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

September 21, 2021

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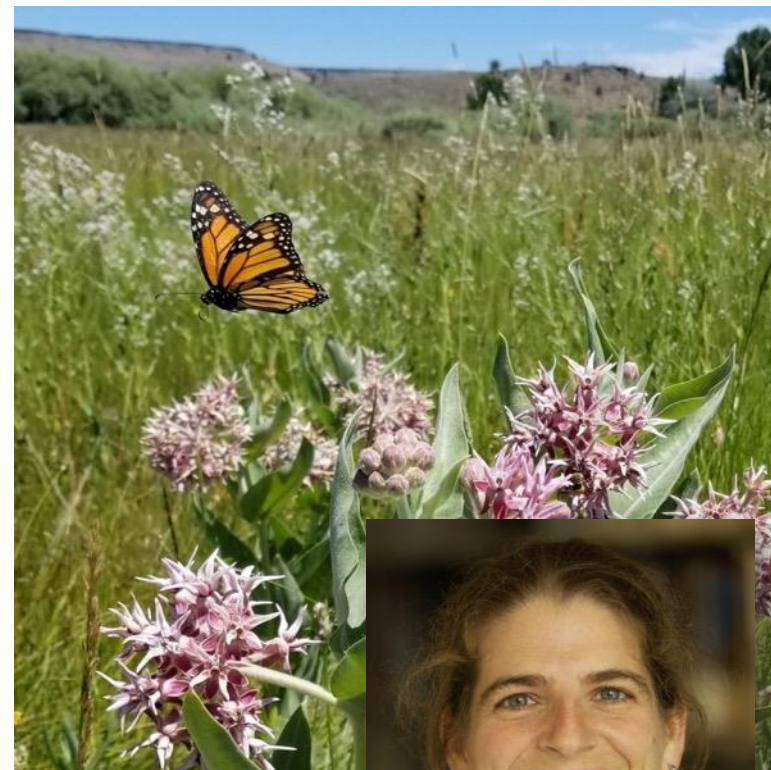
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Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology

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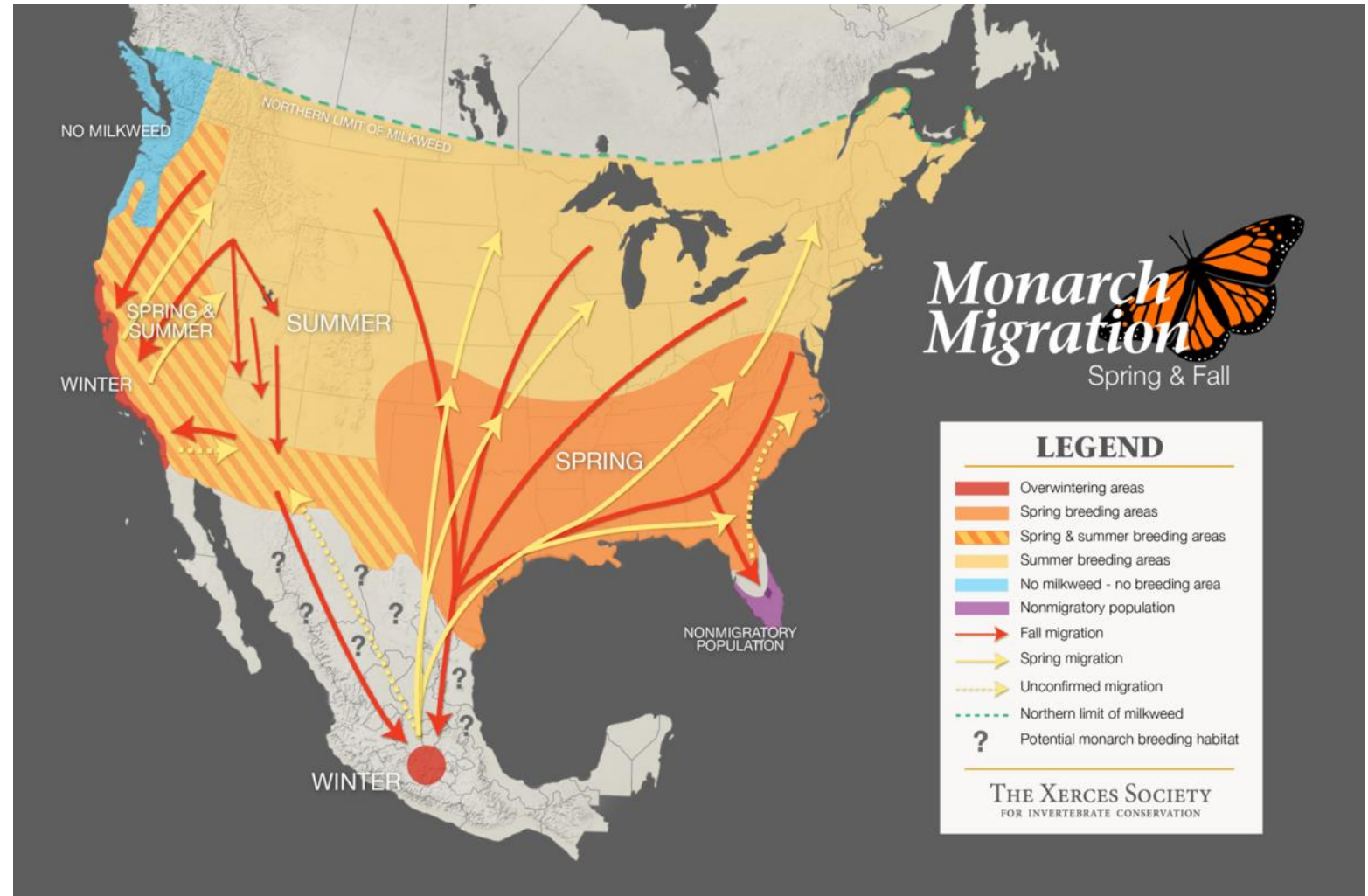


Photo: Stephanie McKnight, Xerces Society

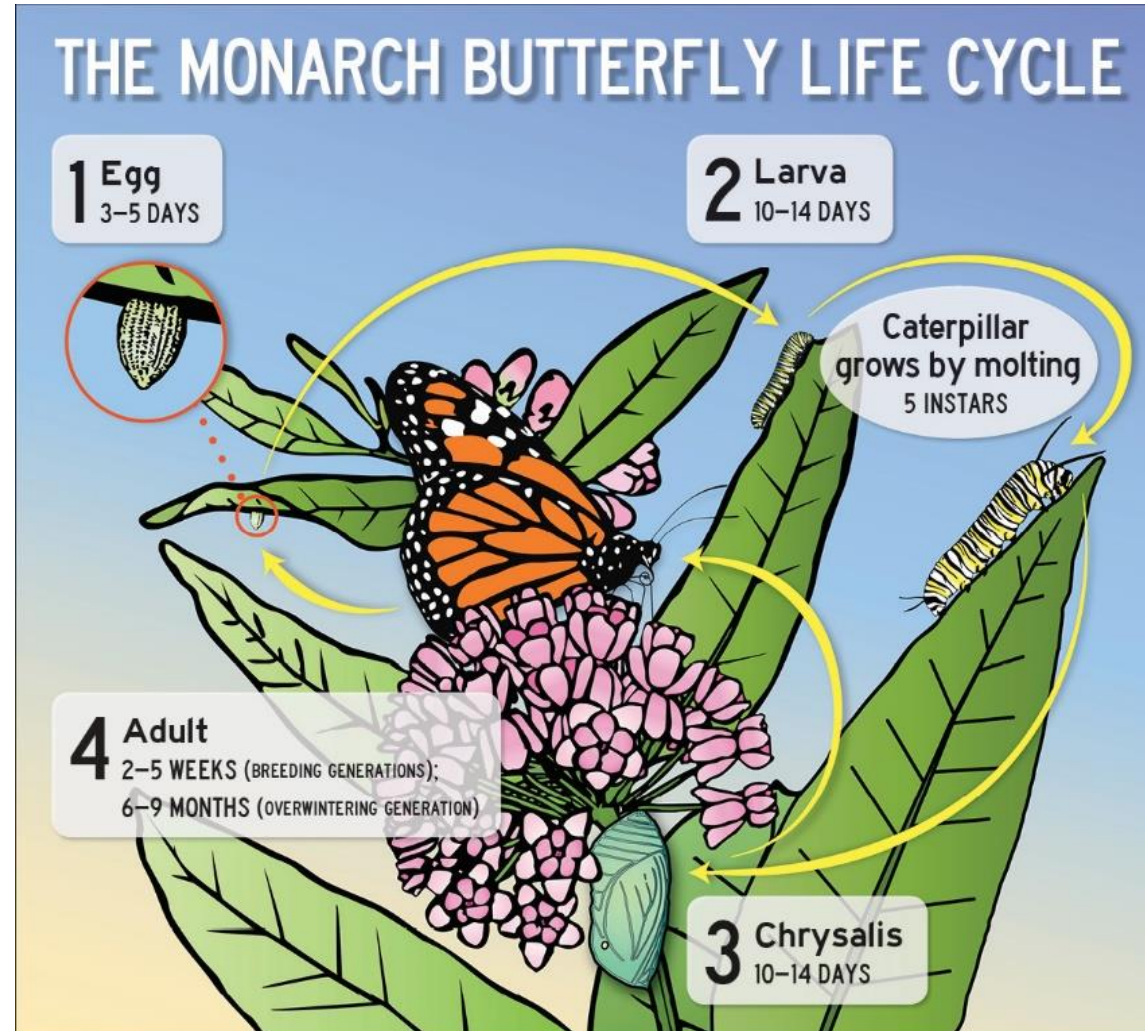
Presentation Overview

- I. Brief Overview of Western Monarch and Western Monarch Population Status
- II. Research and Findings: Conservation and Management of Western Monarchs on DoD Lands: Implications of Breeding Phenology
- III. Implications for Managing DoD Lands for Western Monarch

What is a “western” monarch?



Monarch Life Cycle



Western Monarch Wintering Biology

Adult monarchs winter 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

Wintering 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, Map by, Xerces Society

Western Milkweed Species

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*)



Milkweeds in the Landscape



Milkweeds occur in a wide variety of habitats, including open grasslands, deserts, river canyons, roadsides, and wetlands.

Western Monarchs in Crisis



Photo: Xerces Society / Candace Fallon

A large number of monarch butterflies are clustered together on green leaves. The butterflies have orange wings with black veins and a black border with white spots. The background is a soft-focus green, suggesting a natural outdoor setting.

Western Monarch Thanksgiving Count

*Thanks to Mia Monroe and all the
volunteers for making this work possible*

San Luis Obispo

THE TRIBUNE

A June 9, 1925, article in the San Luis Obispo Daily Telegram described the road from Morro Bay to Atascadero as the "Butterfly Route."

Dec 23, 1989

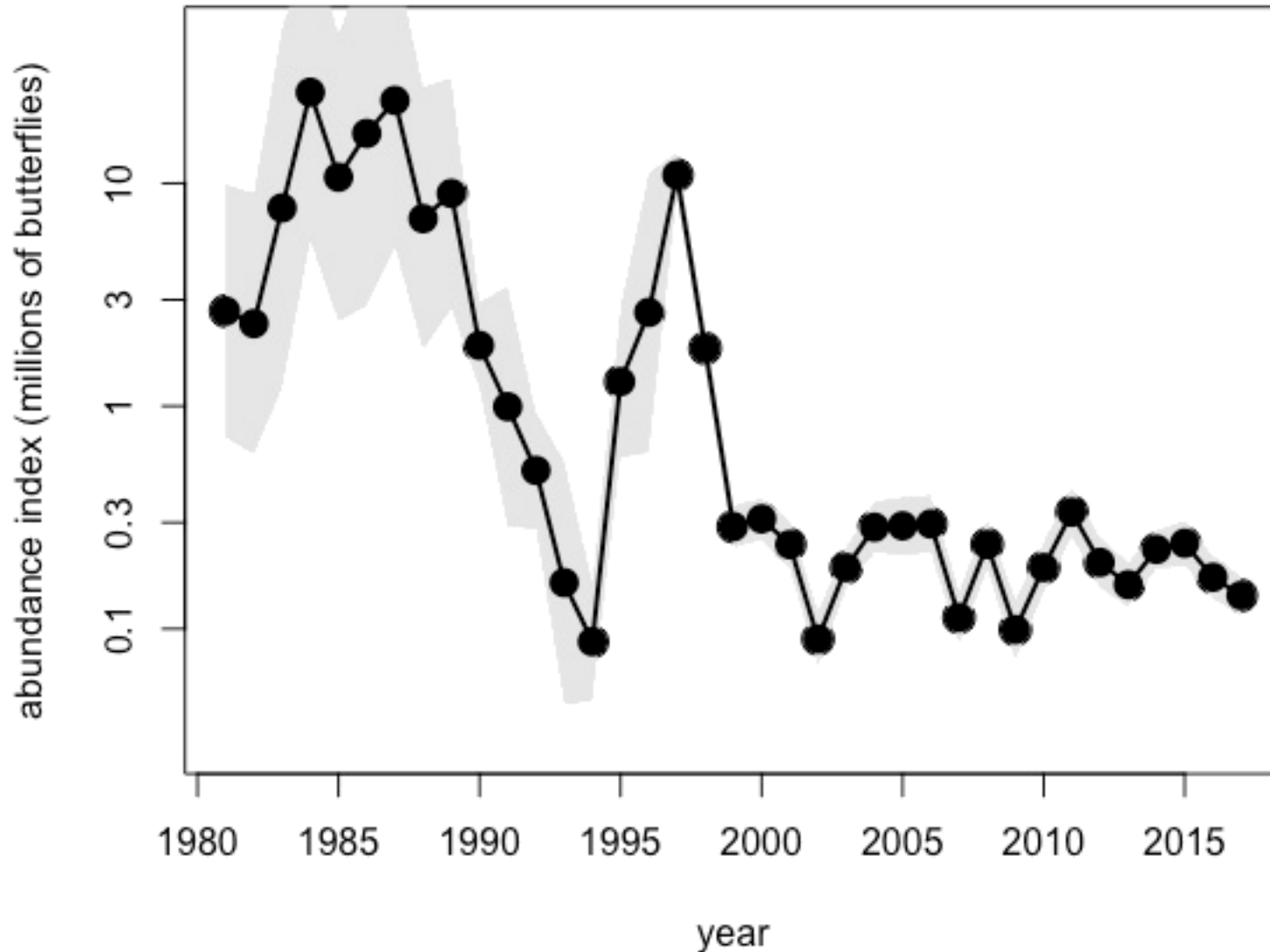
...Up to 5 million come to California;
as many as 100 million turn up at El
Rosario, according to Simpson.



Young and old are fascinated as Dick Simpson shows the legs the monarch keeps tucked next to its body and finds the flexible proboscis it uses to slurp nectar. Pismo Beach butterfly grove has long been a destination for monarch butterflies, and those who study, photograph or watch in wonder. David Middlecamp published 12-23-1989 David Middlecamp

1981-2017: 7.8% decline per year

1980's: millions of butterflies, 2000's: 200-300 thousand



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Biological Conservation

journal homepage: www.elsevier.com/locate/biocon



Short communication

Citizen science monitoring demonstrates dramatic declines of monarch butterflies in western North America

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San Francisco Chronicle

SFCHRONICLE.COM | Thursday, January 17, 2019 | CONTAINS RECYCLED PAPER | \$2.00 ★★★★★

Monarch butterflies' drop stuns scientists

By Peter Fimrite

An alarming, precipitous drop in the western monarch butterfly population in California this winter could spell doom for the species, a scenario that biologists say could also plunge bug-eating birds and other species into similar death spirals.

Only 28,429 of the striking

orange-and-black butterflies were counted at 213 sites in California, an 86 percent drop from a year ago, according to the final tally of the annual Thanksgiving count to be released Thursday by the Xerces Society for Invertebrate Conservation.

That's a 99.4 percent decline since the 1980s, an all-time low for the Pacific Coast,

where an estimated 10 million monarchs once blanketed trees from Marin County to the Baja California peninsula, providing, by all accounts, a spectacular winter display of color.

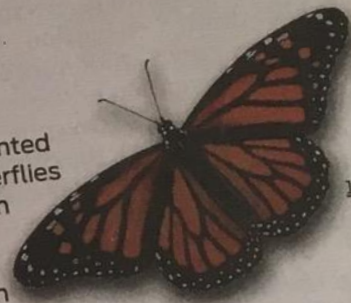
Scientists knew things were bad for the western monarch, but then "there was this other order of magnitude drop,"

Monarchs continues on A8

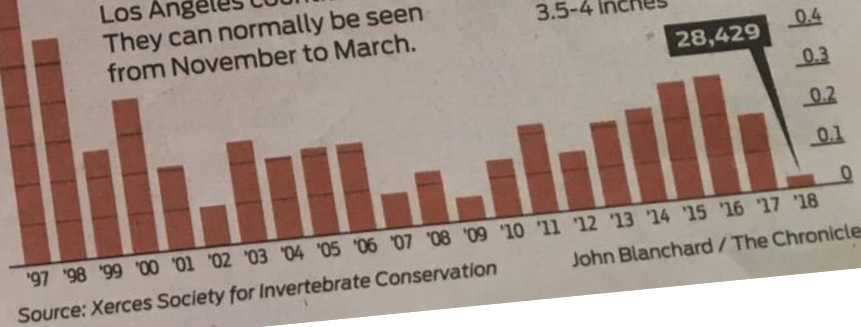
Monarch population

1.26 million

The Xerces Society counted western monarch butterflies in 213 forested groves in California this winter, including Santa Cruz, Fremont, Pismo Beach and several places in Monterey, Riverside and Los Angeles counties. They can normally be seen from November to March.

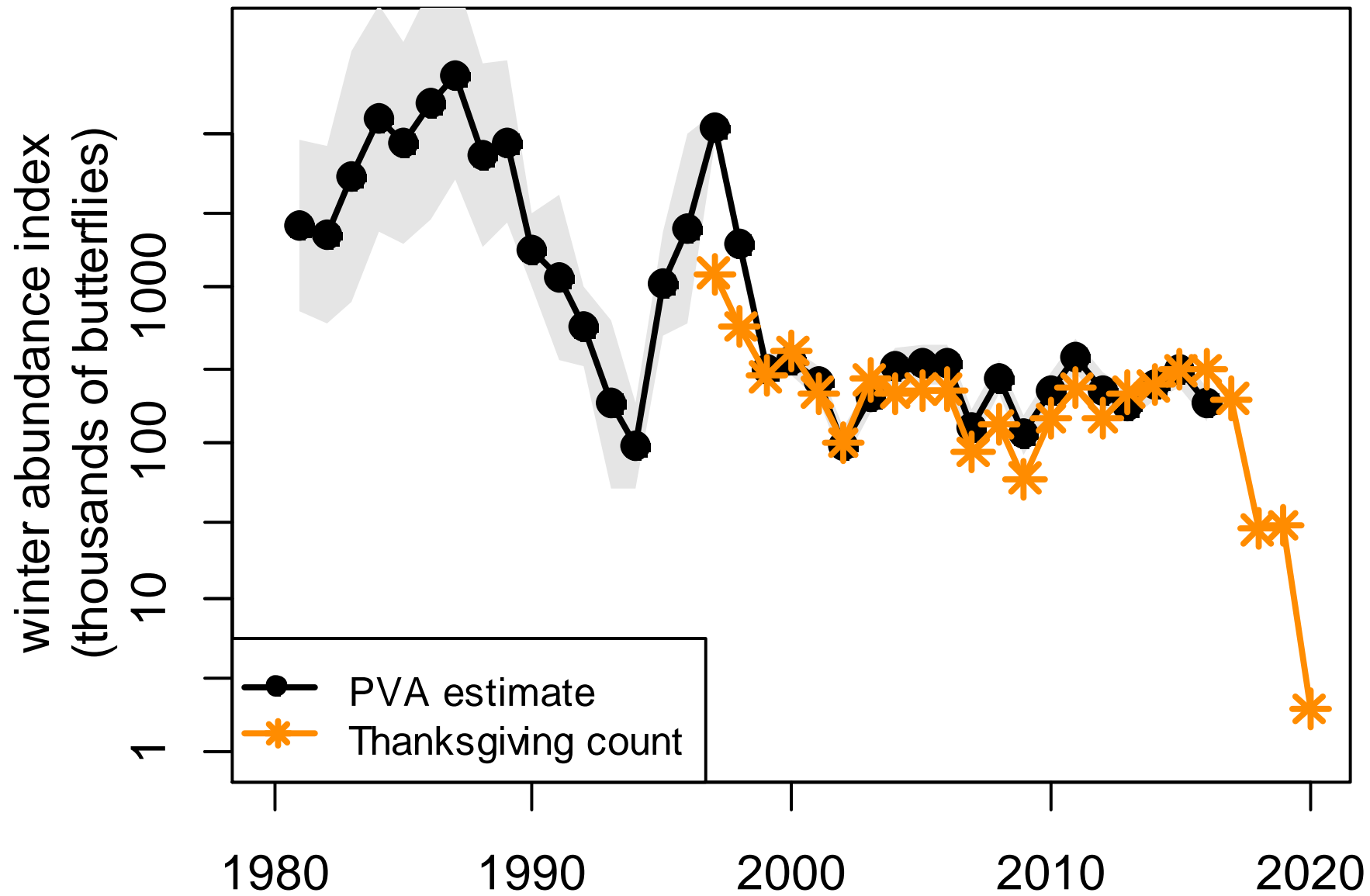


Monarch
Danaus plexippus
Wingspan:
3.5-4 inches



Source: Xerces Society for Invertebrate Conservation

John Blanchard / The Chronicle



What's causing monarch decline?

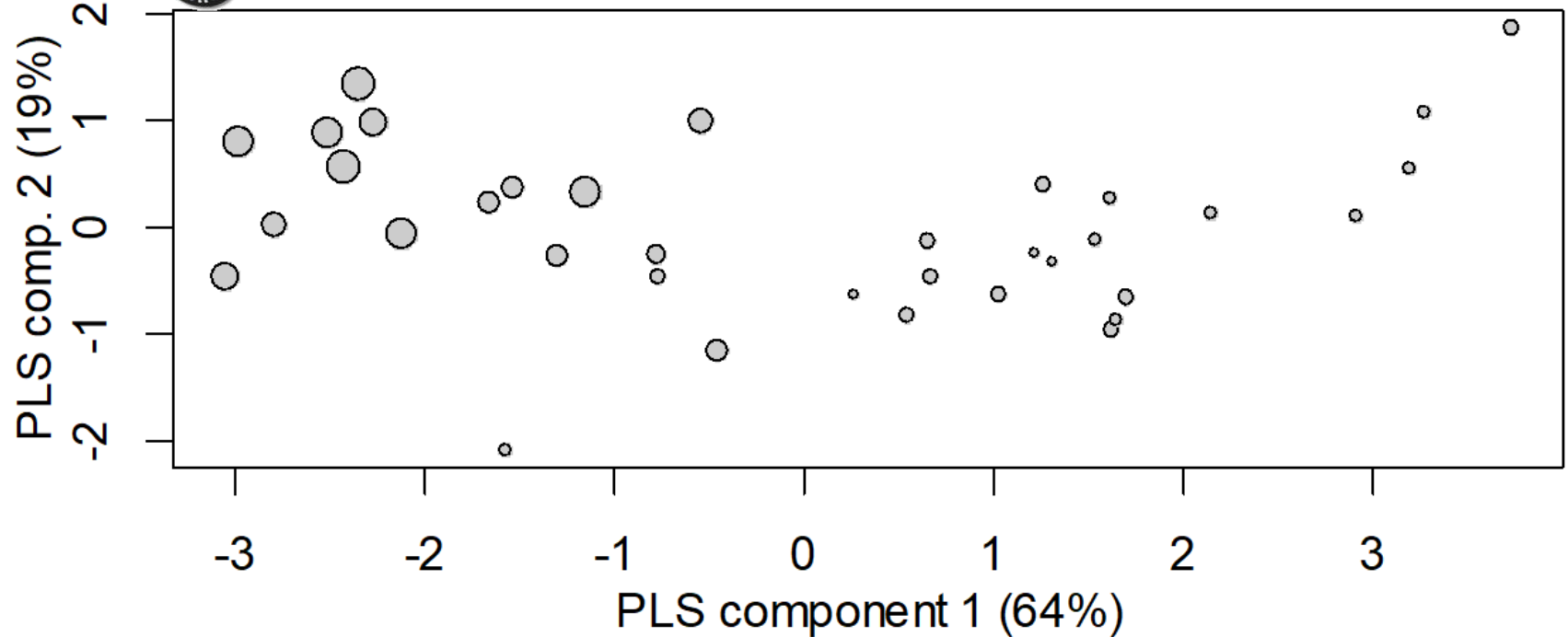
- Climate change (drought & heat) in West?
- Loss of breeding habitat (pesticides & habitat loss)?
- Loss of wintering habitat (coastal development)?



Causes of monarch population declines, 1981-2017 (usual suspects, no smoking gun)

↑ Coastal winter temperature
↓ Coastal winter precipitation

(year-to-year "noise")



(overall trend in abundance)

- Coastal land development
- Glyphosate
- Neonicotinoids
- Breeding season drought
- Breeding season temperature

Research and Findings

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

Legacy NR #17-836 and #19-001

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 analyses to determine seasonal timing of monarch breeding across the West.

Benefit:

Demographic data 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 the West



Western Monarch Migration and Breeding Timing



Map by Cheryl Schultz and Chelsea Thomas

Seasonal monarch movements in the West

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

Shifting vs Expanding population



Early season
March – April



Mid-Season
May- June



Late Season
July - September

Shifting vs Expanding population



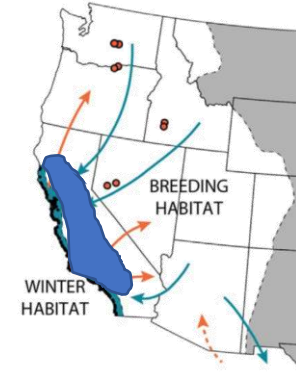
Early season
March – April



Mid-Season
May- June



Late Season
July - September



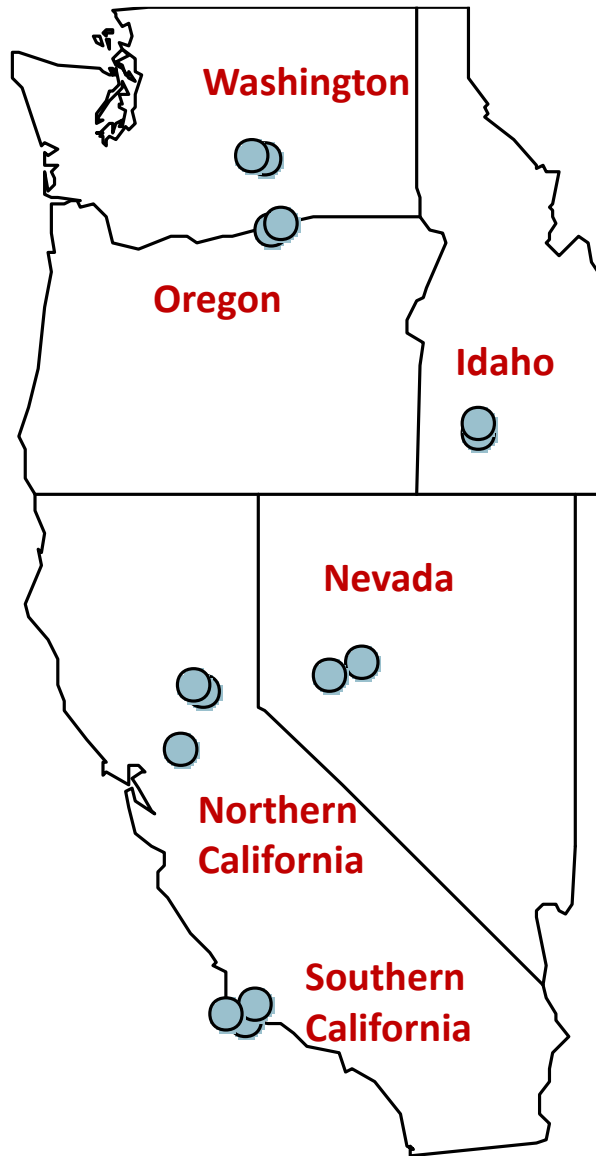
Early season
March – April



Mid-Season
May- June



Late Season
July – September



Research Approach and Field Sites

- Monthly systematic surveys with statistical models to determine seasonal timing of monarch breeding across the West.
- DoD Study sites in 5 Western states:
 - JBLM Yakima Training Center in Washington,
 - NWSTF Boardman in Oregon,
 - Mountain Home AFB in Idaho,
 - NAS Fallon in Nevada, and
 - Vandenberg AFB and Beale AFB in California
- In addition, we worked with several other state and federal organizations.

Thank you to all of the DoD, agency and university partners for participating in this research and allowing access to field sites!

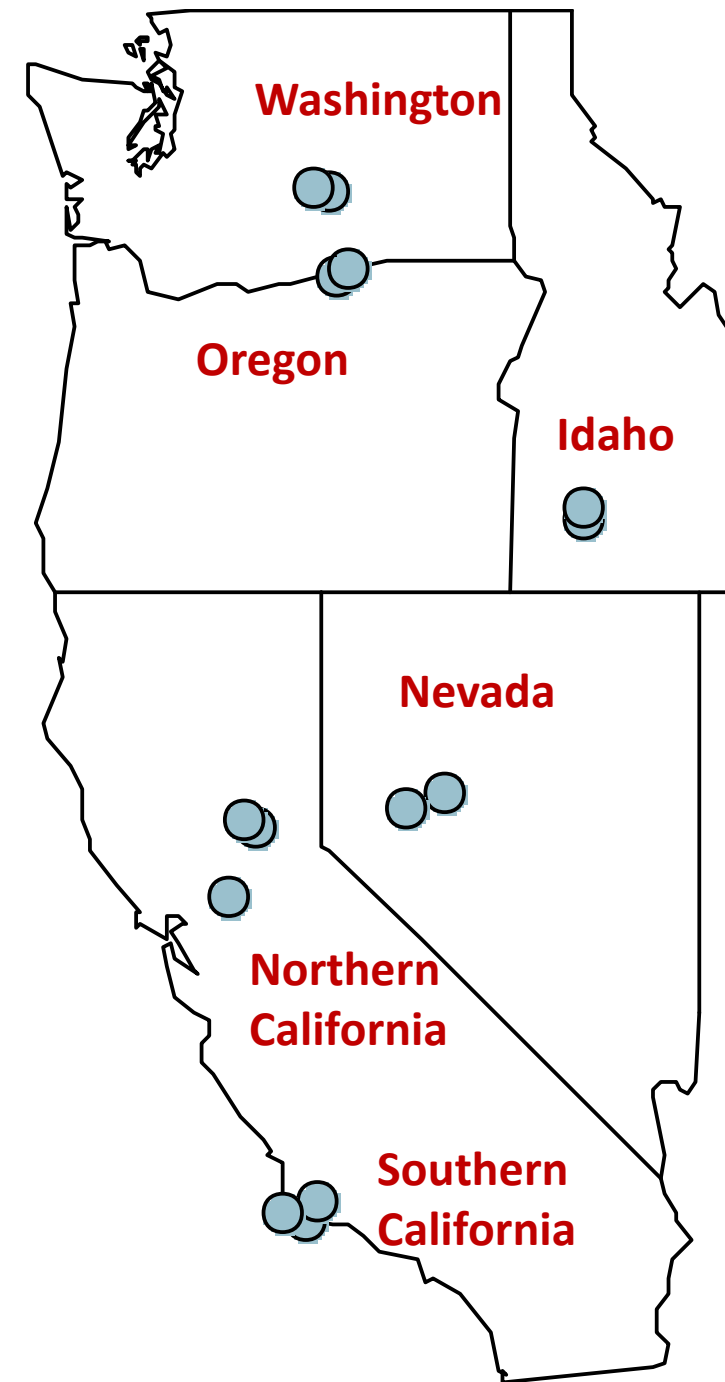


Breeding season monitoring

- 6 regions
- 2-3 sites / region
- Transects 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





All sites, 2017-2019:
Monarch immatures in relation to shade

- Record cover over transects:
 - 0 = no shade
 - 3 = full shade
- Monthly counts of eggs & larvae

Focal sites (Umatilla NWR and Beale AFB):

Effects of shade on temperature

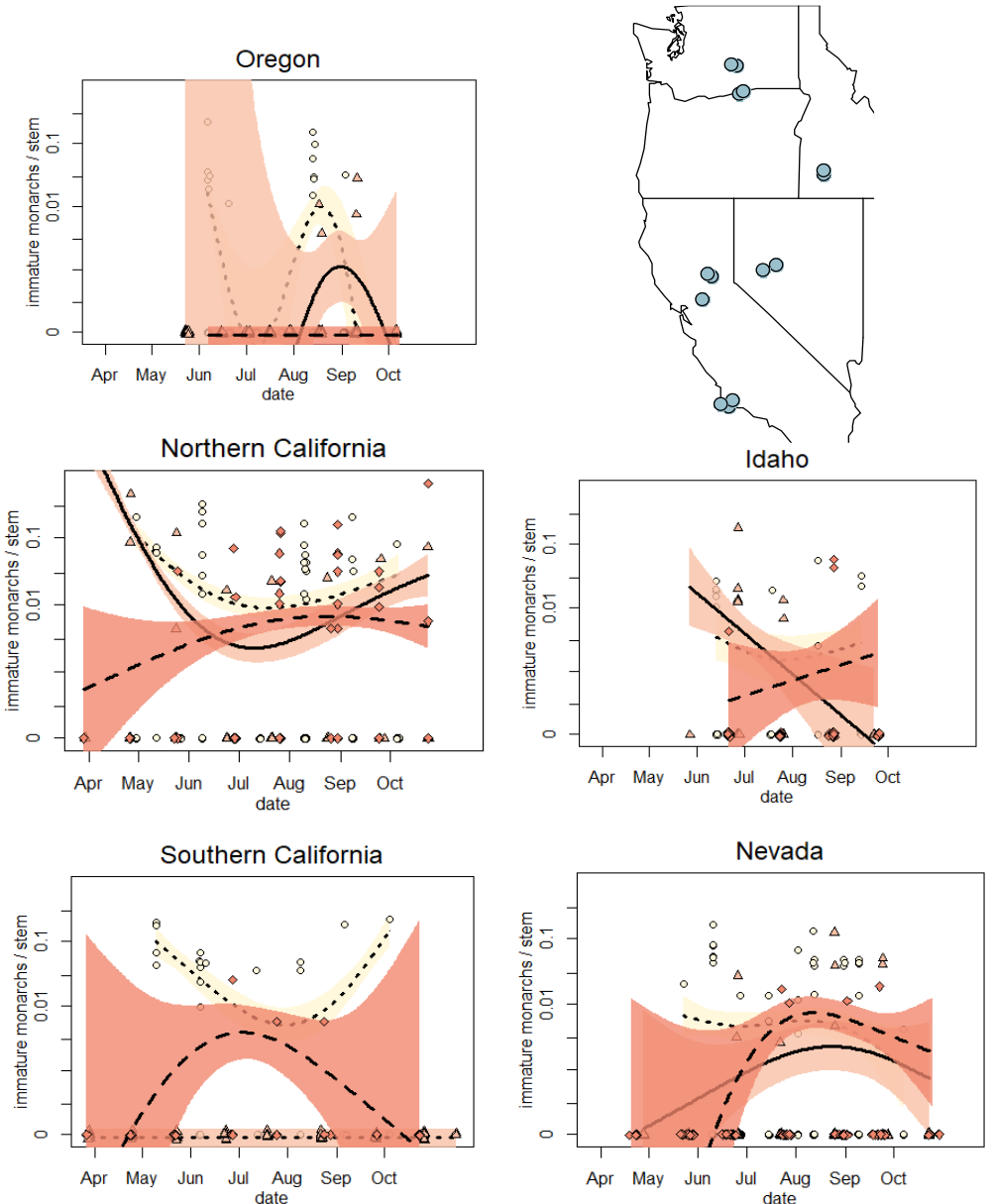
- iButtons, late June through October



What we learned

Immature monarchs/milkweed stem within each region

- monarch breeding was continuous throughout the summer in California and Nevada, and in Oregon there were distinct generations
- no observations of immature monarchs in Washington sites in any year
- 10 fold decline in immature monarchs/stem between 2017 & 2018



Circles/yellow = 2017; triangles/light peach = 2018; diamonds/dark peach = 2019

Shifting vs Expanding population



Early season
March – April



Mid-Season
May- June



Late Season
July - September



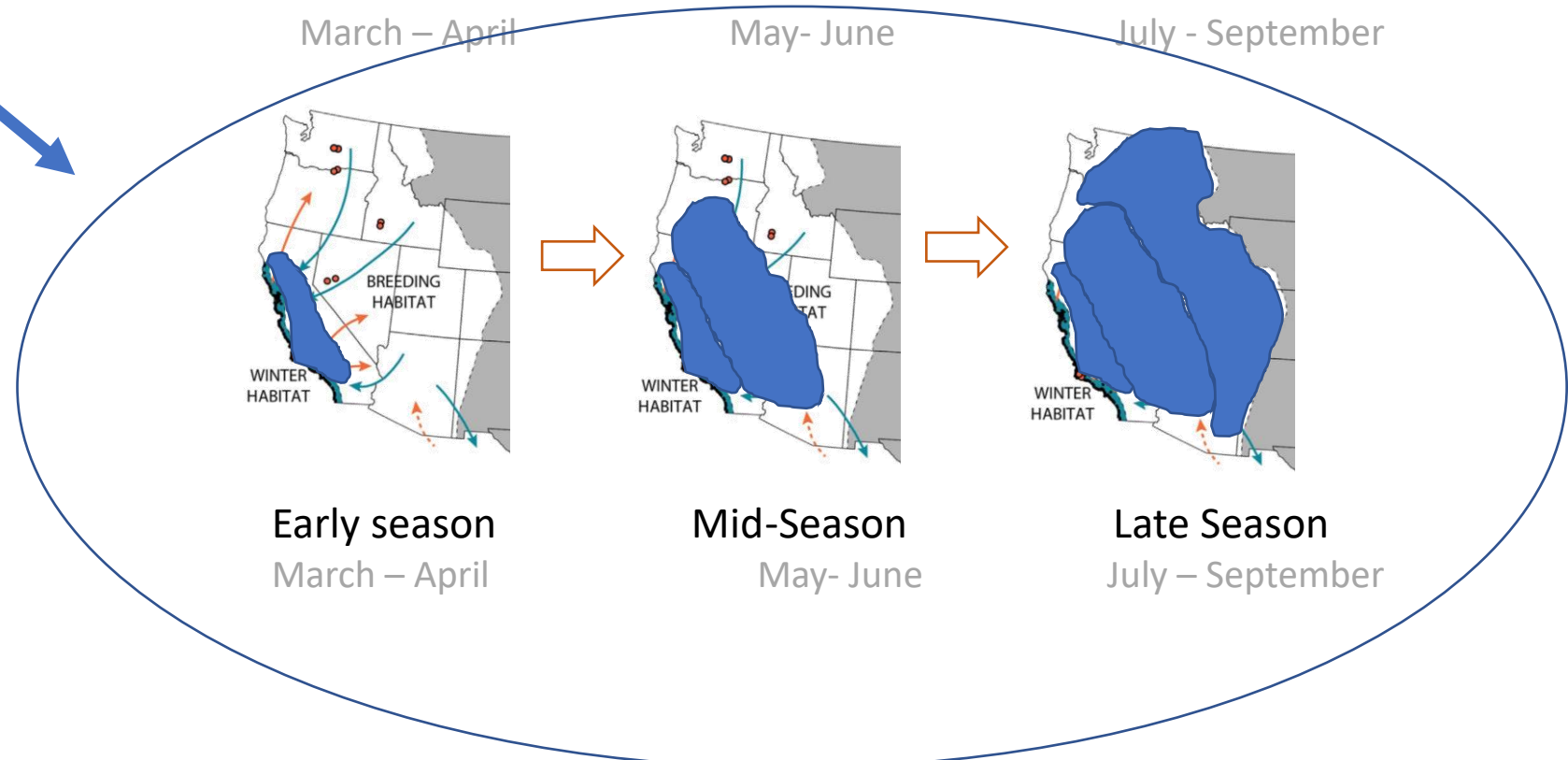
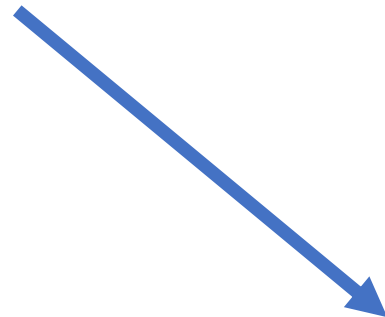
Early season
March – April



Mid-Season
May- June

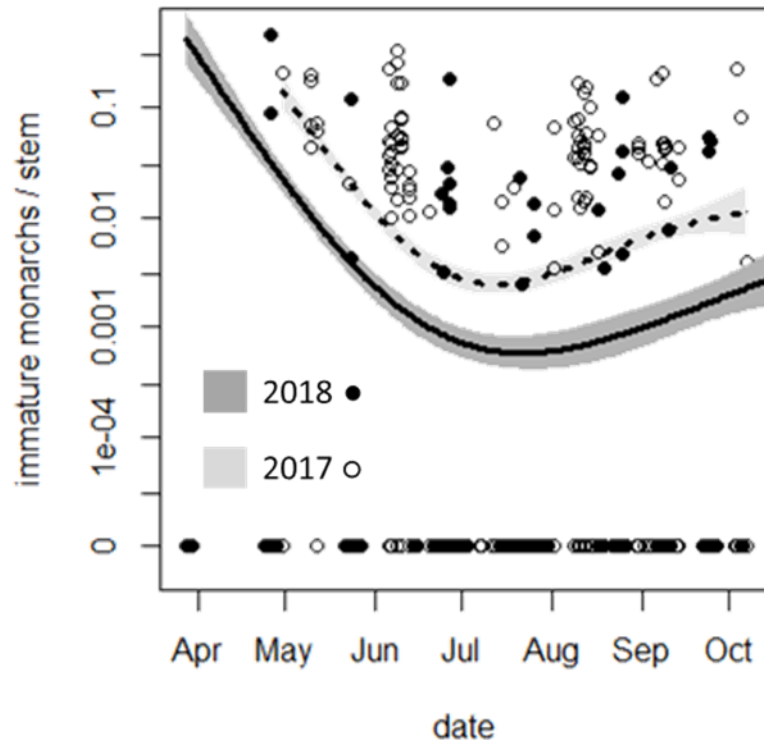


Late Season
July – September



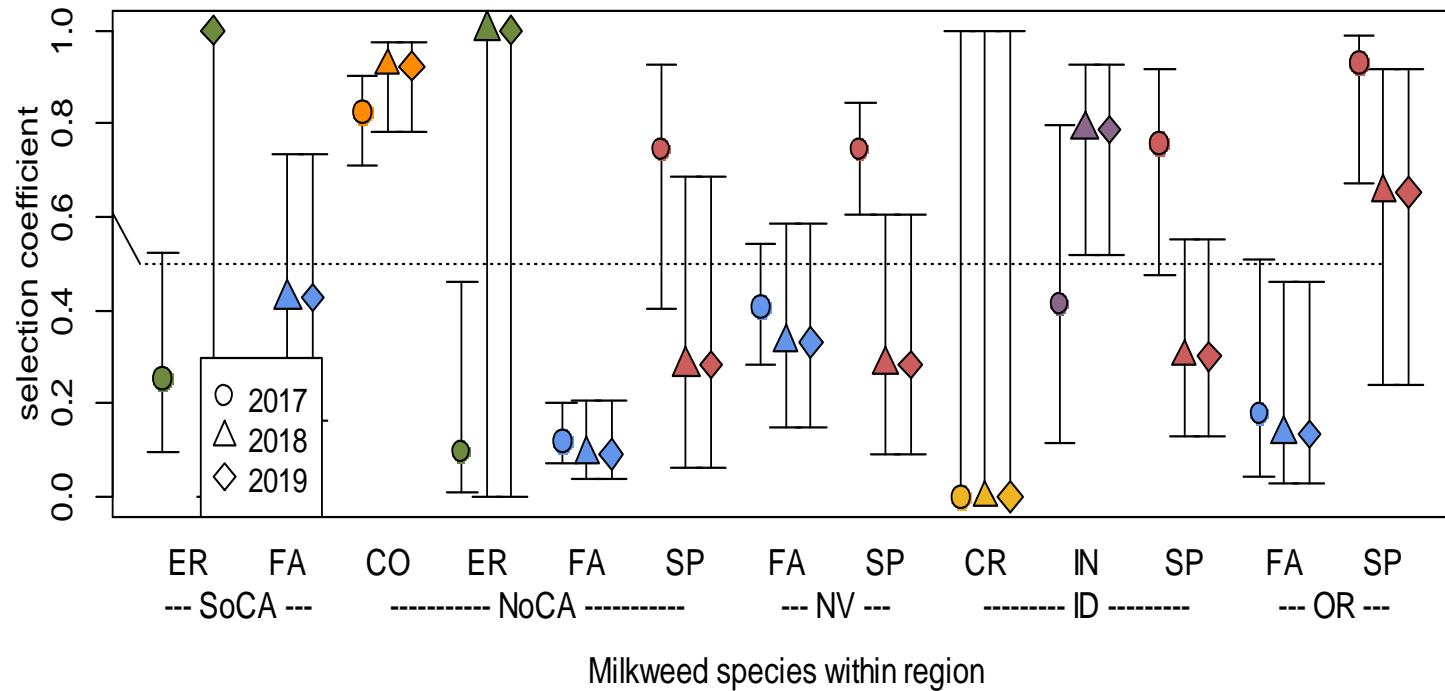
2018 population drop happened before breeding...

We did not set up this research program to understand factors responsible for a population crash, but because we were monitoring the year prior to the crash and in the year of the crash—we can draw valuable and timely insight into western monarch biology and what might (or might not) have caused the crash.



Additional Findings: Habitat Associations

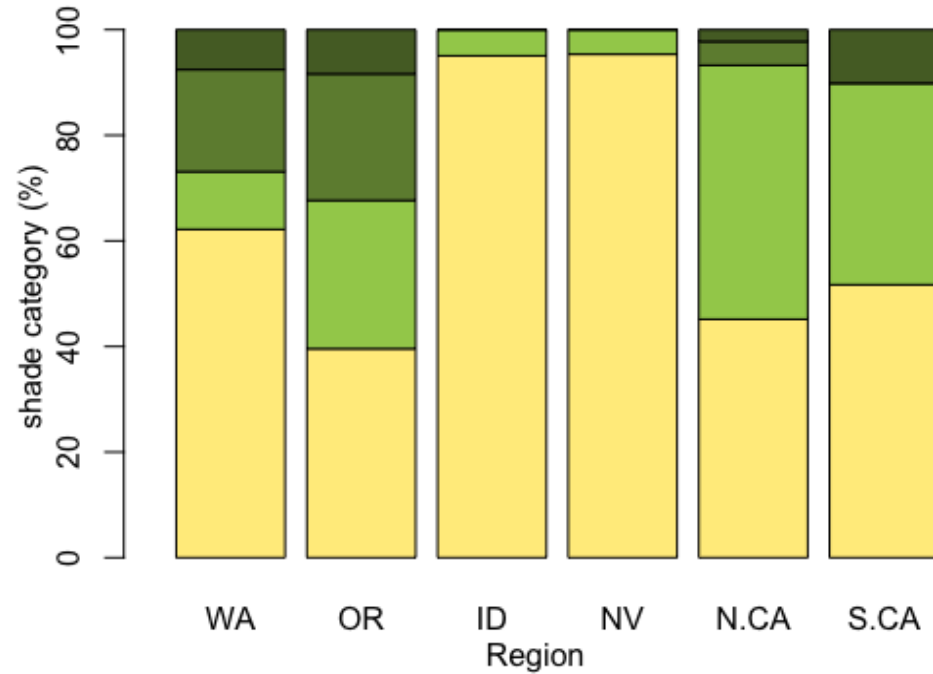
Milkweed preference varies by region and year



CO = *Asclepias cordifolia*
CR = *Asclepias cryptoceras*
ER = *Asclepias eriocarpa*
FA = *Asclepias fascicularis*
IN = *Asclepias incarnata*
SP = *Asclepias speciosa*

Additional Findings: Habitat Associations

Availability of shade differs by region



yellow = full sun

light green = up to 50% cover

olive green = 50-90% cover

dark green = 100% cover (tall canopy but open understory with milkweeds)



Temperature difference in the shade in California:

- 0.6 °C cooler in the day
- 0.7 °C warmer at night

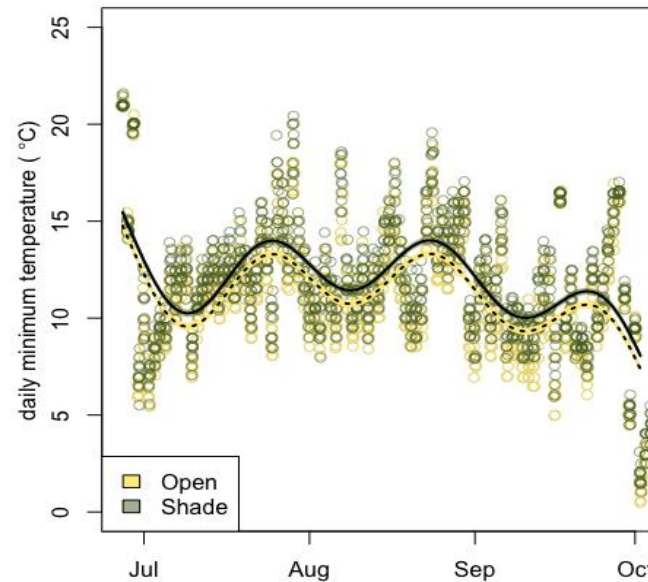
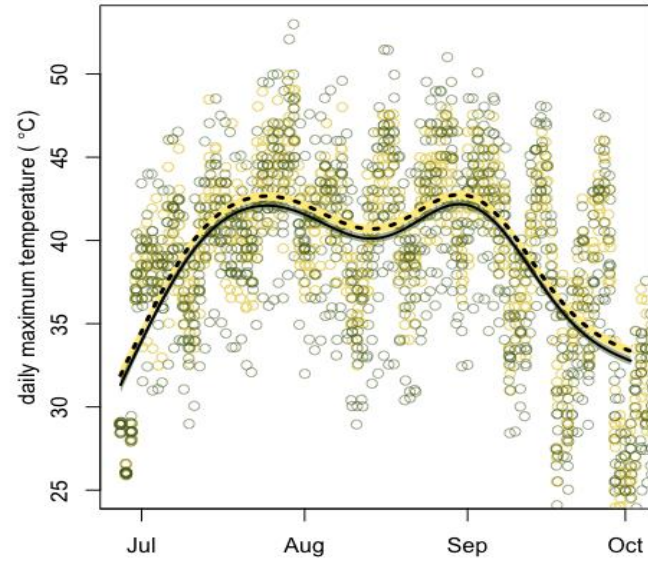


Photo: Stephanie McKnight, Xerces Society

Temperature difference in the shade in Oregon:

- 7.0 °C cooler in the day
- 3.4 °C warmer at night

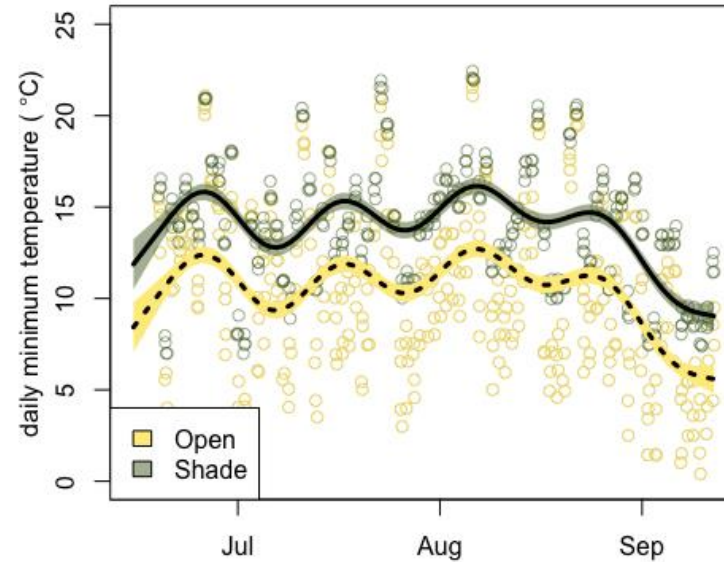
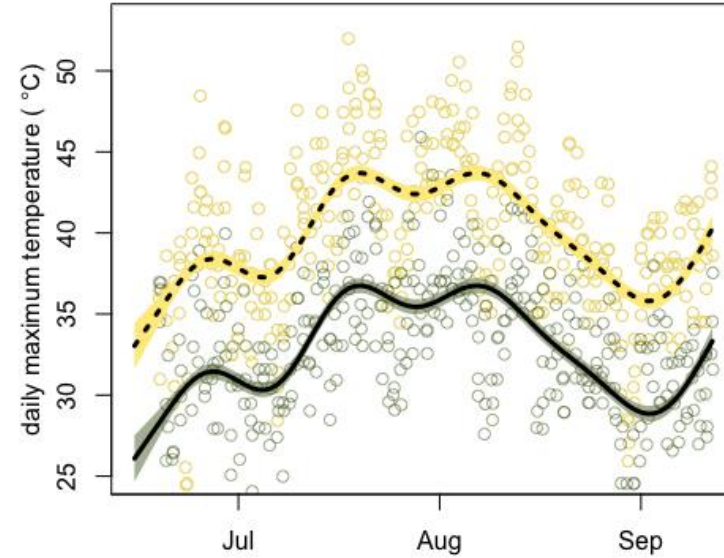
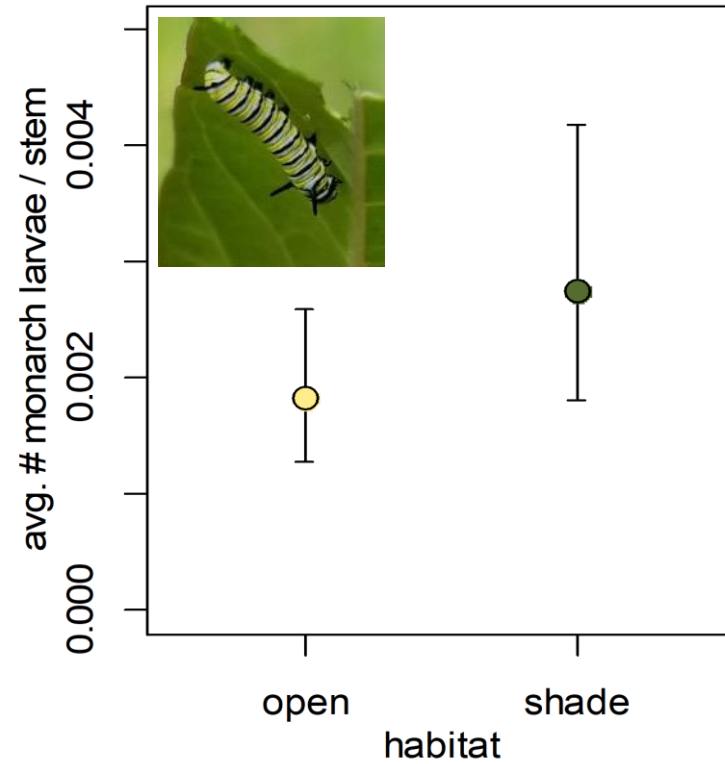
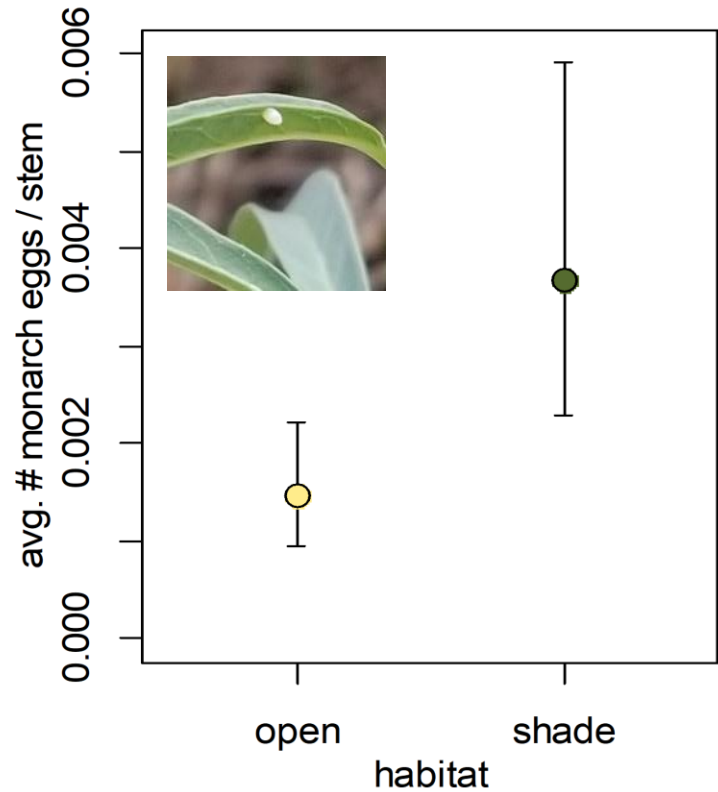


Photo: Stephanie McKnight, Xerces Society

Additional Findings: Habitat Associations

More immature monarchs in the shade:
(but they use both open and shaded sites)





Conclusions of shade/sun research:

1. Monarch butterflies lay eggs in both shade and sun (when both are available)
2. In hot places and at hot times of year, monarchs may prefer shade for egg laying
3. Broadly, effects of changing temperature (so far) can be mitigated with habitat heterogeneity

Unlikely to be a major player in observed declines to date

Research Implications for Management

Timing of Management in Monarch Breeding Habitat

Manage habitat in a way that minimizes harm to monarchs during the breeding season.

Fact sheet developed for DoD land managers – this map is included in the fact sheet.

Western Monarch Management Timing

Date Range to manage within
(monarchs not breeding during this time)

November 30 - March 15

October 31 - March 15

October 31 - April 1

October 31 - May 1

September 30 - May 1

September 30 - May 15

September 30 - June 1

August 31 - June 1

Potential year-round breeding
[Summer: June 20 - August 10, Winter: November 30 - March 15]

Potential year-round breeding
[November 30 - March 15]

No breeding/milkweed

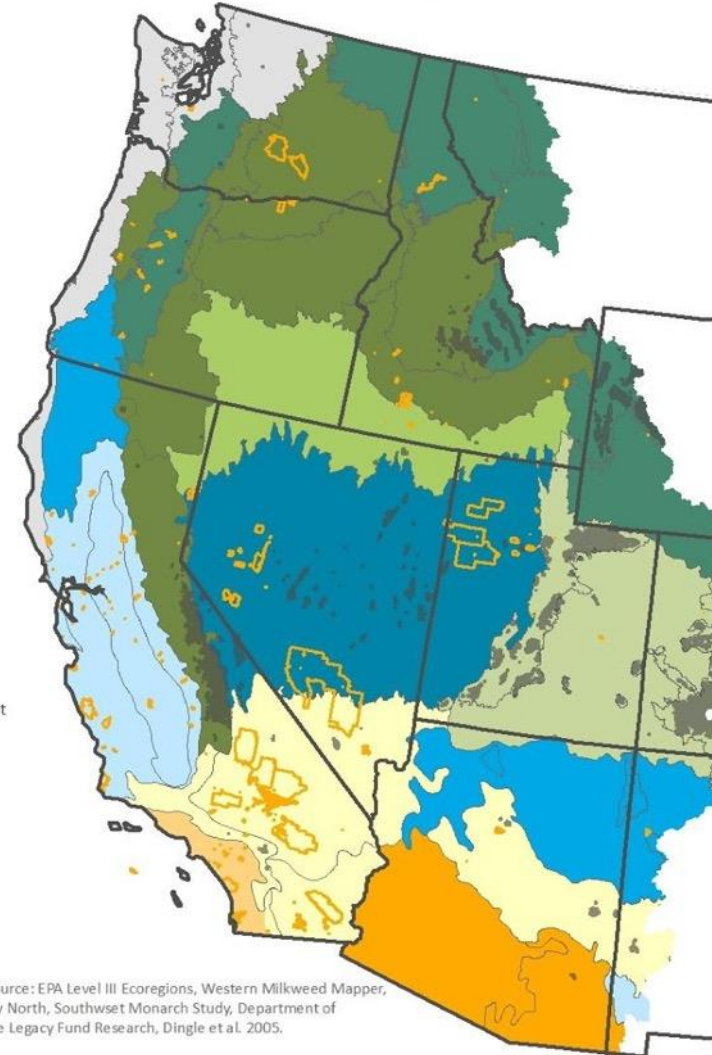
Limited Data

Above 9,000 feet (no breeding)

EPA Level III Ecoregions

DOD Lands

Options listed in [] are recommended only if necessary. These summer management intervals may still cause some mortality. In Arizona, summer management windows are only recommended for low elevation areas with high summer temperatures..



Habitat heterogeneity

**protect
existing milkweed and
plant milkweed in both
sun and shade.**

Increase native milkweed &
nectar plant availability.
Protect existing habitat.
Plant native milkweed and
nectar species, especially
early spring species
(February–April) .
Plant and manage for more
than one milkweed species



A monarch larva on 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)

Regional Milkweed Emergence and Flowering Calendar

Milkweed Emergence and Flowering in California

			Flowering Phenology = x (green box indicates possible plant emergence timing, grey indicates occasional winter growth on the SoCal coast)											
			When do monarchs generally use these plants as a host?											
Species	Common Name	When do monarchs generally use these plants as a host?	J	F	M	A	M	J	J	A	S	O	N	D
<i>Asclepias californica</i>	California milkweed	Early spring - summer			x	x	x	x	x					
<i>Asclepias cordifolia</i>	heartleaf milkweed	Early spring - summer			x	x	x	x	x					
<i>Asclepias eriocarpa</i>	woollypod milkweed	Early spring - summer					x	x	x	x	x	x		
<i>Asclepias erosa</i>	desert milkweed	Early spring - summer				x	x	x	x	x	x	x		
<i>Asclepias vestita</i>	wooly milkweed	Early spring - summer				x	x	x	x					
<i>Asclepias fascicularis</i>	narrowleaf milkweed	Late spring - Fall					x	x	x	x	x	x		
<i>Asclepias speciosa</i>	showy milkweed	Late spring - Fall					x	x	x	x	x			

Manage habitat in a way to minimize harm

Example: 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

Key Management Implications: Managing Western Monarch Breeding Habitat

Incorporate Best Management Practices for Monarchs into INRMPs, including management timing

Increase the availability of nectar and native milkweed. Plant a diversity of milkweed species, plant in sun and shade. Plant a diversity of milkweeds

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



Research Products available at:

<https://www.denix.osd.mil/legacy/nr-legacy-project-deliverables>

Legacy # 17-836 and #19-001

- Best Management Practices: Monarch Conservation on Department of Defense Lands in the West
- Fact Sheets: Western Monarch Management Windows
- Final Reports

Monarch Conservation on Department of Defense Lands in the West: Best Management Practices



Adult monarch butterflies on swamp milkweed (*Asclepias incarnata*) near Mountain Home Air Force Base, Idaho.
Photo by Stephanie McKnight, the Xerces Society.

Stephanie McKnight, Emma Pelton, Candace Fallon, Aimée Code, Jennifer Hopwood, Sarah Hoyle,
Sarina Jepsen, and Scott Hoffman Black
The Xerces Society for Invertebrate Conservation

Elizabeth Crone
Tufts University

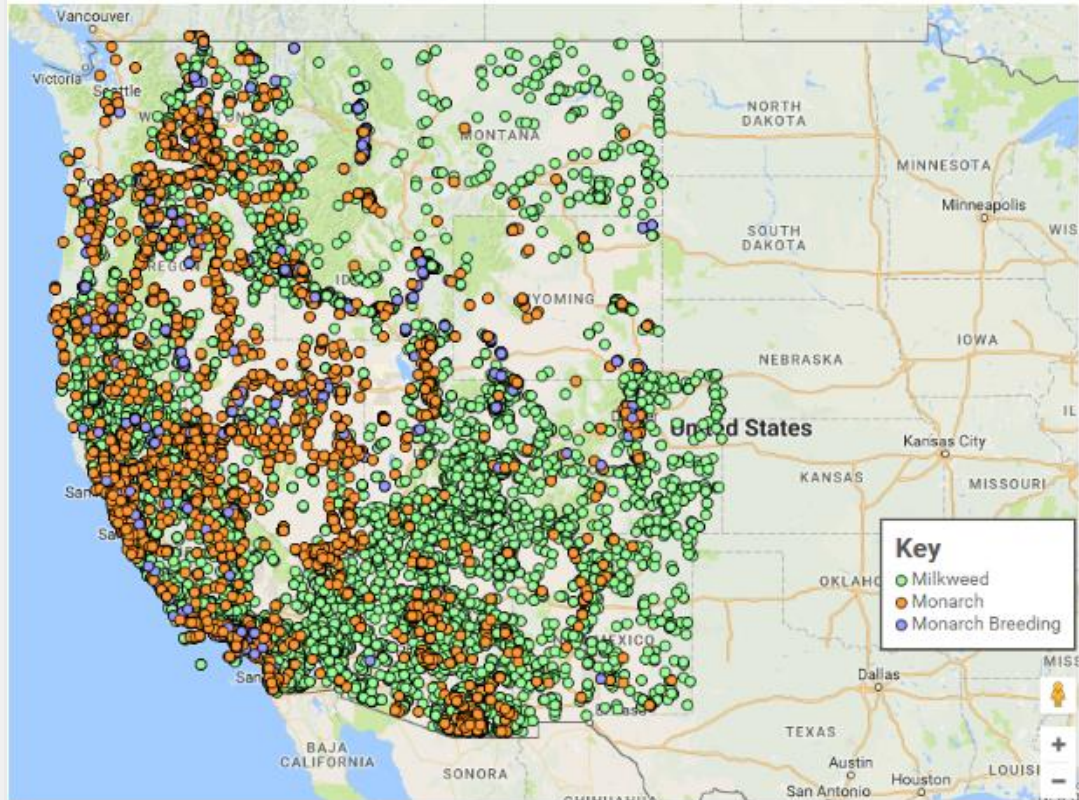
Cheryl Schultz
Washington State University-Vancouver

May 2021

NR-19-001

Western Monarch Milkweed Mapper

Check out sightings submitted in your area! [Explore now](#)



How to Submit a Sighting

1



Take a photo of a monarch and/or milkweed

2



Login and upload your photo(s)

3



Identify your sighting

4



Submit your sighting!!

Get started!



WESTERN MONARCH
MILKWEED MAPPER

Submissions

Milkweed Sightings: **40543**

Monarch Sightings: **19678**

Monarch Breeding
Sightings: **3933**

Total Sightings: **60221**

Learn more & participate at
www.monarchmilkweedmapper.org

Best Management Practices

Protect, manage, and restore summer breeding and fall migration monarch habitat

Best Management Practices for Pollinators on Western Rangelands

(Completed July 2018)



 XERCES SOCIETY
for Invertebrate Conservation

Managing for Monarchs in the West

Best Management Practices for Conserving the Monarch Butterfly and its Habitat



 XERCES SOCIETY
for Invertebrate Conservation

Thank you for supporting this research!



We thank installation resource managers for assistance with our work, access to sites and support of the project Rhys Evans (Vandenberg AFB); Gary Cottle, Donna Withers, Ann Bedlion and Anna Keyzers (NAS Fallon); John Philips and Michael Bianchi (NWSTF Boardman); Colin Leingang, Lisa Weigel and Kimberly Quayle (JBLM Yakima Training Center); Jenni Dorsey-Spitz, Leslie Pena, and Jamieson Scott (Mountain Home AFB); Doug Grothe, Taylor Johnson (USACE Sacramento District); and Tamara Gallentine, Chadwick McCready (Beale AFB). In addition, we thank agency biologists and resource managers at study sites near DoD installations in each region: Kate McCurdy, Avery Hardy, and Mary Jane West-Delgado (UC Natural Reserve System, Sedgewick Reserve); Bart McDermott and Amy Hopperstad (Stone Lake NWR), Dan Lubin (South Yuba River State Park); Lamont Glass, Heidi Newsome and Keely Lopez (Umatilla NWR); and Chad Eidson (Lower Crab Creek Wildlife Area). We thank additional Xerces' staff who have contributed to this project: Candace Fallon. We thank Leone Brown for assistance when we started the project. In addition, we thank many volunteers who assisted at these sites and provided help and support throughout the project. Finally, we thank DoD Legacy Natural Resources staff for support of this work throughout the project.