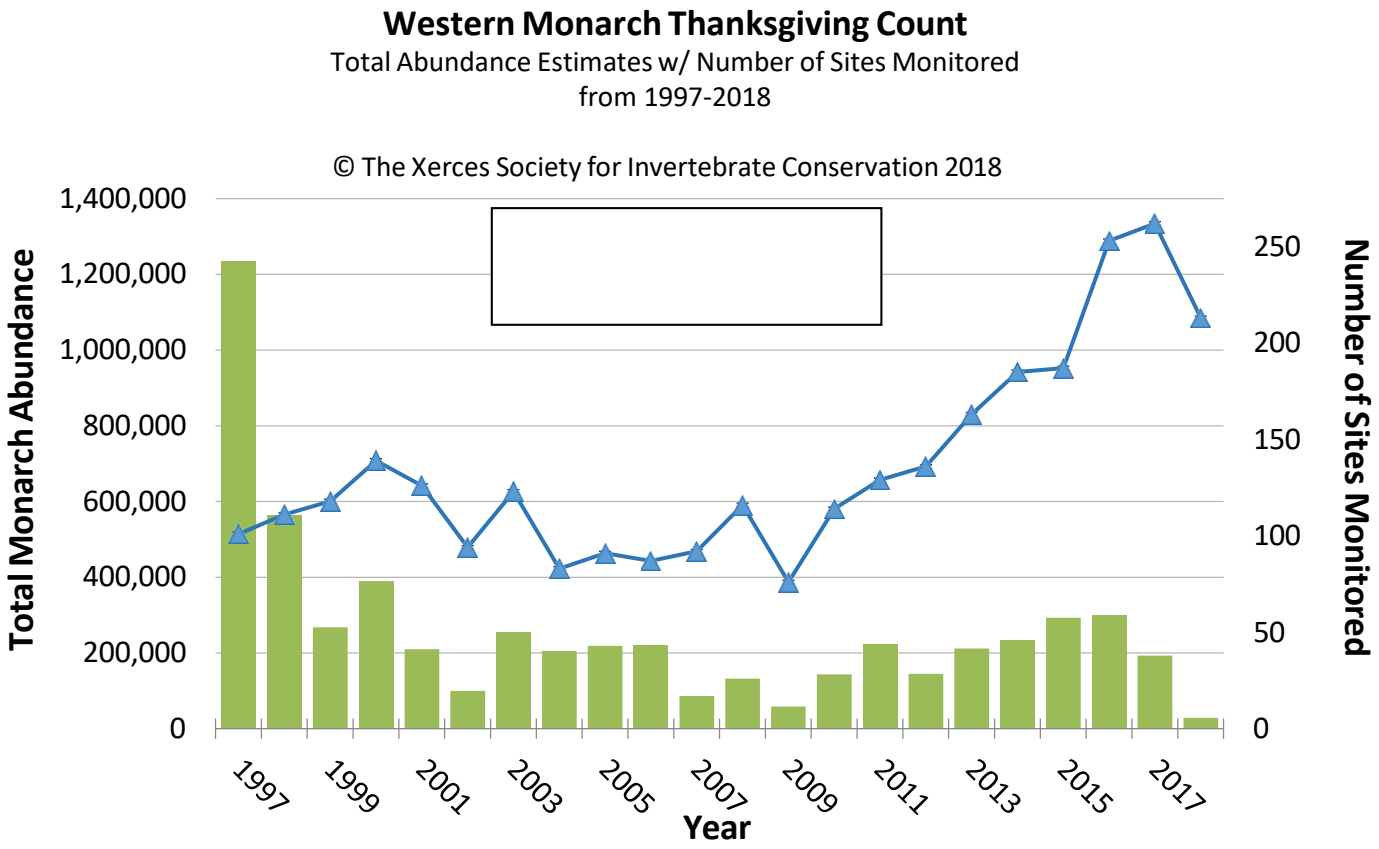
Xerces Western Monarch Thanksgiving Count



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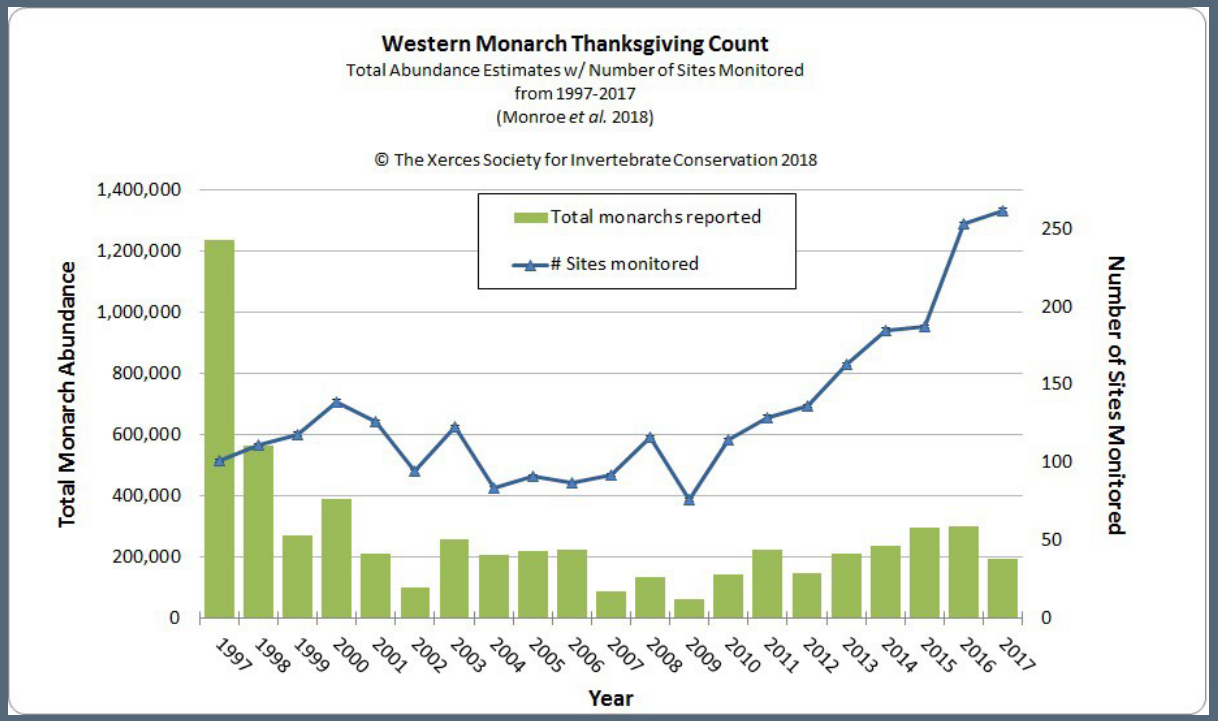
Steep population decline as volunteer effort increases



- 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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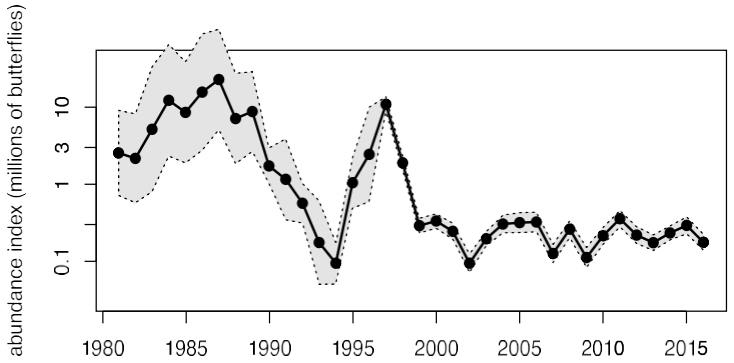
Graph Courtesy of Cheryl Schultz; Photo: Xerces Society / Candace Fallon

Western Monarch Population Viability

- The western monarch population has declined by over 95% since the 1980s and has a **72 percent probability of quasi-extinction** over the next 20 years
- In 2016, the quasi-extinction threshold was proposed by experts to be 30,000 monarchs
- There were an estimated 4-10 million monarchs overwintering in California in the 1980s.



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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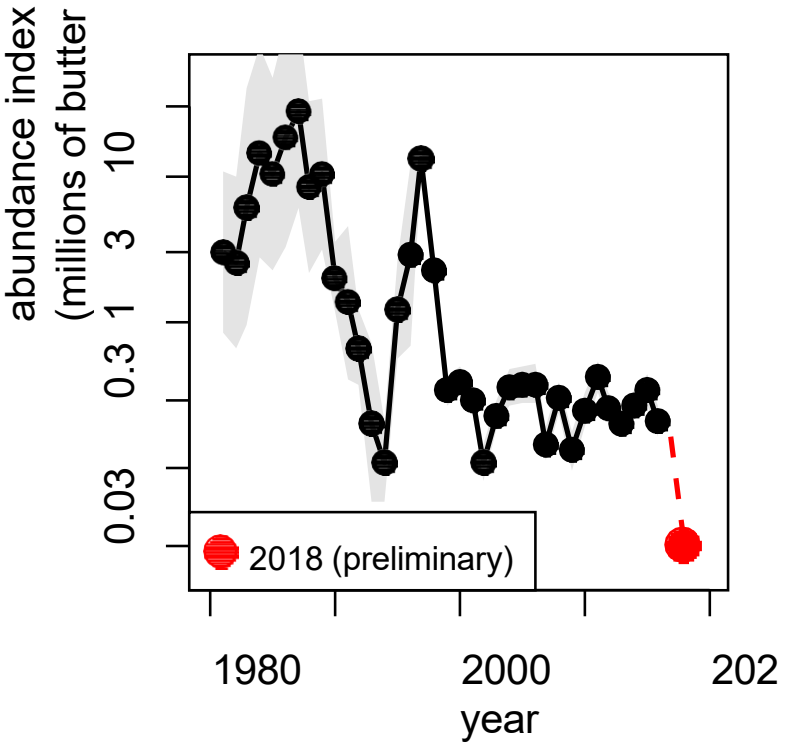
Graph Courtesy of Elizabeth Crone; Photo: Xerces Society / Candace Fallon

Western Monarch Population Viability



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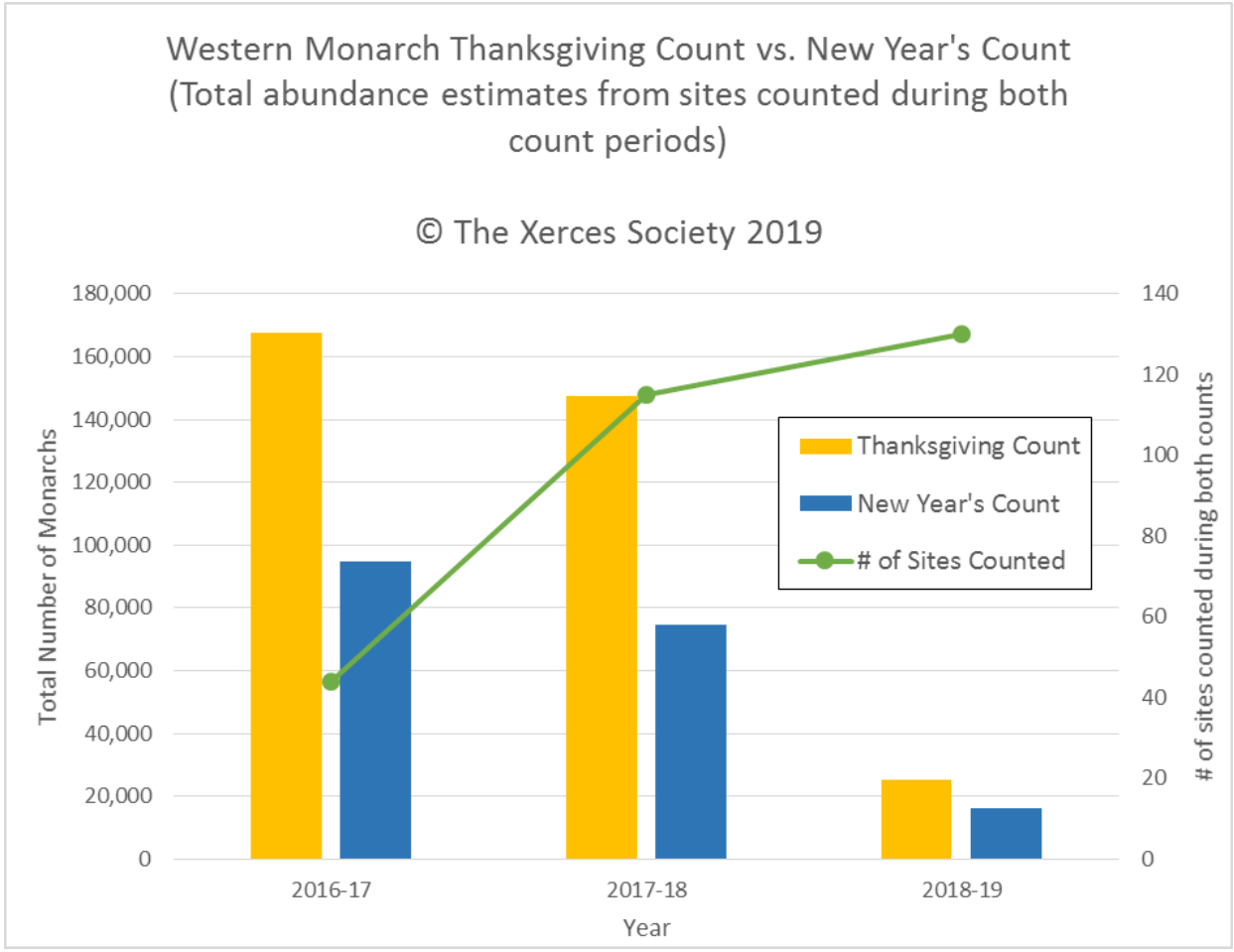
Conservation Status: New Year's Count



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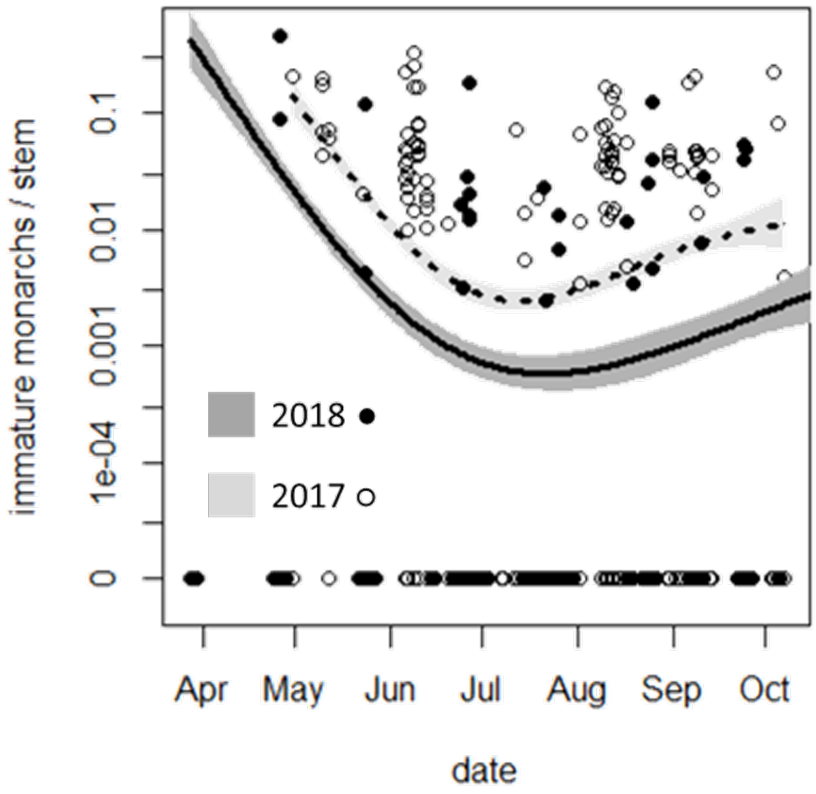
2018 population drop happened before breeding…



2017 vs. 2018: t = -2.53, P = 0.030

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When are monarchs most vulnerable?

- Overwintering and late winter/early spring
- Drop in 2018 probably occurred some time between Thanksgiving Count (Fall) of 2017 and April 2018 and never recovered
- Espeset et al (2016) found monarch declines to be concentrated in early spring (March)

Photo: Stephanie McKnight/Xerces Society

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

Why Are Western Monarchs Declining?

The causes of western monarch decline are not well understood but may include:

- Overwintering habitat loss & degradation
- Breeding habitat loss
- Pesticide use in key breeding areas, including increased use of systemic neonicotinoids
- Climate change
  - potential phenological mismatch in early spring
  - drought effects on overwintering sites; changing winter climate
  - warming summer nighttime temperatures
- Disease, parasites, and predation

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

Why Are Western Monarchs Declining?

- California land use factors including neonicotinoid and herbicide use and coastal habitat development are more strongly correlated with western monarch declines than climatic factors (Crone et al. in review)
- Shifting climatic conditions do not explain the overall long-term negative trend observed in 40 years of monarch summer flight records (Espeset et al. 2016)
- Drop in population in 2018 probably occurred somewhere between December 2017 and April 2018
- Overwinter survival (probably) much lower now than in the past
- Milkweed limitation in early spring?

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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: Douglas Mills, Flickr.

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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

Objective of the Project:

The primary purpose is to determine seasonal timing of monarch butterflies in locations across the West, and to use this information to increase the efficiency and effectiveness of managing habitat for monarchs on DoD lands.

Summary of Approach:

The project involves systematic surveys and demographic models to determine seasonal timing of monarch breeding across the West.

Benefit:

Demographic data will enable DoD managers to balance habitat protection with training activities and other land uses. This work will contribute to key aspects of DoD land management plans, such as Integrated Natural Resources Management Plans (INRMPs) at each installation, by focusing efforts on the temporal windows with greatest importance to breeding monarchs throughout their range.

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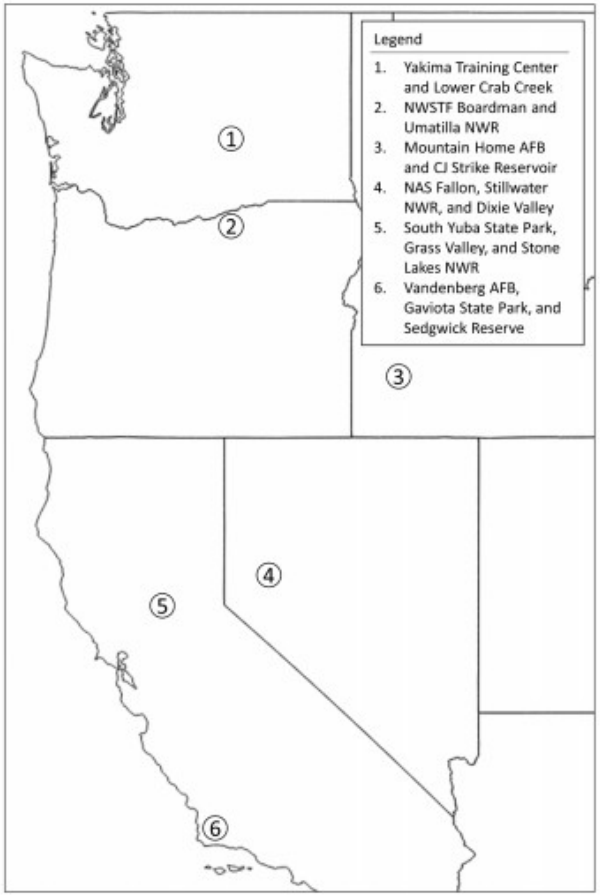
Research Approach and Field Sites



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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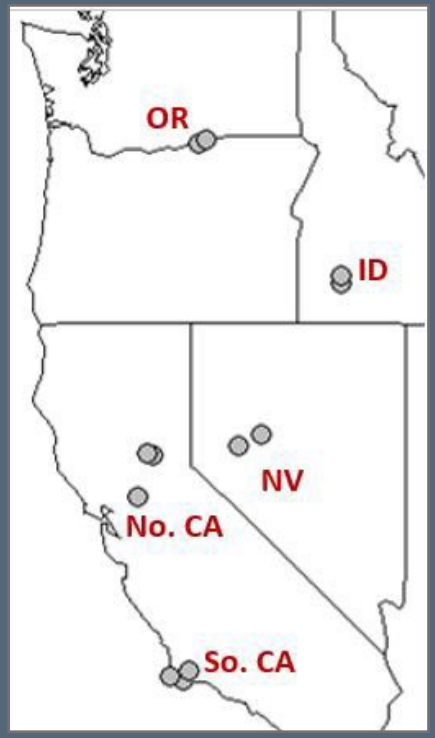
Research Approach and Field Sites



Breeding season monitoring

Site selection

- 5 regions
- 2-3 sites / region
- Transects/monitoring in “best” (not random) locations

Surveys

- Every 4 weeks
- Count milkweed stems, by species
- Count monarch eggs & larvae by stage class
- Surveys in 2017 & 2018 (2019 surveys ongoing)

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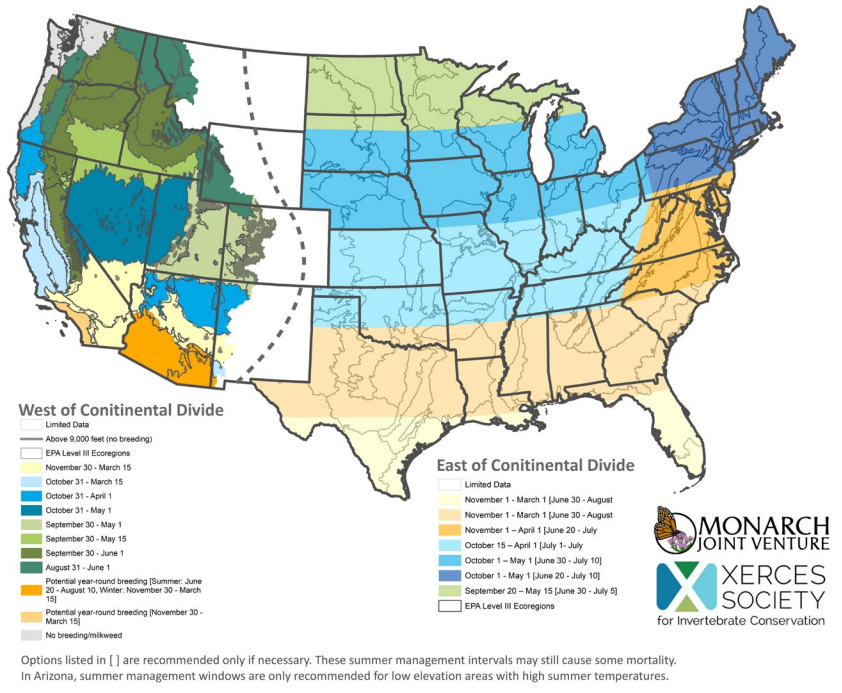
What we have learned so far



Western monarchs differ from eastern monarchs in at least two ways:

1. Western monarchs breed throughout the summer in central parts of their breeding range (California and Nevada), in contrast to eastern monarchs which migrate north through successive summer generations
2. Densities of immature monarchs (eggs and larvae per milkweed stem) in the west are much lower than reported numbers for the east (<0.1 eggs/stem in the West vs. 0.2 – 0.4 eggs/stem in the East); this implies that stem densities of milkweed per se are not the critical limiting factor in the same way that they are for eastern monarch (Nail et al. 2015, Thogmartin et al. 2017).
3. Milkweeds may be most limiting in Spring; immature densities are highest in spring and summer
4. Data from this project fills a critical gap in western monarch knowledge; past research focused on broad trends in overwintering populations in the west, and mechanisms responsible for declines in the west are poorly understood (USFWS 2018).

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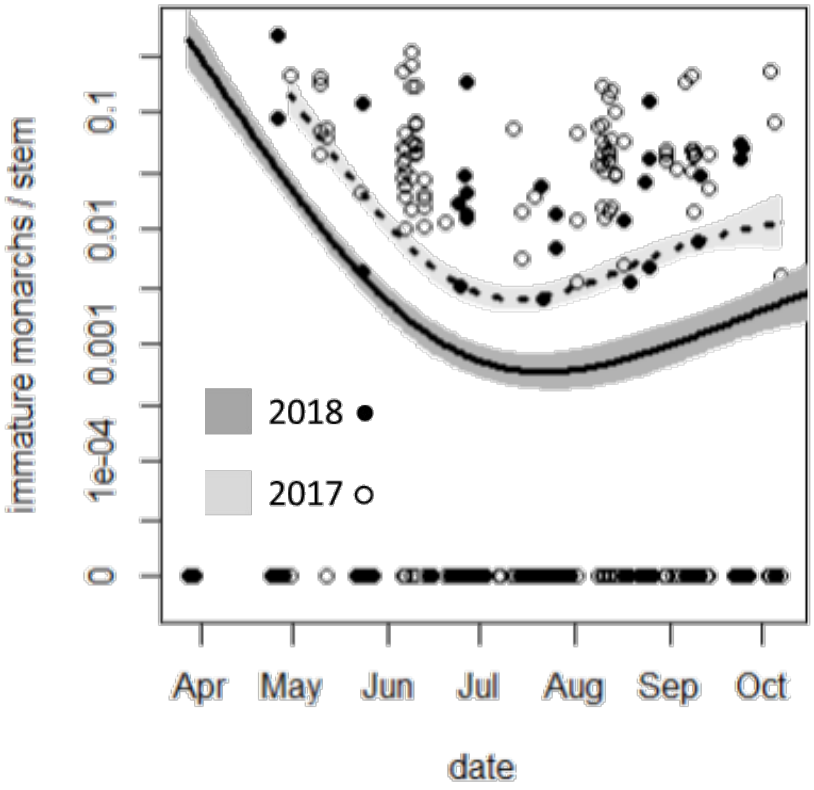
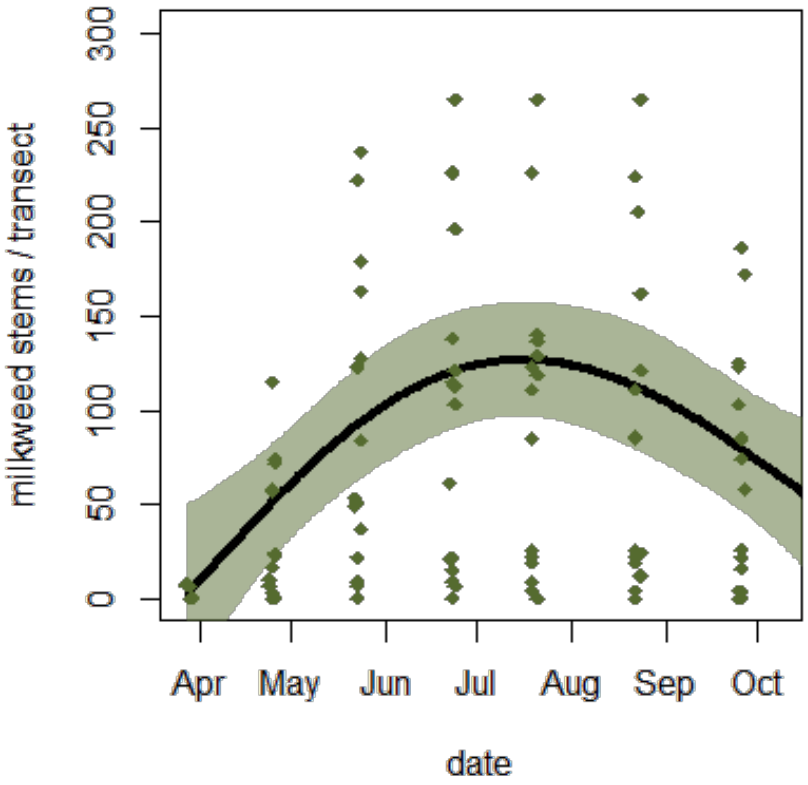
Higher immature densities in Spring than Summer

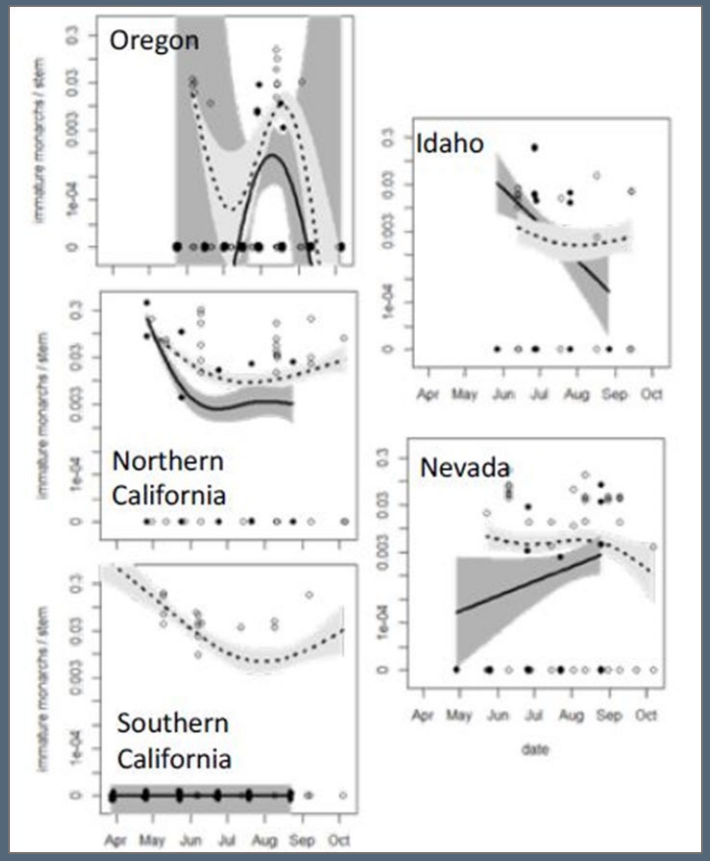
→ milkweed limitation in spring…?





Slide courtesy of Elizabeth Crone and Cheryl Schultz

What we have learned so far



- 2017-2018 monarch breeding was continuous throughout the summer in California and Nevada, and in Oregon there were distinct generations.
- Breeding within the survey area was too limited in Idaho to document breeding phenology.
- Monarchs did not breed in Washington in 2018 and was limited in 2017
- 10 fold decline in immature monarchs/stem between 2017 & 2018!

(light gray = 2017, dark gray = 2018).

Figure courtesy of Elizabeth Crone and Cheryl Schultz

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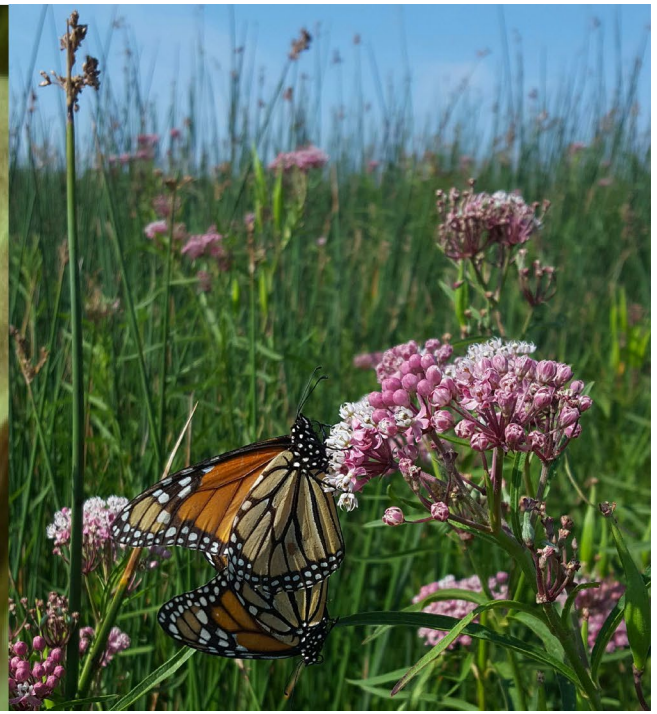
Additional Findings from Year One

- 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.



Photos: Stephanie McKnight/Xerces Society

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Additional Findings: Habitat Associations

Preliminary data suggest that some habitat associations such as shade may be important for monarch breeding particularly in areas of the arid intermountain west. Data from Oregon and Washington suggest that monarchs may be selecting milkweed plants in the shade or near water for breeding more frequently than plants without shade or that are not near water.

Figure shows estimates of habitat selection ratios for monarch butterfly reproduction, calculated from the locations of immature monarchs (eggs and larvae) relative to the number of plots surveyed in each habitat type. Points show selection ratios ± 95% CI based on pilot surveys conducted near NWSTF Boardman in 2017. Overall test for habitat selectivity, based on these pilot data: c2 = 5.5, p = 0.063.

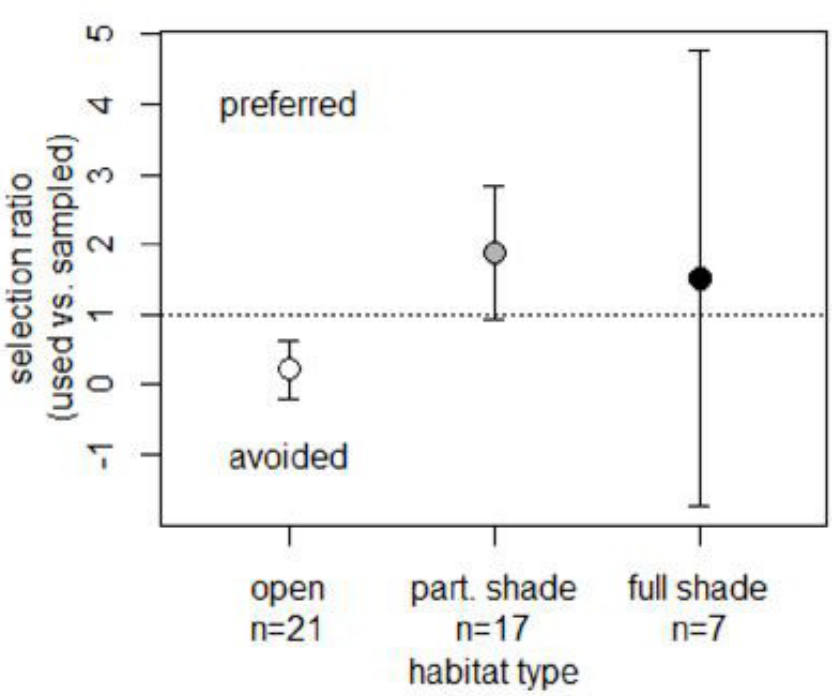

Figure courtesy of Elizabeth Crone and Cheryl Schultz

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

Next Steps

Continuation of the project in 2019 will contribute in three important ways:

1. The first two seasons of the project had extreme weather conditions. It is difficult to tell whether patterns of monarch phenology and abundance observed in first two seasons reflect the western norm, or two very unusual years.
2. A new site was added to the project in 2019: Beale AFB, an installation in a critical part of the western monarch range and with substantial potential monarch breeding habitat.
3. 2019 monitoring will add a new component —quantify tree cover and proximity to water for locations with immature monarchs because monitoring-to-date indicates that shaded areas and those close to water may be more important for monarch productivity than areas exposed to summer heat.

Together these data will help us pinpoint locations where additional management may be needed and are critical to minimizing impacts of management on training activities on DoD lands.

Monarch BMPs specific to DoD lands, with specific guidance for each installation participating in the research project (expected 2020).

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Western Monarch Call to Action

This Western Monarch Call to Action, led by the Xerces Society for Invertebrate Conservation & with the input of the western monarch science community, aims to provide a set of rapid-response conservation actions that can help the western monarch population bounce back from its extremely low 2018–19 overwintering size.

Photo: Xerces Society / Stephanie McKnight

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Western Monarch Call to Action

1.) Protect and manage California overwintering sites.

2.) Restore breeding and migratory habitat in California.

3.) Protect monarchs and their habitat from pesticides.

4.) Protect, manage, and restore summer breeding and fall migration monarch habitat outside of California.

5.) Answer key research questions about how to best aid western monarch recovery.

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Western Monarch Call to Action

1. Protect and manage California overwintering sites.

Monarchs cluster on a Monterey pine in California in 2011. Although the numbers of overwintering monarchs at various sites in California are much smaller now, overwintering sites are still crucial to the recovery of the western monarch. (Photo: Xerces Society / Candace Fallon)

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Western Monarch Call to Action

1. Protect and manage California overwintering sites.

<u>Right now</u>:

- Halt the destruction of overwintering habitat.
- Give overwintering sites sufficient legal and enforced protection.

(Photo: Jessica Griffiths)

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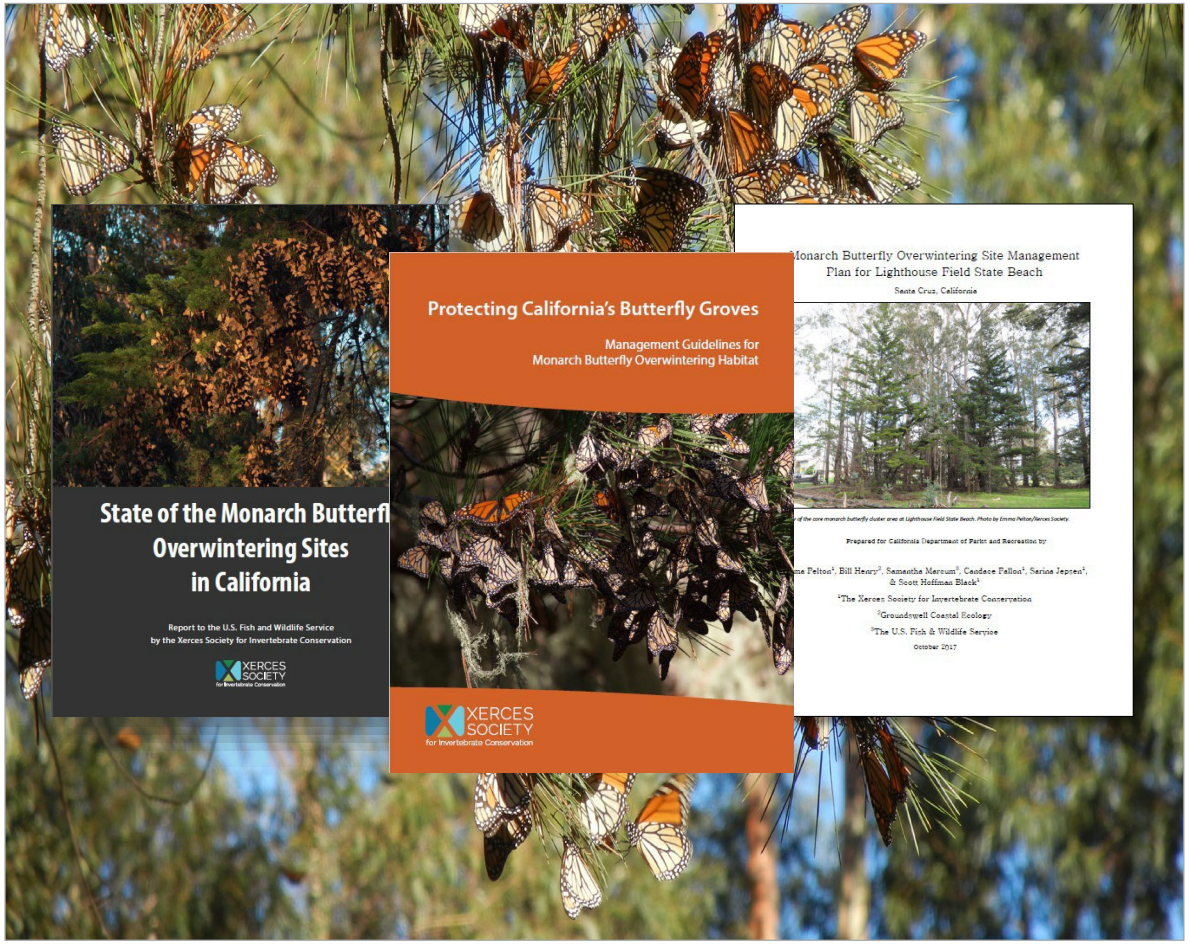
Western Monarch Call to Action

1. Protect and manage California overwintering sites.

<u>In the next year</u>:

Create and implement overwintering site management plans at as many sites as possible



Monarchs cluster on a Monterey pine in California in 2011. Although the numbers of overwintering monarchs at various sites in California are much smaller now, overwintering sites are still crucial to the recovery of the western monarch. (Photo: Xerces Society / Candace Fallon)

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Western Monarch Call to Action

1. Protect and manage California overwintering sites.

In the next year:

- Adopt a site and become an advocate.
- Contact your local elected official.

westernmonarchcount.org

Monarchs cluster on a Monterey pine in California in 2011. Although the numbers of overwintering monarchs at various sites in California are much smaller now, overwintering sites are still crucial to the recovery of the western monarch. (Photo: Xerces Society / Candace Fallon)

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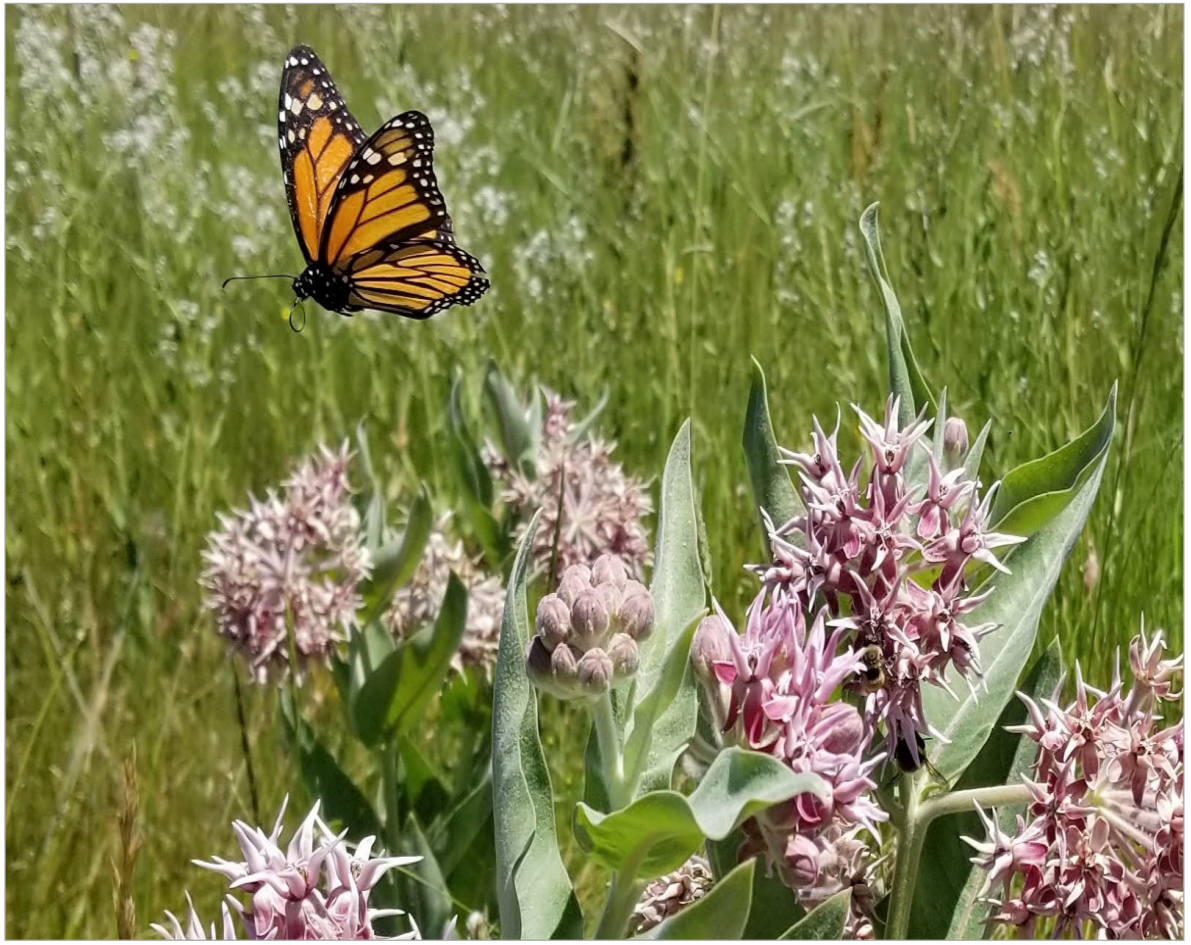
Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.



A monarch flies over showy milkweed (*A. speciosa*). Providing sufficient milkweed (the monarch's larval host plant) and other nectar plants is a key component to aiding western monarchs' recovery. (Photo: Xerces Society / Stephanie McKnight)

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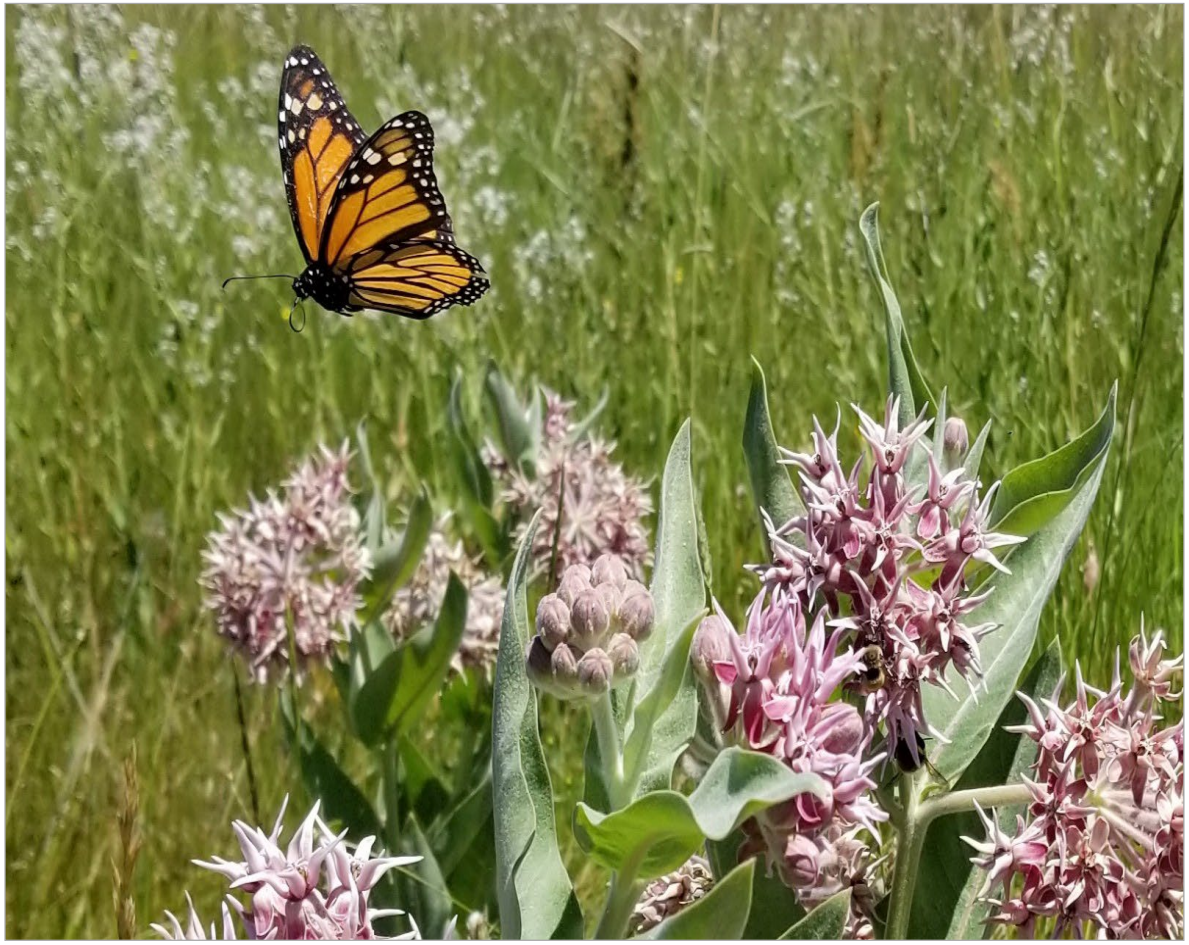
Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.

Right now:

Plant nectar species, especially early spring species (February–April)



A monarch flies over showy milkweed (*A. speciosa*). Providing sufficient milkweed (the monarch's larval host plant) and other nectar plants is a key component to aiding western monarchs' recovery. (Photo: 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

Images: www.xerces.org

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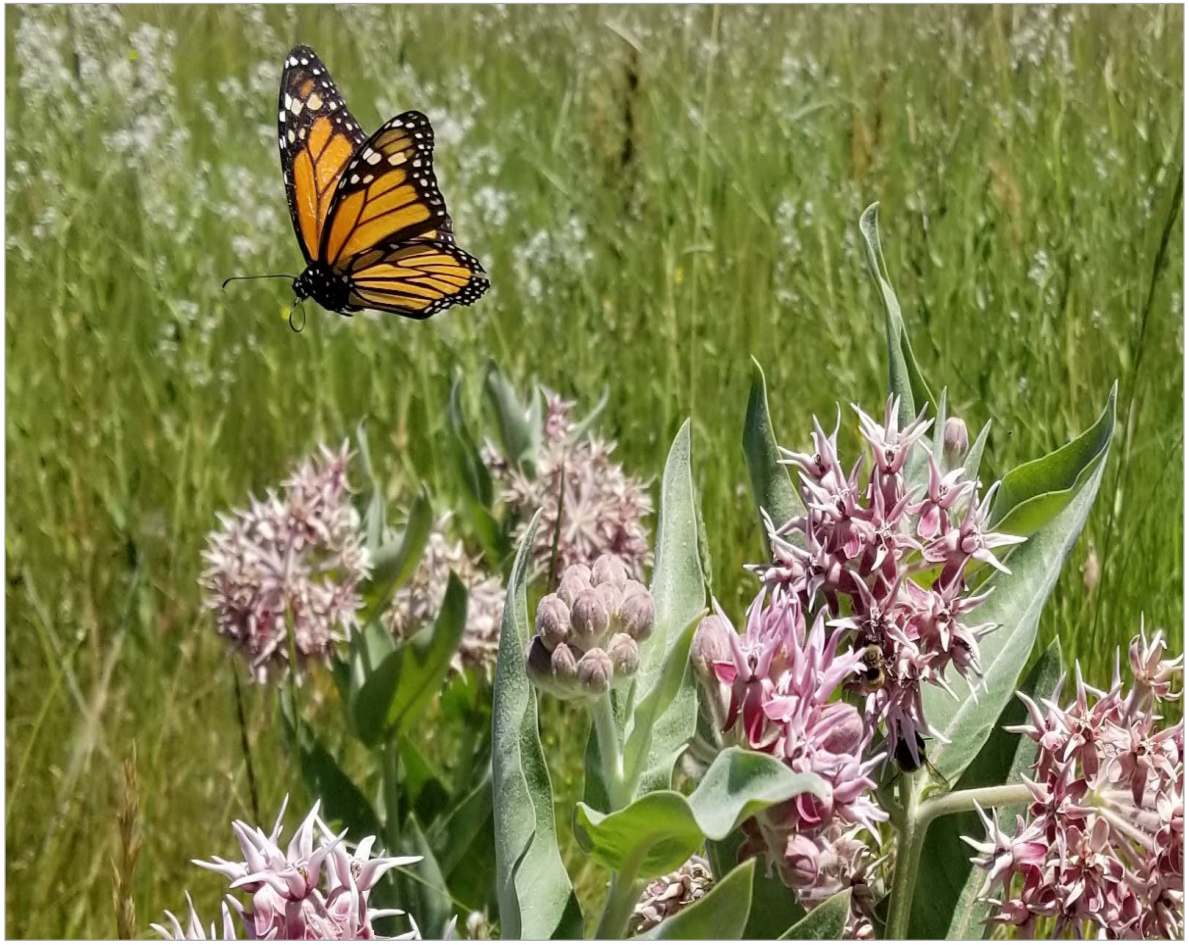
Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.

Right now:

Plant native milkweed

Ideally, plant milkweed greater than 5 miles inland from overwintering sites.



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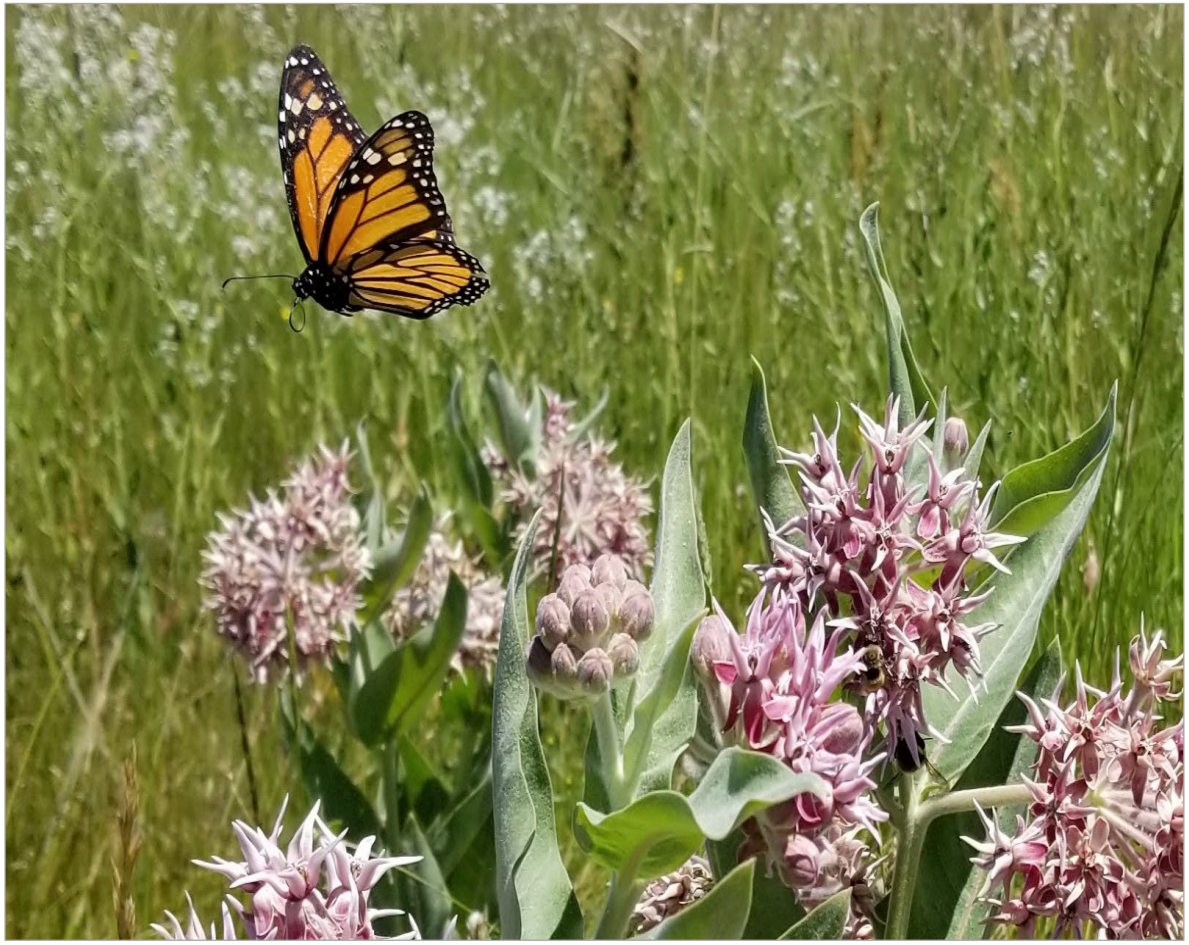
Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.

In the next year:

Increase native milkweed & nectar plant availability



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Milkweed Emergence and Flowering in California

		Milkweed Flowering Phenology = Blue Milkweed Emergence = Green											
Species	**Common Name**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Asclepias californica	California milkweed				x	x	x	x					
Asclepias cordifolia	heartleaf milkweed					x	x	x					
Asclepias eriocarpa	woollypod milkweed					x	x	x	x	x	x		
Asclepias vestita	wooly milkweed				x	x	x	x					
Asclepias fascicularis	narrowleaf milkweed					x	x	x	x	x	x		
Asclepias speciosa	showy milkweed					x	x	x	x	x			

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Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.

<u>In the next year</u>:

Remove tropical milkweed to replace it with native milkweed and nectar plants.

Still wondering if tropical milkweed is so bad? Read Satterfield et al. 2018

A monarch flies over showy milkweed (*A. speciosa*). Providing sufficient milkweed (the monarch's larval host plant) and other nectar plants is a key component to aiding western monarchs' recovery. (Photo: Xerces Society / Stephanie McKnight; inset by Adam Rodriguez, Desert Botanical Garden, Flickr)

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Western Monarch Call to Action

2. Restore breeding and migratory habitat in California.

In the next year:

Support wild, migratory monarchs.

Low numbers is NOT a reason to increase home rearing or move monarchs.

(Photo: Xerces Society / Stephanie McKnight)

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Western Monarch Call to Action

3. Protect monarchs and their habitat from pesticides.

Right now:

Halt all cosmetic use of pesticides.

Green lacewing, a natural predator of aphids and other crop pests. Conservation biocontrol is an environmentally sound alternative to pesticides. (Photo: Judy Gallagher / Flickr Creative Commons 2.0)

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Western Monarch Call to Action

3. Protect monarchs and their habitat from pesticides.

Right now:

Suspend the use of neonicotinoids in the commercial production of milkweed plants.

Green lacewing, a natural predator of aphids and other crop pests. Conservation biocontrol is an environmentally sound alternative to pesticides. (Photo: Judy Gallagher / Flickr Creative Commons 2.0)

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Western Monarch Call to Action

3. Protect monarchs and their habitat from pesticides.

In the next year:

Reduce herbicide and insecticide use in important monarch habitat areas.

Green lacewing, a natural predator of aphids and other crop pests. Conservation biocontrol is an environmentally sound alternative to pesticides. (Photo: Judy Gallagher / Flickr Creative Commons 2.0)

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Western Monarch Call to Action

4. Protect, manage, and restore summer breeding and fall migration monarch habitat outside of California.

Right now:

Identify existing habitat and protect it from destruction.

Narrowleaf milkweed (*A. fascicularis*) in rangeland in Nevada. Though the most urgent tasks are centered in California, the rest of the west has a role to play in the conservation of western monarchs. (Photo: Xerces Society / Stephanie McKnight)

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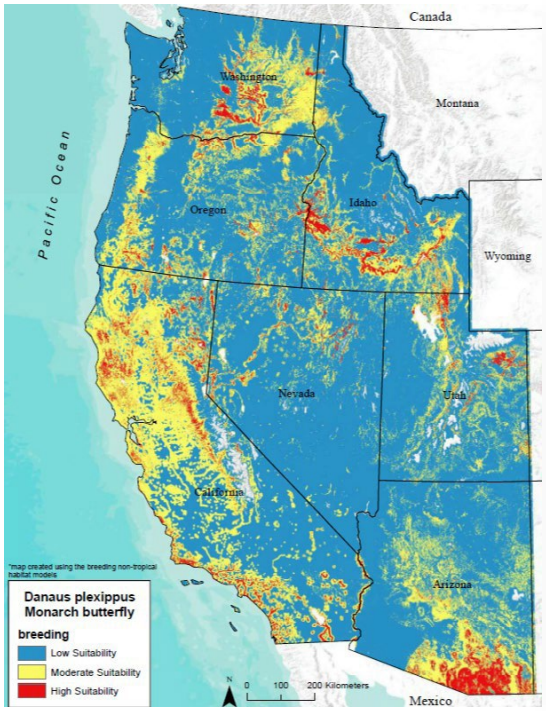
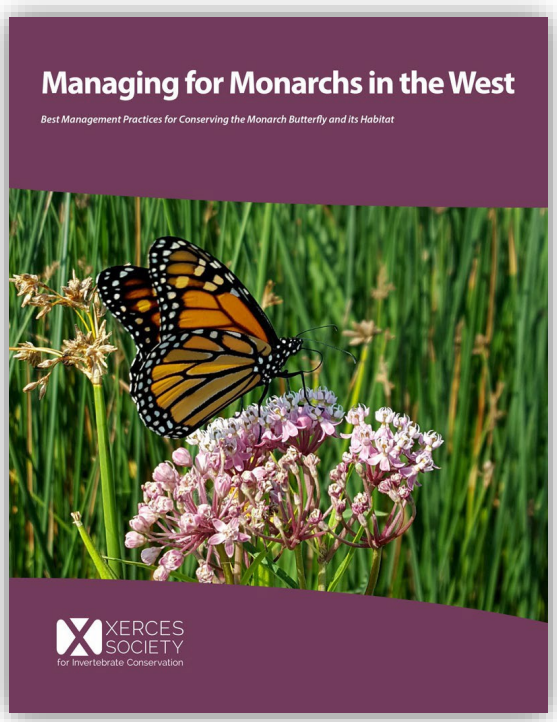
Western Monarch Call to Action

4. Protect, manage, and restore summer breeding and fall migration monarch habitat outside of California.

Especially in the most important areas where it has been lost.





Dilts et al. 2019

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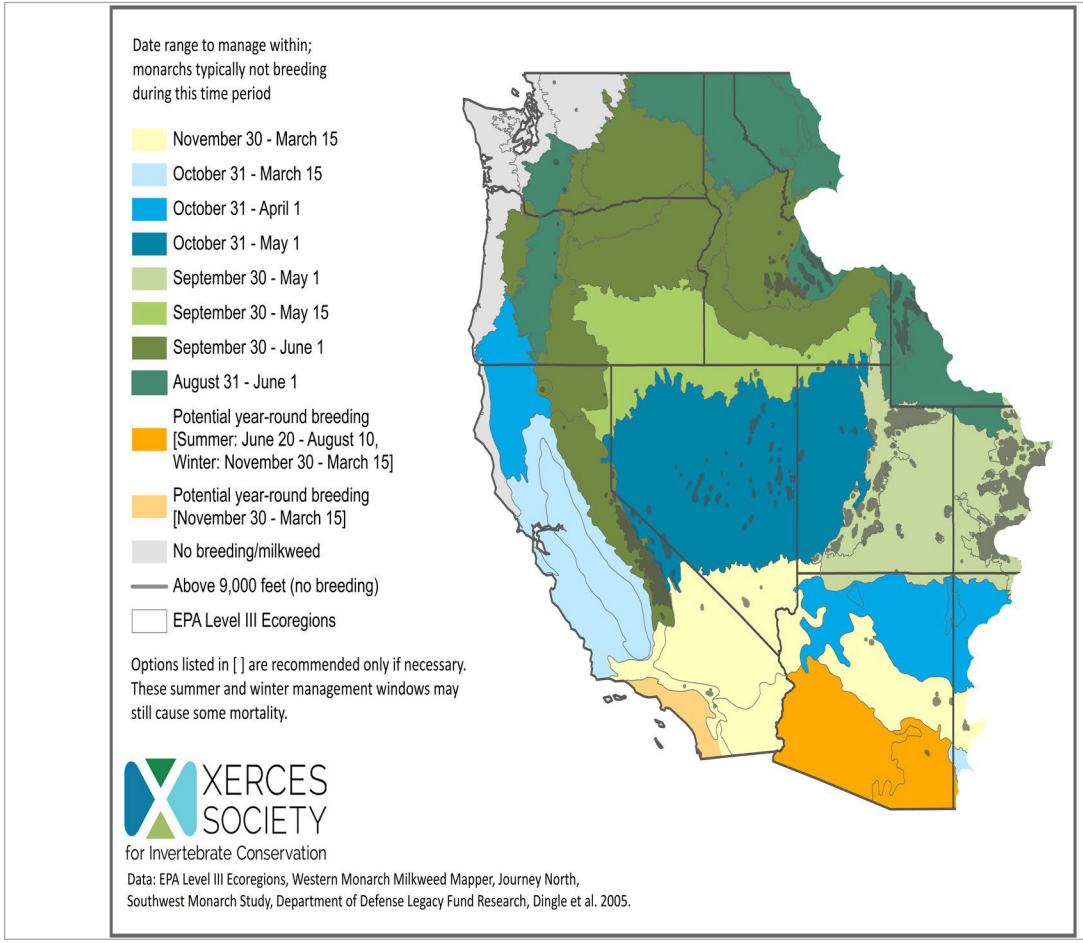
Western Monarch Call to Action

4. Protect, manage, and restore summer breeding and fall migration monarch habitat outside of California.

Right now and in the next few months:

Manage habitat in a way that minimizes harm.



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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

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

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Western Monarch Call to Action

4. Protect, manage, and restore summer breeding and fall migration monarch habitat outside of California.

<u>Right now and over the next year</u>:

Restore monarch habitat.

Narrowleaf milkweed (*A. fascicularis*) in rangeland in Nevada. Though the most urgent tasks are centered in California, the rest of the west has a role to play in the conservation of western monarchs. (Photo: Xerces Society / Stephanie McKnight)

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Western Monarch Call to Action

5. Answer key research questions about how to best aid western monarch recovery.

Right now: Californians & Arizonans to collect observations of monarchs and milkweeds, especially February–April.

+ Look for tags!

Volunteers participate in the Western Monarch Thanksgiving Count, an annual citizen science effort to monitor the population of western monarchs overwintering on the California coast—which has helped to sound the alarm about the population's decline. (Photo: Charis van der Heide)

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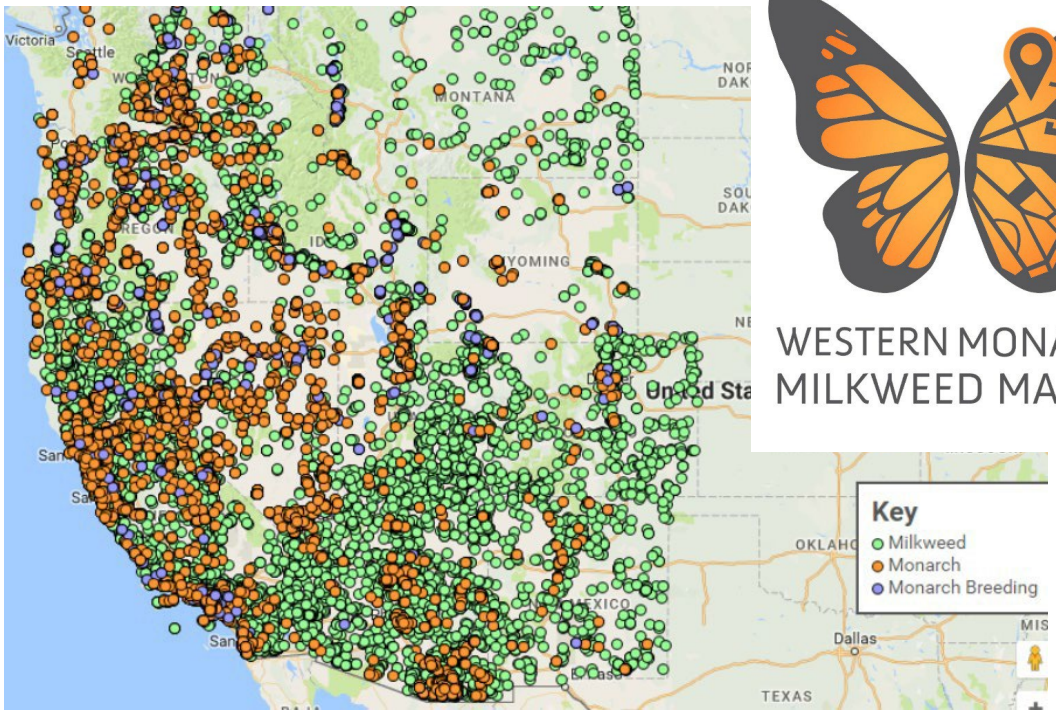
Western Monarch Call to Action

5. Answer key research questions about how to best aid western monarch recovery.

In the next few weeks and months: particularly New Mexico, Colorado, Utah, Idaho, and other western states.



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Western Monarch Call to Action

5. Answer key research questions about how to best aid western monarch recovery.

Right now:

Conduct research at overwintering & breeding sites

- Microclimate study by Cal Poly
- Survivorship and phenology studies by WSU, Tufts, Xerces

Monarchs in the greenhouse as part of an NSF Rapid project (Photo: Cheryl Schultz)

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Western Monarch Call to Action

5. Answer key research questions about how to best aid western monarch recovery.

In the next year:

Answer other key research questions to help target and refine conservation efforts.

Volunteers participate in the Western Monarch Thanksgiving Count, an annual citizen science effort to monitor the population of western monarchs overwintering on the California coast—which has helped to sound the alarm about the population's decline. (Photo: Charis van der Heide)

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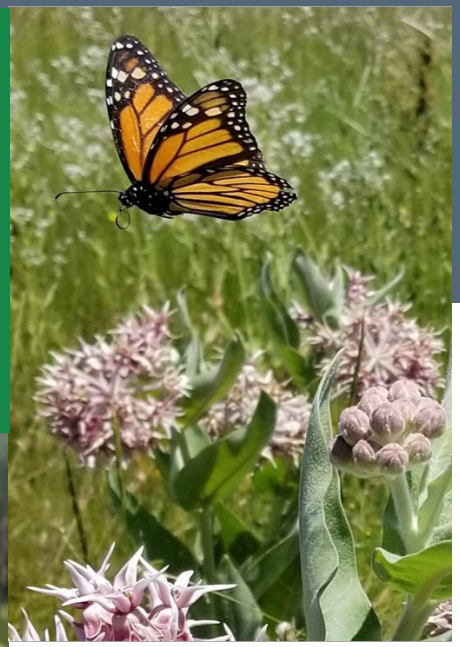
Three Key Actions for DoD Managers

Managing Western Monarch Breeding Habitat

Identify and protect existing milkweed populations from disturbance (mowing, fire, road maintenance, pesticide application, etc.) during the active monarch breeding season.

Increase the availability of nectar during the spring and fall migration

In semi-arid areas prioritize management of milkweed in areas near water and/or nearby access to shade or roosting structures



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Ways to Support and Advance Monarch Conservation in the West with Community Science

Community Science Monitoring Programs for Monarchs

Western Monarch Milkweed Mapper

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

Journey North and Tagging Programs

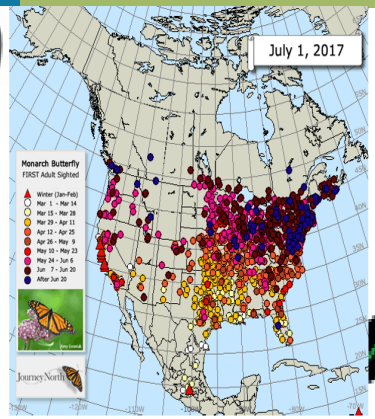
Are there migration pathways, and if so, where? To what extent do monarchs move between OW sites?

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

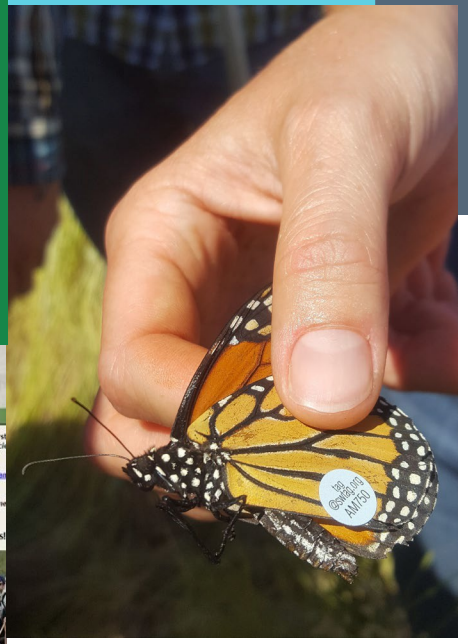
Monarch Alert at Cal-Poly

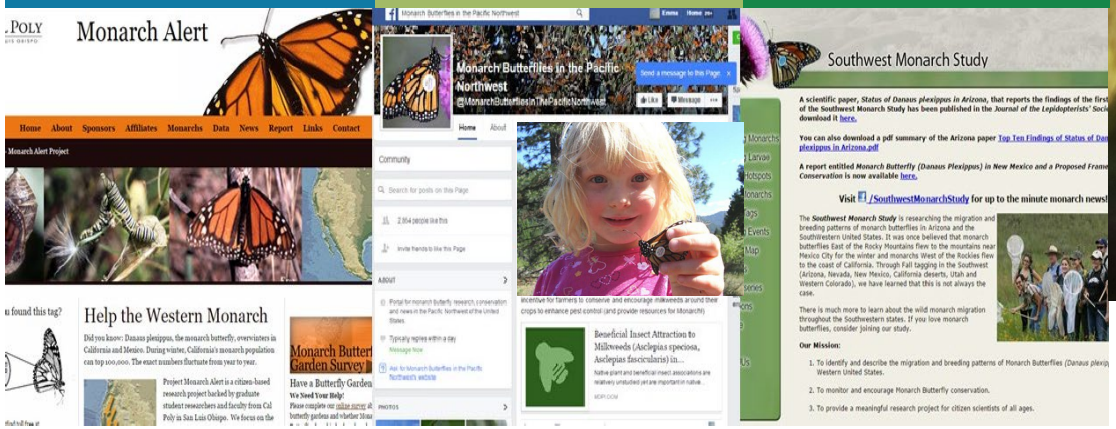
Northwest

Pacific Northwest Monarch Butterflies

Southwest

Southwest Monarch Study





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Thank you to those supporting this research!

This work is funded by the Department of Defense Legacy Natural Resources Program, as well as the Ceres Trust, CS Fund, The Dudley Foundation, Endangered Species Chocolate, J. Crew, Justin's, Madhava Natural Sweeteners, The New Land Foundation, Turner Foundation, White Pine Fund, Wholes Systems Foundation, and Xerces members.

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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Photo: Rusty patched bumble bee, © Clay Bolt

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