



Western Monarch Butterfly Conservation Plan



Sponsored by the **Western Association of Fish and Wildlife Agencies**

2019-2069

Western Monarch Working Group

TAYLOR COTTEN

Washington Department of Fish and Wildlife

JIM DEVOS

Arizona Game and Fish Department

CHRIS KELEHER

Utah Department of Natural Resources

STAFFORD LEHR

California Department of Fish and Wildlife, Executive Sponsor

SAMANTHA MARCUM

U.S. Fish and Wildlife Service

KAREN MINER

California Department of Fish and Wildlife, Working Group Chair

JENNIFER NEWMARK

Nevada Department of Wildlife

DAVIA PALMERI

Oregon Department of Fish and Wildlife

REX SALLABANKS

Idaho Department of Fish and Game

MARIA ULLOA BUSTOS

Bureau of Land Management

BILL VAN PELT

Western Association of Fish and Wildlife Agencies

MINDY WHEELER

Utah Department of Natural Resources

Contributing Authors

CHERI BOUCHER

Arizona Game and Fish Department

VIKKI FINN

U.S. Fish and Wildlife Service, Pacific Region

MIKE HOUTS

Western Association of Fish and Wildlife Agencies

ANN POTTER

Washington Department of Fish and Wildlife

DAYDRE ROSER

California Department of Fish and Wildlife

HELEN SWAGERTY

California Department of Fish and Wildlife

LEONA SVANCARA

Idaho Department of Fish and Game

PAUL THOMPSON

Utah Department of Natural Resources

Editor

BETH WATERBURY

Idaho Department of Fish and Game, retired

Graphic Design

KELLY KENNEDY YOKOYAMA

Sighthound Graphic Design

Recommended citation:

Western Association of Fish and Wildlife Agencies. 2019. Western monarch butterfly conservation plan, 2019–2069. Version 1.0.

Cover photo credits:

Upper left: Volunteers search for adult monarchs as part of a tagging project at Fort Boise Wildlife Management Area, Parma, Idaho. Dusty Perkins/CWI.

Upper right: Overwintering cluster of monarchs at Pismo Beach State Park. Ryan Hagerty/USFWS.

Bottom: Composite photos of monarchs and showy milkweed. Beth Waterbury/IDFG.



"Delivering conservation through information exchange and working partnerships"

Acknowledgments



Monarch butterflies cluster on native Monterey cypress at Pismo Beach State Park, ranked number 1 in the Top 50 list of overwintering sites in California in greatest need of management attention. Ryan Hagerty/USFWS.

The Western Monarch Working Group is grateful to the panel of western monarch researchers who generously provided their time and energy to this effort: Elizabeth Crone, Thomas Dilts, Matthew Forister, Sarina Jepsen, Gail Morris, Emma Pelton, and Cheryl Schultz. In addition, selected individuals representing various agencies and public sectors provided comments on a preliminary rough draft of the Plan. Their thoughtful review and input was invaluable in refining this final Plan.

We also acknowledge and express our appreciation to all monarch researchers, past and present, whose field and laboratory studies have illuminated our understanding of the North American monarch butterfly.

Hundreds of volunteer citizen scientists have contributed thousands of hours observing, collecting, and recording data to increase our collective knowledge of monarchs in North America. We sincerely thank these individuals, organizations, and businesses for their commitment and valuable contributions. We also thank the stakeholders who took time to comment on this Plan.

To the National Fish and Wildlife Foundation, we express our gratitude for providing a grant to support the development of this Plan.



Executive Summary

The monarch butterfly is one of the most familiar and charismatic insects of North America, renowned for its distinctive migratory phenomena and reliance on milkweed, the monarch's larval host plant. Once widespread and common throughout its range, populations have undergone significant declines. The western population of monarchs that breeds west of the Rocky Mountains and largely overwinters in coastal California has declined 74% since the late 1990s. The much larger eastern population that breeds east of the Rockies and overwinters in Mexico has declined at a similar rate.

In 2014, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the monarch as a threatened species under the Endangered Species Act of 1973 (ESA). The USFWS found that the petition contained sufficient information to demonstrate that listing may be warranted and initiated a formal status review to inform their listing decision, anticipated in June 2019.

Concurrent with the status review, USFWS and the Association of Fish and Wildlife Agencies have actively promoted collaborative efforts across state, organizational, and landownership boundaries to address threats and opportunities facing monarchs and other pollinators. In 2017, the Western Association of Fish and Wildlife Agencies (WAFWA) established the Western Monarch Working Group (WMWG) to proactively lead a multistate cooperative agenda for conservation of the western monarch population. If implemented in a timely manner, WMWG efforts could preclude the need to list the monarch under the ESA. This document, The Western Monarch Butterfly Conservation Plan (hereafter "Plan"), is intended to articulate and attain WAFWA's vision to identify and promote a shared set of coordinated, ecosystem-based conservation strategies across all partner agencies to achieve the vision of a viable western monarch population.

The Plan currently encompasses the states of Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington, which comprise the core of the western

monarch range. In contrast to the eastern range, the western range is distinct in containing overwintering, breeding, and migratory habitats comprising the entirety of the monarch's migratory life cycle. With the exception of the California wintering sites, critical knowledge gaps still exist on the distribution and quality of monarch breeding and migratory habitats and primary threat factors influencing monarch declines in the western landscape.

The Plan is organized in seven sections as follows:

Section 1: Introduction and Plan Overview describes the need, purpose, planning approach, and state authorities for developing the Plan.

Section 2: Western Monarch Butterfly Ecology is a primer on monarch life history, habitat requirements, and population status of western monarchs.

Section 3: Summary of Potential Threat Factors provides an overview of a suite of potential threats impacting the western monarch population and its habitat.

Section 4: Current Conservation Efforts summarizes recent and ongoing activities of federal and state agencies, NGOs, academia, industry sectors, and citizen scientists on behalf of monarch and pollinator conservation.

Section 5: Monarch Population and Habitat Goals establishes near term (5-year) measurable objectives for population size and habitat targets with the goal of reversing western monarch declines and providing for population growth. Additional short- and long-term goals will be established as crucial data on monarch life history and habitat selection are attained.

Section 6: Monarch Conservation Strategies outlines approaches to:

- Protect and restore overwintering groves, including development of site-specific grove management plans; and conserve monarch breeding and

migratory habitats in natural lands, urban and industrial, rights-of-way, and agricultural habitat sectors;

- Harness the widespread appeal of the monarch to engage eight different audiences in education, conservation, and scientific research programs;
- Research priorities for overwintering and breeding/migratory life stages, and monitoring priorities to track population trends and threat reduction efforts.

Section 7: Capacity, Funding, Implementation provides summary-level clarity to the question of how WMWG state members will mechanize Plan implementation as a matter of law, funding, and governance structure. This section also describes a framework for monitoring

conservation activities in the Plan to identify whether they are producing the desired results or whether adjustments in approaches under the adaptive management process are warranted.

This Plan is a call to action. It provides a collaborative framework for action and accountability among state, federal, NGO, academic, private, and local partners to advance near-term and long-term objectives to address and ameliorate threats and ensure improvement and long-term persistence of the western monarch population into the foreseeable future (50 years). Plan implementation will require public sector engagement and community-based efforts to reach the population and habitat goals herein.



The Idaho Legislature adopted the monarch butterfly as the official State Insect in 1992. Brett Magnuson.



Contents

- Acknowledgments..... ii
- Executive Summary iii
- Acronyms and Abbreviations Used in this Document ..vii
- SECTION 1: Introduction and Plan Overview 1
 - 1.1. Need 2
 - 1.2. Purpose Statement 2
 - 1.3. Planning Approach 2
 - 1.4. State Authorities 3
- SECTION 2: Western Monarch Butterfly Ecology 5
 - 2.1. Description 5
 - 2.2. Taxonomy..... 5
 - 2.3. Life History 6
 - 2.4. Migration and Distribution..... 6
 - 2.5. Habitat 8
 - 2.6. Population Status 10
- SECTION 3: Summary of Potential Threat Factors..... 11
 - 3.1. Loss and Degradation of Overwintering Habitat 11
 - 3.2. Loss and Degradation of Monarch Breeding and Migratory Habitat 11
 - 3.3. Insecticides..... 15
 - 3.4. Climate Change..... 16
 - 3.5. Disease and Predation..... 17
 - 3.5.1. Disease..... 17
 - 3.5.2. Predation 18
 - 3.6 Other Factors 19
 - 3.6.1. Wildfire 19
 - 3.6.2. Mortality at Concentrated Solar Facilities. 20
 - 3.6.3. Overutilization for Commercial, Recreational, Educational, or Scientific Purposes..... 20
- SECTION 4: Current Conservation Efforts 21
 - 4.1. Federal Efforts 21
 - 4.2. State Efforts..... 25
 - 4.3. Citizen Conservationist Efforts 31
- SECTION 5: Monarch Population and Habitat Goals and Objectives 33
 - 5.1. Monarch Population Goals and Objectives..... 33
 - 5.2. Habitat Goals and Objectives 34
- SECTION 6: Monarch Conservation Strategies..... 37
 - 6.1. Overwintering Habitat 37
 - 6.2. Natural Lands 41
 - 6.3. Urban and Industrial Development..... 46
 - 6.4. Rights-of-Way..... 52
 - 6.5. Agricultural Lands 57
 - 6.6. Education and Outreach..... 61
 - 6.6.1 General Public..... 62
 - 6.6.2 Natural Resource Land Managers..... 63
 - 6.6.3 Agricultural Land Managers..... 64
 - 6.6.4 Rights-of-Way Managers 64
 - 6.6.5 Landowners Adjacent to Overwintering Sites. 65
 - 6.6.6 State and Local Political Leadership..... 66
 - 6.6.7 Monarch Enthusiasts 66
 - 6.6.8 Teachers and Non-Classroom Educators ... 67
 - 6.7. Research and Monitoring Priorities..... 68
 - 6.7.1. Overwintering Life Stage..... 68
 - 6.7.2. Breeding/Migration Life Stages..... 70
 - 6.7.3. Monitoring Strategies..... 73
- SECTION 7: Capacity, Funding and Implementation 77
 - 7.1. Capacity and Funding 77
 - 7.2. Implementation 78
 - 7.3. CHAT: A Tool for Western Monarch Conservation Work 80
 - 7.4. Adaptive Management of the Western Monarch Conservation Effort 81
- LITERATURE CITED 85
- APPENDIX A. Summary of Strategies, Actions, and Timelines for Implementation..... 91
- APPENDIX B. Resources for Western Monarch Conservation..... 100
- APPENDIX C: Overwintering Site Management Plan Template 105
- APPENDIX D: Western States Monarch Conservation Survey Results 106

List of Tables

Table 1. Summary of authority for management of insects within each participating state, including whether the state has the ability to list an insect species as state threatened or endangered, and the presence of monarchs in each state’s state wildlife action plan.4

Table 2. Intersection of the high-medium-low categorized suitability and uncertainty maps for each model results in a 3x3 matrix. 81

Table 3. Hypothetical fields in a data table related to the CHAT and the Nested Hexagon Framework. 81

Table 4. Identified activities or situations that will trigger the adaptive management process or a specific conservation action. 82

List of Figures

Figure 1. Adult male (top) and female monarch butterflies showing wing pattern differences.5

Figure 2. The five instar stages of the monarch caterpillar. .5

Figure 3. Monarch migration and distribution in North America.....7

Figure 4. Predicted “all milkweed species” habitat suitability model of the seven western states (Dilts et al. 2018).....9

Figure 5. The Xerces Society Western Monarch Thanksgiving Count, 1997-2017..... 10

Figure 6. Milkweed model potential for suitable habitat within croplands of the western states and proportion of high, medium, and low milkweed suitability in seven western states. 14

Figure 7. Increasing glyphosate use on agricultural land in the U.S. in 1992 versus 2016.15

Figure 8. Estimated agricultural use of Imidacloprid, a widely-used neonicotinoid insecticide, in 1992 (left) and 2012 (right). 16

Figure 9. Proposed monarch butterfly conservation units in the U.S..... 35

Figure 10. Distribution of current and historic monarch overwintering sites in California..... 38

Figure 11. Landownership in the seven-state region comprising the core range of the western monarch butterfly population..... 42

Figure 12. Spatial extent of the Nested Hexagon Framework where hexagons can be ranked with CHAT scores80

Figure 13. A diagram depicting how raw data sets are aggregated into hexagons and used to inform the identification of monarch priority rankings.....80



Edward K. Boggess.

Acronyms and Abbreviations Used in this Document

AFWA	Association of Fish and Wildlife Agencies
AGFD	Arizona Game and Fish Department
AZDA	Arizona Department of Agriculture
BLM	Bureau of Land Management
BMP	Best Management Practice
CCAA	Candidate Conservation Agreement with Assurances
CDPR	California Department of Pesticide Regulations
CPR	California Department of Parks and Recreation
CDFW	California Department of Fish and Wildlife
CHAT	Critical Habitat Assessment Tool
Corps	Army Corps of Engineers
DoD	U.S. Department of Defense
DOT	Department of Transportation
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FSA	Farm Services Agency
IDFG	Idaho Department of Fish and Game
IMMP	Integrated Monarch Monitoring Program
LCP	Local Coastal Program
MAFWA	Midwest Association of Fish and Wildlife Agencies
NGO	Non-governmental Organization
NPS	National Park Service
NRCS	Natural Resources Conservation Service
ODFW	Oregon Department of Fish and Wildlife
OE	<i>Ophryocystis elektroscirrha</i>
ROW	Right-of-way
SGCN	Species of Greatest Conservation Need
SSA	Species Status Assessment
SWAP	State Wildlife Action Plan
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
WAFWA	Western Association of Fish and Wildlife Agencies
WCB	Wildlife Conservation Board
WDFW	Washington Department of Fish and Wildlife
WMPIC	Western Monarch Population Initiative Council
WMTC	Western Monarch Thanksgiving Count
WMWG	Western Monarch Working Group



Monarch eggs on new growth of narrow-leaved milkweed (*Asclepias fascicularis*). Stephanie McKnight/Xerces Society.



SECTION 1: Introduction and Plan Overview



Beth Waterbury/IDFG.

The monarch butterfly (*Danaus plexippus plexippus*) is one of the most recognized, well-studied, and charismatic butterflies in North America. This familiar orange and black butterfly is known for its unique long-distance, multi-generational migratory cycle and its reliance on milkweed, the monarch’s larval host plant. The widespread appeal of monarchs serves as a powerful catalyst to engage, network, and mobilize people on their behalf.

Two populations of monarchs are recognized in North America. The larger eastern population breeds east of the Rocky Mountains and migrates to high elevation forests in central Mexico. The much smaller western population breeds west of the Rockies and migrates to hundreds of wooded groves along the California coast. However, the boundary between populations is permeable with considerable interchange occurring at breeding and overwintering sites (Vandenbosch 2007, Pyle 2015). Over the last three decades, both populations have experienced significant declines (Jepsen et al. 2015; Schultz et al. 2017; Rendón-Salinas et al. 2018; Xercus 2018). As early as 2008, stakeholders from Canada,

Mexico and the U.S. produced the North American Conservation Plan with the aim of maintaining healthy monarch populations and habitats throughout the tri-national migration flyway (Commission for Environmental Cooperation 2008). The plan primarily focused on collaborative actions, priorities, and targets to be considered for adoption, though it explicitly did not impose obligations on the three party nations.

In 2014, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the monarch as a threatened species under the Endangered Species Act of 1973 (ESA). The USFWS responded with an initial finding that listing the monarch may be warranted and launched a formal status review under the Species Status Assessment (SSA) framework. The USFWS expects to make a listing decision by June 2019.

In March 2015, the USFWS and the Association of Fish and Wildlife Agencies (AFWA) issued a joint memorandum encouraging state and territorial fish and wildlife agencies to promote collaborative efforts supporting “voluntary and incentive-based efforts to

address threats of loss, fragmentation, and modification of monarch breeding habitat (AFWA and USFWS 2015).” The memorandum also encouraged states to consider adding the monarch butterfly and other pollinator taxa as a Species of Greatest Conservation Need to State Wildlife Action Plans. Building from this call to action, the Midwest Association of Fish and Wildlife Agencies completed the Mid-America Monarch Conservation Strategy in June 2018. The Mid-America strategy focuses on the mid-continental range of the eastern monarch population, considered the core of breeding and migrating habitat for the migratory generation overwintering in Mexico (Flockhart et al. 2013). The Western Monarch Conservation Plan focuses on the seven westernmost states in the conterminous United States (U.S.) comprising the majority of known western monarch range. In contrast to the eastern range, the western range is distinct in containing overwintering, breeding, and migratory habitats supporting the entirety of the monarch’s migratory cycle.

1.1. Need

Once common and widespread throughout North America, monarch populations have experienced recent and rapid declines. Western monarchs overwintering in coastal California have declined 74% since the late 1990s, from >1.2 million to <200,000 individuals (Xerces 2018). A recent population viability analysis of long-term California overwintering count data estimated a decline of >95% since the 1980s (Schultz et al. 2017). This mirrors an 84% decline estimated for the eastern monarch population overwintering in central Mexico (Semmens et al. 2016). Preliminary reports from the 2018 Thanksgiving Count of overwintering monarchs in California indicate a very large population decline to perhaps less than 0.5% of historical size. The concurrence of monarch population declines with a similar global decline in abundance, diversity, and health of pollinator taxa (IPBES 2016) underscores the need and urgency to conserve these species and the vital ecosystem services they provide. Rapid and extensive loss of milkweed in the Midwest has been identified as a primary driver for declines in the well-studied eastern monarch population (Pleasants and Oberhauser 2012; Flockhart et al. 2015). Other major drivers for eastern population declines include logging at overwintering sites, insecticide use, climate change, and parasites, disease, and predators (Jepsen et al. 2015; Xerces 2018). The primary factors driving western monarch population

declines are gradually coming into focus. Parallel threats of habitat loss, insecticides, climate change, and parasites, disease, and predators are implicated in western monarch declines (Xerces 2018), but the relative contribution of these factors requires further study. Further mediating western monarch population dynamics are its small population and widely-scattered breeding habitats within an otherwise arid landscape.

While the majority of conservation focus has been on the eastern population as the core North American migratory population, the western population is important to the overall viability of the species in representing a large geographic portion of the North American monarch’s range. This representation conserves western monarch adaptive capabilities, which in turn contributes to redundancy and resiliency in the North American population. Its demographic importance is also important for its contribution of unique variations in migratory and reproductive behaviors, disease and parasite resistance, and ecological variation at both breeding and overwintering habitat sites. Preserving distinct evolutionary lineages and variations in biological characteristics observed in the western population are important to sustain the species’ capacity to adapt to changing physical and biological conditions now and into the future. Due to this uniqueness and that the two populations largely function as separate populations, a separate conservation strategy specific to the western population is needed to effectively reverse the decline of the western population of monarch butterflies.

1.2. Purpose Statement

The purpose of the Western Monarch Conservation Plan (Plan) is to identify and promote a shared set of conservation strategies for the entire life cycle of the western monarch population, including the overwintering grounds in California and breeding and migratory habitats throughout the western U.S., to achieve the vision of a viable western population of monarch butterflies.

1.3. Planning Approach

The Western Association of Fish and Wildlife Agencies (WAFWA) provides a forum for western states and provinces to coordinate and address identified conservation issues that cross jurisdictional lines. WAFWA established the Western Monarch Working

Group (WMWG) in 2017 to develop a west-wide, multi-state cooperative approach towards improving grassland, wet meadow, riparian, and shrubland ecosystems that support the monarch butterfly during its breeding and migratory life stages. Efforts to protect and restore monarch habitats also enhance ecosystem services provided by a host of beneficial insects, including pollinators, which in turn benefit other species of conservation need identified by western states. Because California overwintering habitats are vitally important to the western population, the working group chose to include strategies for protecting and conserving these habitats in an effort to ensure a comprehensive approach. Such a collaborative and comprehensive approach is intended to increase political, social, and financial focus and support from partner agencies, private industries, non-government organizations (NGO), and the public. Plan development was somewhat constrained by existing gaps in regionally-specific information, particularly for breeding and migratory habitat. Therefore, the planning approach by necessity is adaptive and the need for regular review and updates is recognized. See Section 7.2 Implementation for a schedule of review and updates to the Plan.

States currently involved in the WMWG and development of this Plan include Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington. Given our current state of knowledge, these states comprise the core of western monarch range. However, western monarchs are known to overwinter in Baja, Mexico, and breed in other western states and Canada; thus, the conservation strategies contained in this Plan are also applicable to these areas.

Success of the Plan will depend on many partners, including federal, state, and local agencies, NGOs, academic institutions, and interested individuals throughout western North America. Current partners include, but are not limited to, USFWS, Bureau of Land Management, U.S. Forest Service, U.S. Department of Defense, National Park Service, California Wildlife Conservation Board, California State Parks, California Department of Transportation, California Polytechnic University-San Luis Obispo (Monarch Alert), Washington State University, The Xerces Society of Invertebrate Conservation, Environmental Defense Fund, Pollinator Partnership, Southwest Monarch Study, and Southern Oregon Monarch Advocates.

1.4. State Authorities

Under the U. S. federal system of government, legal authority to manage most wildlife species that occur in the U.S. is vested in the individual states. As public trustees of wildlife, states manage wildlife for their citizens, working to sustain wildlife populations for present and future generations. Exceptions are those species where federal law has created a special management authority at the federal level, such as endangered species or migratory birds. Under this authority, federal and state governments co-manage these species. Where wildlife species are not currently listed under the ESA, management authority for the species resides with the states.

All states have established some form of fish and wildlife management agency, either as a stand-alone cabinet-level agency or as a department within a larger natural resource management agency. The management authorities granted to these departments by state statute and regulations differ, however, and not every state wildlife agency has the formal authority to manage native insects such as the monarch butterfly. Some state agencies lacking explicit management authority over butterflies are incorporating monarch habitat requirements (particularly larval and nectaring habitats) into their broader wildlife habitat management activities. Some states have authority to designate species as endangered, threatened, or fully protected, and regulate activities that impact those species.

Although some states may lack specific insect management authority, state wildlife agencies have authorities and resources to manage wildlife habitat for other target species that provide surrogate benefits to monarchs. For example, habitat management work designed for grassland game species can easily incorporate plantings of milkweed and native nectar plants to benefit monarchs and a wide range of pollinators. Some states lacking insect management authority have designated the monarch butterfly as a Species of Greatest Conservation Need (SGCN) in their State Wildlife Action Plans (SWAP) to reflect the conservation priorities of their partners (AFWA 2015). The table below illustrates the current legal authority and conservation status of the monarch butterfly in each of the seven states covered in this Plan.



Conservation practices aimed at monarchs also benefit a variety of pollinators, native insects, and birds. Jim Huddins/USFWS.

Table 1. Summary of authority for management of insects within each participating state, including whether the state has the ability to list an insect species as state threatened or endangered, and the presence of monarchs in each state’s State Wildlife Action Plan.

State	Agency ¹ with Management Authority for Native Insects	State has Threatened/Endangered Designation	Insects Eligible for Threatened/Endangered Designation	Monarch included as SGCN in SWAP
Arizona	None	No	No	No
California	CDFW	Yes	Yes	Yes
Idaho ²	IDFG	Yes	Yes	Yes
Nevada	None	Yes	No	No
Oregon	None	Yes	No	Yes
Utah	None	Yes	No	No
Washington	WDFW	Yes	Yes	Yes

¹ CDFW = California Department of Fish and Wildlife; IDFG = Idaho Department of Fish and Game; ODFW = Oregon Department of Fish and Wildlife; WDFW = Washington Department of Fish and Wildlife.

² The monarch butterfly is the official State Insect of Idaho.



SECTION 2: Western Monarch Butterfly Ecology



Overwintering cluster of monarchs at Pismo Beach State Park. Ryan Hagerty/USFWS.

Detailed information about monarch life history, range, migration, and habitat requirements is provided in the monarch ESA petition (Center for Biological Diversity et al. 2014), as well as multiple books, articles, and websites (e.g., see Monarch Joint Venture, Monarch Watch, Xerces Society websites and references therein). The following sections provide an overview of monarch ecology most pertinent to this Plan, with a focus on the western North American population of monarch butterflies.

2.1. Description

Adult monarch butterflies are characterized by their large size (10 cm wingspan) and bold wing patterns (Fig. 1). The upper surface of forewings and hindwings exhibit black to dark-brown veins on an orange background with two rows of white spots at the margins. Underwings have a similar color pattern, but are paler, and the body is black or dark-brown with white spots. Male butterflies have a black scent pouch in the center of each hindwing and generally possess slightly larger wings. Wing venation in females tends to be darker and thicker than that of males.

Monarch caterpillars (larvae) are similarly boldly-patterned, displaying a vivid black, white, and yellow transverse banded pattern along the length of their bodies. Monarch larvae go through five size stages known as instars, growing to a larger size after each skin molt (Fig. 2).

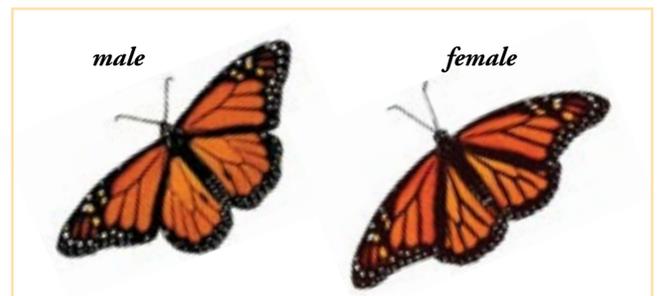


Figure 1. Adult male (left) and female monarch butterflies showing wing pattern differences. Norchester Garden Club.



Figure 2. The five instar stages of the monarch caterpillar. Monarch Joint Venture.

2.2. Taxonomy

The monarch (*Danaus plexippus plexippus*) is a member of the order Lepidoptera (moths and butterflies) and family Nymphalidae, a family characterized in part by small front legs with specialized hairs, thus the common name “brushfoot butterflies.” Monarchs are further classified in the subfamily Danaianae, the “milkweed

butterflies.” Their larval and adult bodies are specialized to accumulate toxins from milkweed plants to deter predators (Brower 1984).

The monarch is the type species in the genus *Danaus*, comprised of 12 mostly tropical species. There are six recognized subspecies of *Danaus plexippus*, including *D. p. plexippus* (the subject of the ESA petition and this Plan), which occurs in migratory populations across North America from southern Canada to overwintering sites in central Mexico and coastal California. Evaluation of the genetic structure of eastern and western North America populations of *D. p. plexippus* shows no genetic differentiation (Lyons et al. 2012). However, morphological differences between eastern and western populations have been noted, with eastern monarchs having comparatively larger and more angular forewing sizes consistent with adaptation for long-distance migration (Altizer and Davis 2010; Yang et al. 2016).

2.3. Life History

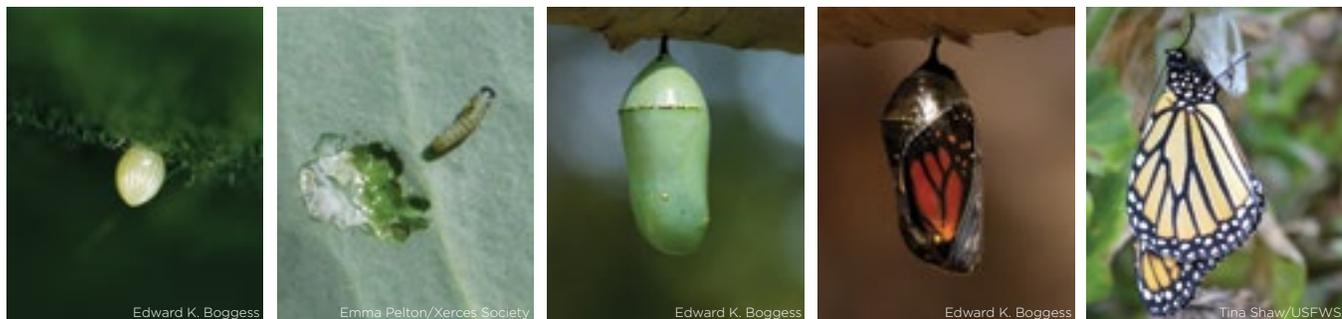
The monarch, as with all moths and butterflies, undergoes complete metamorphosis comprised of four stages: egg, larva (caterpillar), pupa (chrysalis), and adult. This cycle is completed in approximately one month, but is highly temperature dependent, with cooler temperatures resulting in slower development. Female monarch butterflies lay their eggs singly on the underside of young leaves or flower buds of milkweed (*Asclepias* spp.) and related genera. The tiny cream-colored eggs take 3–5 days to develop, at which point the caterpillars hatch and immediately begin feeding on milkweed plants. Milkweeds provide energy and protective cardenolides, toxic compounds rendering the caterpillars unpalatable to many predators. Caterpillars go through five stages (instars) which can take between 9–14 days. Fifth instar caterpillars form a green chrysalis with gold trim which may be attached to milkweed, surrounding

vegetation, or other structures. The pupal stage lasts on average about 10 days. At the end of metamorphosis, the adult emerges from the chrysalis, pumps bodily fluid into its wings, and flies off in search of nectar and mates.

Monarch eggs, caterpillars, and pupae are vulnerable to extreme weather, predation, parasites, and disease, resulting in perhaps less than 10% survival rate to adulthood in the eastern population (Nail et al. 2015). Vital rates (i.e., survival, individual growth, reproduction, recruitment) are generally lacking for western monarchs. Breeding adults in the spring and summer mate just a few days after emergence and live 2–5 weeks. Up to several generations are produced during the spring and summer as they migrate northward across the western U.S. and southern Canada. In response to changing day length, temperature conditions, and declining milkweed quality, the fall generation of monarchs undergoes physiological changes resulting in reproductive diapause, lipid accumulation, and south-southwest directional migration to overwintering sites. Monarchs in reproductive diapause may live 6–9 months.

2.4. Migration and Distribution

Monarch butterflies are found throughout North America to southern Canada (up to about 50° N latitude) (Fig. 3), but are uncommon in western Washington, northwest Oregon, and western British Columbia, where native milkweeds are currently and generally absent (Pyle 2015). Western monarchs typically reach overwintering sites in coastal California and Baja California in September and October. Tagging studies revealed at least some portion of western monarchs (primarily from the Southwest) migrate to Mexico overwintering grounds where they intermix with eastern monarchs (Morris et al. 2015; Pyle 2015). In addition to these sites, small numbers of monarchs overwinter in



Monarch life cycle stages (from left to right) egg, larva, pupa, adult.

the Saline Valley of California (Xerces Society Western Monarch Thanksgiving Count 2018a); the Mojave Desert near Lake Mead, Nevada; several locales in Arizona (Yuma, Parker, Lake Havasu, and Phoenix) (Morris et al. 2015); and Rancho Mirage, California (Gail Morris, pers. comm.). Most overwintering monarchs are in reproductive diapause, with activity limited to sunning, nectaring, and rehydrating. This dormancy allows monarchs to conserve lipid reserves needed to survive winter and disperse in spring (Brower et al. 2011). Notable exceptions are in southern coastal California and the Phoenix, Arizona metropolitan area where the widespread planting of non-native tropical milkweed (*A. curassavica*) and mild winter climates allow monarchs to breed year-round and possibly abandon overwintering behavior (Xerces 2018; Fisher et al. 2018). In late February or March, changing environmental conditions trigger monarchs to break diapause. Evidence suggests mating occurs at overwintering sites before spring dispersal (Herman et al. 1989) and travel resumes northward or eastward as milkweeds emerge and develop. Successive generations will continue to migrate and colonize states to the north and the east, following the growth of milkweed plants and suitably warm weather to support larvae development and survival.

Considerable progress has been made in recent years to better understand the distribution of milkweeds and monarch natal habitats in the West. For a species broadly defined by the distribution of milkweed, addressing these knowledge gaps is an essential first step to conserving monarch seasonal habitats and the migratory phenomenon. In 2017, the Xerces Society launched the Western Monarch Milkweed Mapper, an interactive web portal to engage public reporting of monarch and milkweed observations in 11 western states. This landscape-scale database, along with extensive on-the-ground surveys in Idaho, Nevada, Oregon, and Washington in 2016-2017, amassed sufficient high-accuracy records to develop habitat suitability models for monarch breeding and several species of native milkweeds in the seven westernmost states (Dilts et al. 2018 [datasets through 2016 analyzed]). The models reveal that suitable breeding and migratory habitat is widespread in this region, with notable concentrations of potential highly suitable habitats in California's Central Valley, southern Idaho, eastern Washington, northern Nevada, southern Arizona, and portions of Oregon and Utah (Fig. 4). The models provide a valuable tool for prioritizing areas for conservation, restoration, and monitoring in the West.

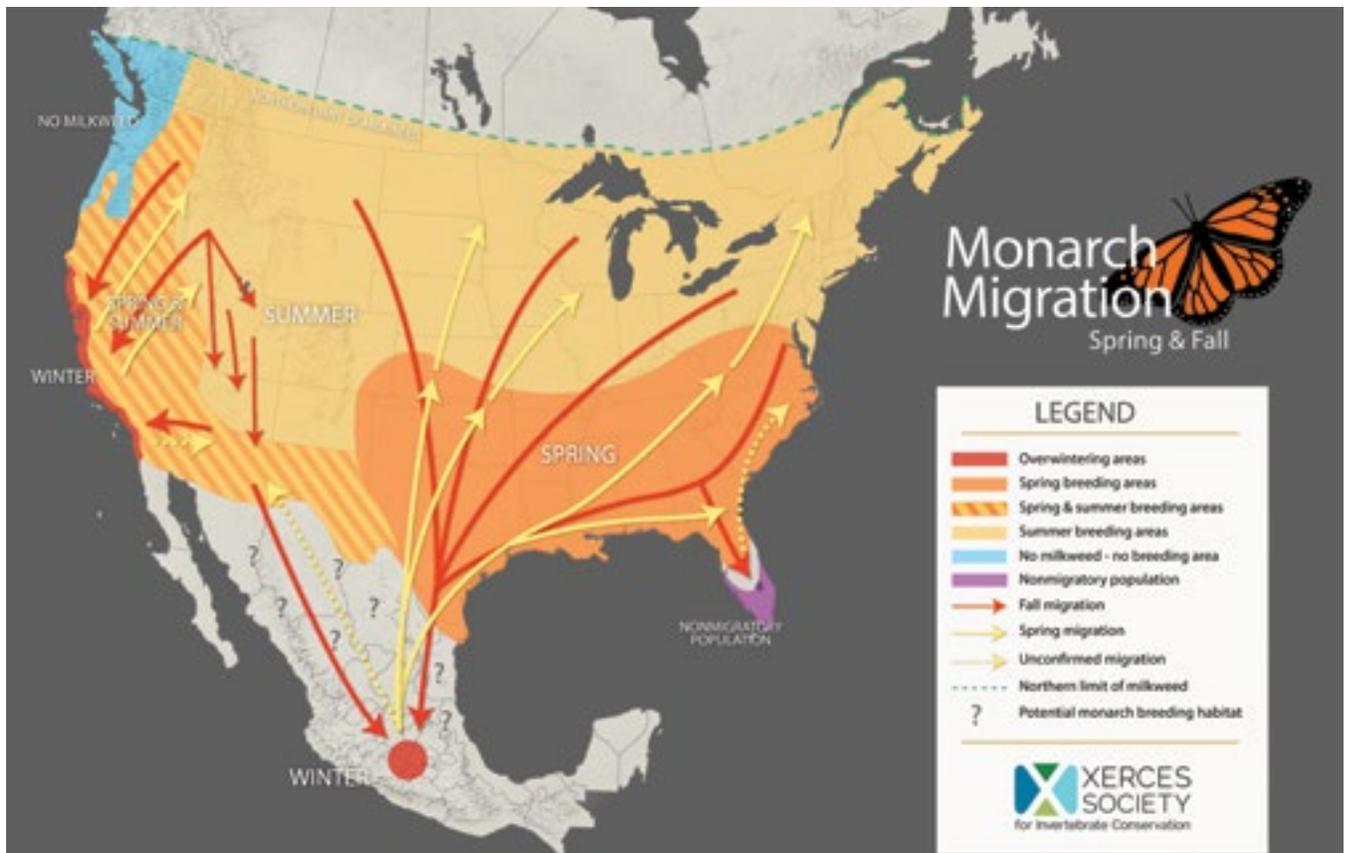


Figure 3. Monarch migration and distribution in North America. Map courtesy of Xerces Society.



Monarch breeding habitat at Montour Wildlife Management Area within the Payette River floodplain in southwest Idaho. Beth Waterbury/IDFG.

In contrast to the eastern population, information is lacking on established migration routes for both spring and fall western migrants. Historical records of monarch collections in the western North America suggested fall migrants often followed riparian corridors, likely reflecting reliable distribution of water, nectar resources, and roost trees in these landscapes (Brower and Pyle 2004; Dingle et al. 2005). Recently, the non-profit citizen scientist research group, Southwest Monarch Study, has documented the use of several river corridors as primary monarch migration routes (Morris et al. 2018). Tagging conducted in 2012–2016 by the Monarchs of the Pacific Northwest project documented destinations of captive-reared monarchs from Washington and Oregon to coastal California overwintering sites (James et al. 2018). The project also found some evidence of south and southeast vectoring of captive-reared fall migrants from eastern Washington and Idaho, indicating possible movement to Arizona or Mexico overwintering sites. A recent isotopic study of monarchs at California overwintering sites showed natal origins from all regions of the West, with large contributions (40%) from interior western states such as Idaho and eastern Washington (Yang et al. 2016). While this study importantly identified natal origins and destinations of western migrants, specific migration routes of western monarchs remain largely undefined.

2.5. Habitat

Monarch habitat is often described in terms of breeding, migratory, and overwintering habitats. Breeding habitat essentially features native milkweeds to provide food for larvae and other flowers to provide nectar for adults, but may also include trees or shrubs for shading and roosting, and connectivity among these



Coastal California overwintering sites provide suitable microhabitat conditions, including protection from wind and freezing temperatures. Brandi Ivy.

habitat elements. In some areas of the West, monarchs rely on non-native nectar resources (e.g., non-native thistles, purple loosestrife [*Lythrum salicaria*]) where habitats have poor native nectar abundance in summer and fall (James 2016; Waterbury and Potter 2018). Migratory habitat consists of nectar plants for adults during spring and fall migration and, in some locales, trees for roosting (Pyle 1999). Breeding and migratory habitats are often synonymous since they contain the same key components (milkweed, nectar sources, and roosting structure) that sustain monarch reproduction and migration. Monarchs have been described as being “wedded, not welded” to rivers during migration (Pyle 1999) and watercourses offer all requisite habitat elements (Dingle et al. 2005), but may not be followed if their direction is contrary to the overall direction of migration (Pyle 1999). It is important to note that presence of milkweeds is not synonymous with presence of monarchs. Breeding monarchs, like all butterflies, select for a range of characteristics for successful reproduction. These characteristics, as well as other critical aspects of monarch habitat (i.e., roosting habitat, vertical structure for shade, distance to water), are poorly understood in the West and require further research.

Overwintering habitat is comprised of a grove of trees that produce the necessary microclimate for monarch survival. The majority of sites are located within 1.5 miles from the Pacific Ocean or San Francisco Bay (Leong et al. 2004), where these water bodies moderate temperature fluctuations (Chaplin and Wells 1982). Most sites occur at low elevations (<300 feet), in shallow canyons (Lane 1993), and on south-, southwest-, or west-facing slopes to maximize solar radiation and shelter from wind (Leong et al. 2004). Suitable grove conditions include temperatures above freezing, high

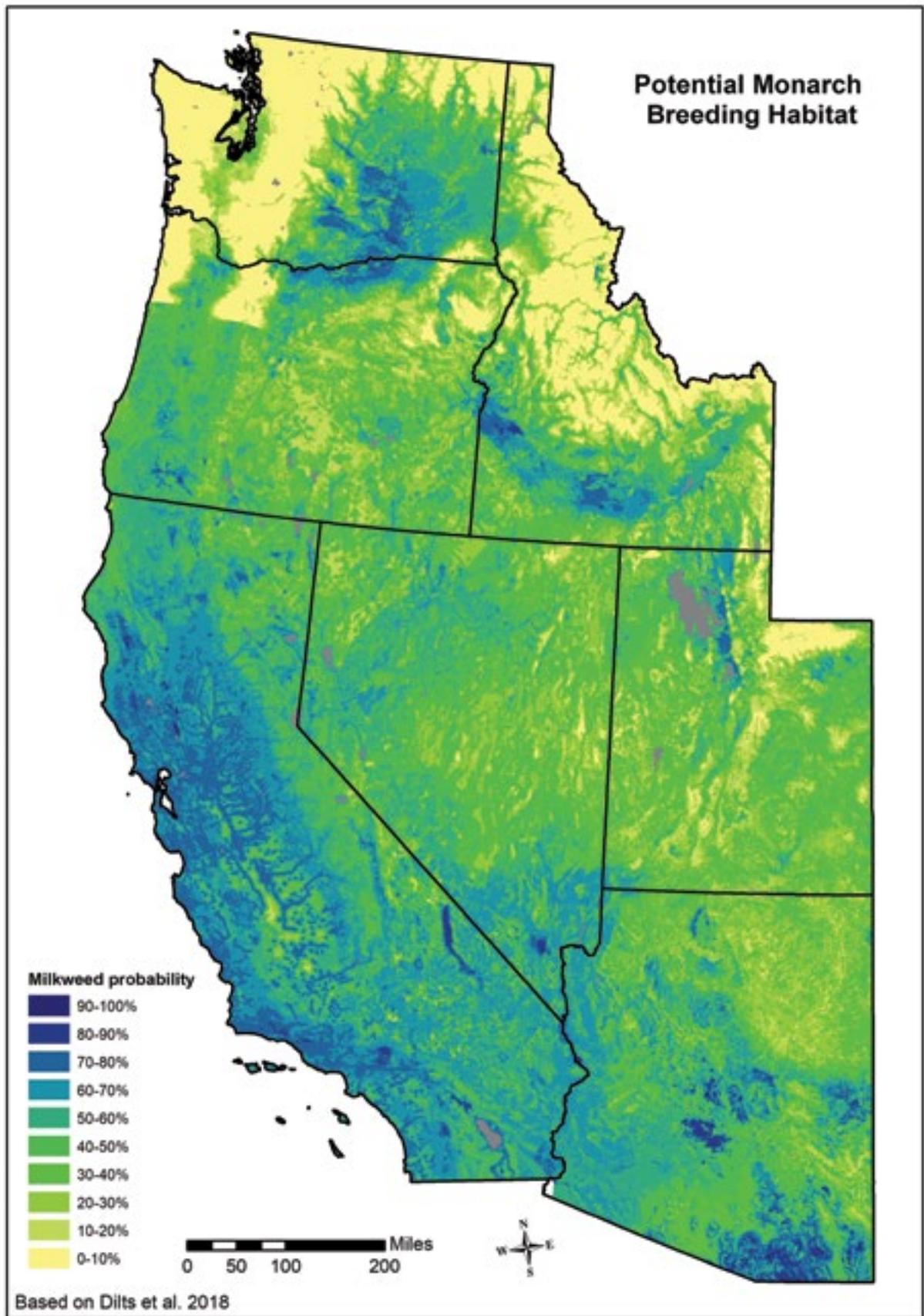


Figure 4. Predicted “all milkweed species” habitat suitability model of the seven western states (Dilts et al. 2018). Given that monarch breeding habitat is delimited by distributions of its obligate milkweed host plants, this map provides a relative measure of potential monarch breeding areas in the West.

humidity, dappled sunlight, access to water and nectar, and protection from high winds and storms.

Although non-native eucalyptus (*Eucalyptus* spp.) trees dominate most coastal California and Baja overwintering sites, monarchs will select the native Monterey pine (*Pinus radiata*), Monterey cypress (*Cupressus macrocarpa*), western sycamore (*Platanus racemosa*), and other native tree species when they are available (Griffiths and Villablanca 2015; Xerces 2018a). In the desert southwest, overwintering aggregations are found near rivers or ephemeral creeks, with Goodding's willow (*Salix gooddingii*) and Fremont's cottonwood (*Populus fremontii*) utilized as roost trees.

2.6. Population Status

Historical data estimates that the California overwintering population size ranged from 1 to 10 million butterflies (Nagano and Lane 1985; Nagano and Freese 1987). Since the 1980s and early 1990s, citizen science monitoring at many of the California overwintering sites documented declining population trends. In 1997, standardized surveys were initiated to estimate the number of overwintering monarchs via the Western Monarch Thanksgiving Count (WMTC). Western monarch overwintering numbers were estimated at 1.2 million this initial year (Pelton et al. 2016). The

2017 WMTC reported 192,000 butterflies from 262 sites (Fig. 5). The population has drastically declined over the last two decades (-75%), despite more sites being monitored compared to the late 1990s. Preliminary results from the 2018 WMTC estimate <30,000 monarchs, representing an 86% decline since 2017. Though overwintering populations fluctuate from year to year, the 2018 preliminary count is concerning given the rapidly declining population trend since the 1980s. A recent population viability analysis of the western monarch population showed that western overwintering monarch numbers have declined by over 95% since the 1980s, placing their historic population size at about 10 million butterflies (Schultz et al. 2017). The authors concluded that current trends suggest a quasi-extinction risk of 72% in 20 years and 86% in 50 years. Additionally, monitoring of monarchs along a west-east transect spanning Northern California for the past 40 years demonstrated that monarch observations during the spring and summer migration and breeding season declined as well (Espeset et al. 2016). A recent threats analysis (Crone et al., *in review*) evaluated the potential importance of changes in land use and climate variables that may be contributing to population declines. Results indicated stronger support for land use change than climate change as a driver of monarch declines in the West.

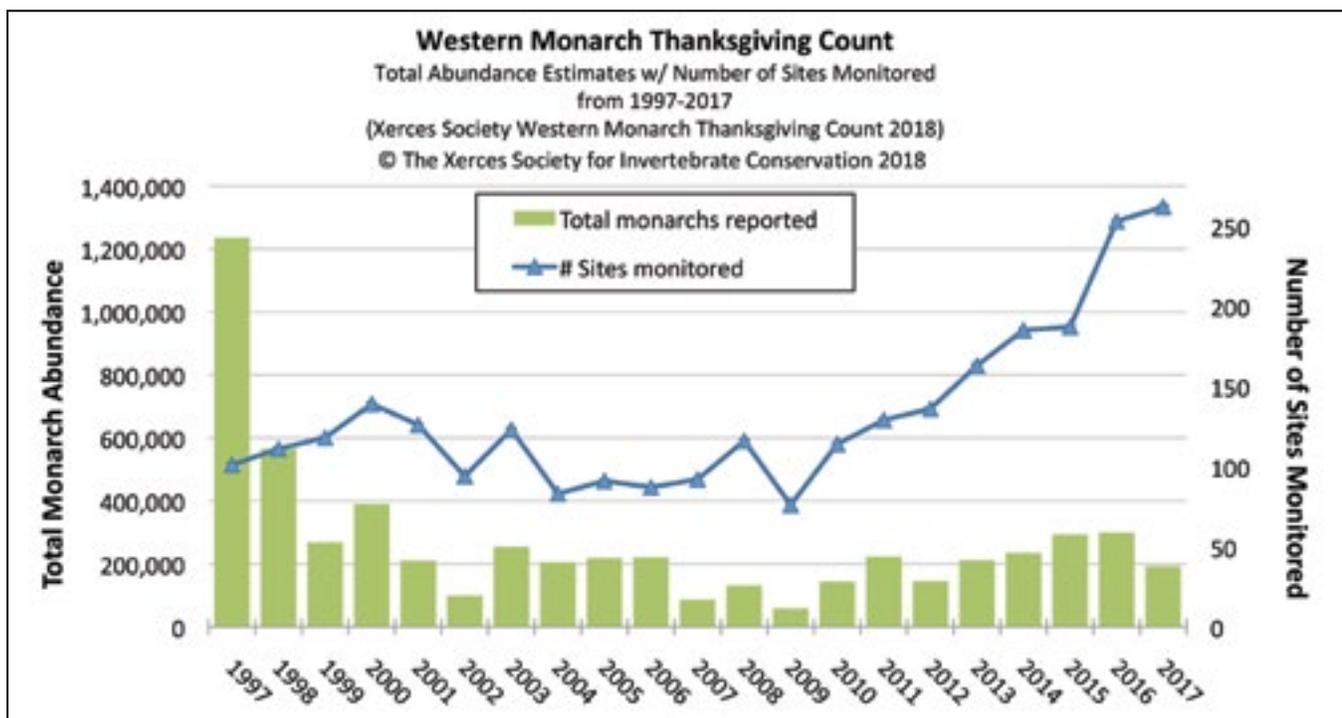


Figure 5. The Xerces Society Western Monarch Thanksgiving Count, 1997–2017. Despite large increases in monitoring effort since 2010, counts reflect only small fluctuations in abundance estimates. Graph courtesy of Xerces Society.



SECTION 3:

Summary of Potential Threat Factors



Edward K. Boggess.

This section describes potential threats that have led to the declining status of the western monarch population. The factors influencing this decline have not been investigated to the degree of the eastern population (Jepsen et al. 2015); however, a threats analysis for western monarchs has recently been completed and is currently *in review* (Crone et al.). Identifying the threats affecting the western monarch population is an essential step to understanding and effectively conserving this imperiled species.

3.1. Loss and Degradation of Overwintering Habitat

Pyle and Monroe (2004) suggested the overwintering stage is the most vulnerable of the monarch's annual cycle, and loss and degradation of California overwintering habitat may be an important driver of western monarch declines (Pelton et al. 2016). Overwintering habitat in coastal areas of California is directly threatened by urban development and, to a lesser extent, agricultural development. Habitat alterations, whether by human activity (tree trimming, cluster tree removal) or as the result of some natural factor (fire, severe storms, drought, disease or senescence of trees) can alter the structure and microclimate of an overwintering site leading to less suitable habitat conditions (Sakai and Calvert 1991; Pelton et al. 2016). Historically, western monarchs overwintered in forested groves along the California coast from Mendocino County south to

Baja California. In 1991, the California Department of Parks and Recreation released a statewide monarch management plan documenting the loss or destruction of 38 of 412 (9%) known overwintering sites. Of these, 16 were lost to housing developments (Sakai and Calvert 1991). Again in the 1990s, 11 additional monarch overwintering sites were lost to housing developments (Meade 1999) and at least eight additional sites were destroyed in the 2000s and 2010s (Pelton et al. 2016; Xerces Society Overwintering Sites Database 2018, unpublished data). An analysis based on data from the Farmland Mapping and Monitoring Program indicated ~50% of area within 500m of overwintering sites was developed by 1982, and are now ~56% developed (Crone et al., *in review*). Overwintering sites in California have mixed ownerships, and therefore variable levels of protection that collectively do not provide consistent or comprehensive protections from development, habitat modification, or monarch collection (Pelton et al. 2016).

3.2. Loss and Degradation of Monarch Breeding and Migratory Habitat

The loss of breeding habitat is a principal driver of decline in the eastern monarch population (Pleasant and Oberhauser 2012; Flockhart et al. 2015; Thogmartin et al. 2017), and whether similar losses at the scale observed in the Midwest have occurred in the West is unclear. The western landscape is ecologically diverse and less

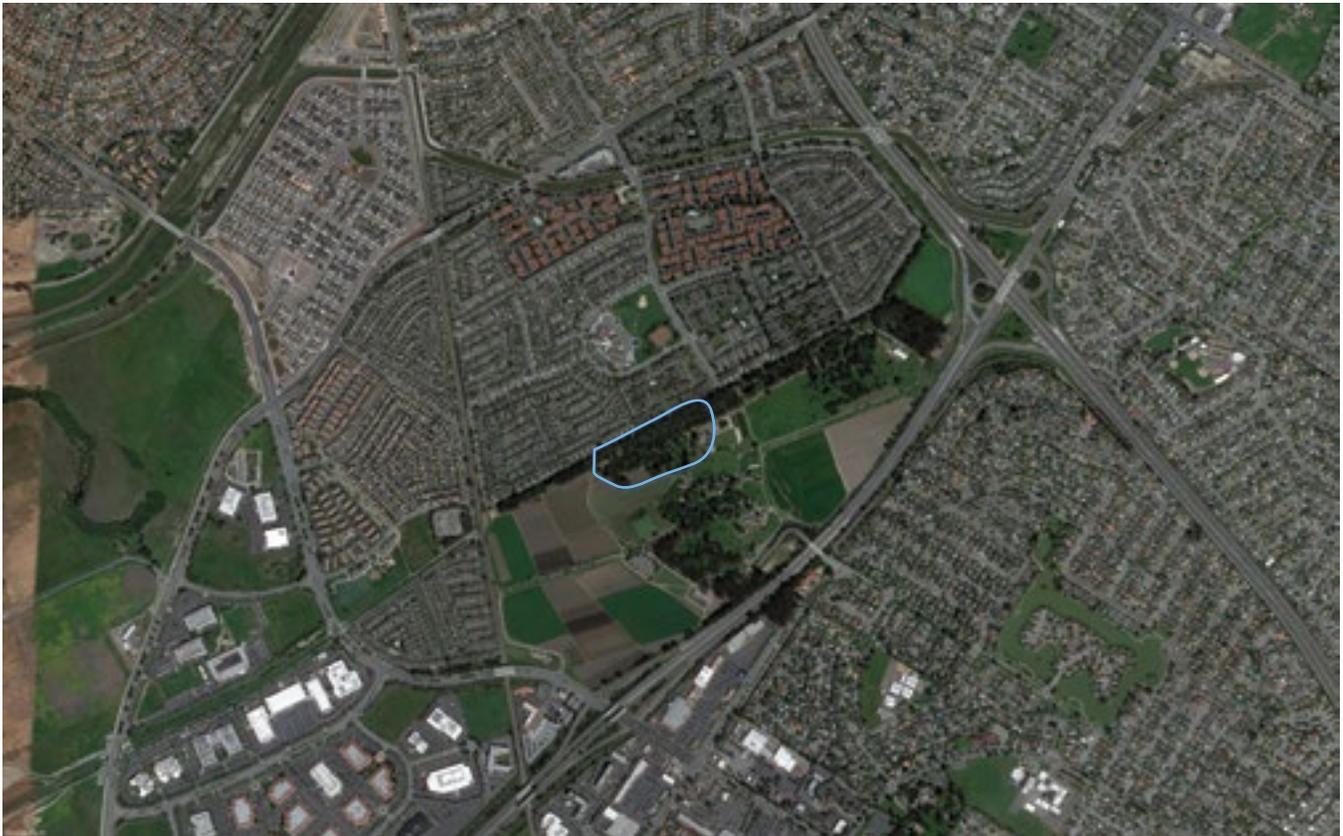
SECTION 3: Summary of Potential Threat Factors

fragmented than the East (owing to large tracts of public land). Thus, gauging the extent of habitat loss in the West at the landscape scale over time is a complex and challenging task (McGarigal et al. 2005). Settlement of the West in the 19th and early 20th centuries established each state's primary agricultural production areas and urban centers, which continue to vitally influence state economies, landscapes, and social/cultural fabrics. Meeting the food needs of burgeoning populations led to the historic conversion of native grasslands, shrub-steppe, and wetlands to agricultural purposes, reducing the extent of milkweed and nectar sources on the landscape.

Urban development is another important factor of monarch breeding habitat loss in the West. Human population in the western region of the continental U.S. grew 161% from 1950 to 1990 and 45% from 1990 to 2015 (U.S. Census Bureau 2017). Western states are growing at an annual rate of 1.66% to 2.03%, more than twice the 0.7% national population growth rate (U.S. Census Bureau 2017). Population growth drives the need for more land to support urban infrastructure such as homes, schools, shopping areas, office building, and roads, converting natural habitat and open space into highly modified landscapes. For example, in California between 1992–2008, about 640,000 net



Population growth drives the conversion of natural areas and open space into highly modified urban environments. Guy Hand.



The Ardenwood Historic Farm monarch overwintering site (outline in blue), Alameda County, California, engulfed by housing developments. Google Earth Pro.

acres of agricultural land were converted to urban or built-up uses (University of California Agricultural Issues Center 2012). Twenty-eight percent was formerly cropland and 34% was grazing land or farmland of local importance. California's Central Valley has seen a loss of approximately 1,054 km² of grassland land cover between 1980 and 2000 (Sleeter 2016). Given the juxtaposition of the Central Valley between coastal overwintering sites and western breeding habitats, further loss of milkweed and nectar resources in this area may be especially detrimental to first spring-generation monarchs.

In many areas of the West, agricultural production centers often intersect with suitable monarch breeding habitats (Fig. 6; Dilts et al. 2018). Depending on the crop or commodity, agricultural practices can impact monarch breeding habitat quality and quantity. While agricultural practices are generally directed by practical management and economics, in many cases they must also address social policy objectives like food safety or water efficiency. In these cases, farmers and ranchers are put in the difficult position of navigating policies (i.e., food safety, monarch conservation) that appear to directly conflict. For example, policies promoting efficient irrigation practices have resulted in water savings through clean farming practices, subsequently reducing milkweed and nectar resources in field margins which may have historically received indirect water. Food safety is a major concern for fresh-produce growers due to public health concerns of *Escherichia coli* contamination. Removal of all non-crop vegetation where food is produced is required to minimize contact with animals known to be carriers of *E. coli*. As the Food Safety Modernization Act is implemented, similar requirements are likely to be expanded to other commodities. These limitations and trends in western agriculture underscore



Industrial agricultural practices often employ herbicides to minimize weedy field edges or understories that may once have provided monarch habitat. Walla Walla/Wikimedia.

the importance of conducting monarch conservation activities where compatible and likely to be most effective.

Data from the USGS Pesticide National Synthesis Project (USGS 2018) shows increasing use of herbicides on agricultural lands in the West, particularly the broad-spectrum, systemic herbicide glyphosate (Fig. 7). Glyphosate use generally corresponds to predicted high-suitability monarch breeding habitat in the West. In California alone in 2016, the number of acres treated with glyphosate, the most commonly applied herbicide, was about 5.6 million (California Department of Pesticide Regulation 2016). An *in review* threats analysis for the western monarch population (Crone et al.) indicated that ~20% of glyphosate use in California is for non-agricultural uses. In Idaho and Washington, herbicide use was frequently observed to control or eradicate milkweed or other nuisance plants on a variety of managed lands, including roadways, railroad rights-of-way (ROW), parking areas, and irrigation ditches/canals (Waterbury and Potter 2018). Herbicide impacts can also extend to nectar plants growing within treated areas and beyond the intended target (Wang and Rautmann 2008; Boutin et al. 2014).



Herbicide practices can contribute to declines in milkweeds and nectar plants available to western monarchs. Beth Waterbury/IDFG

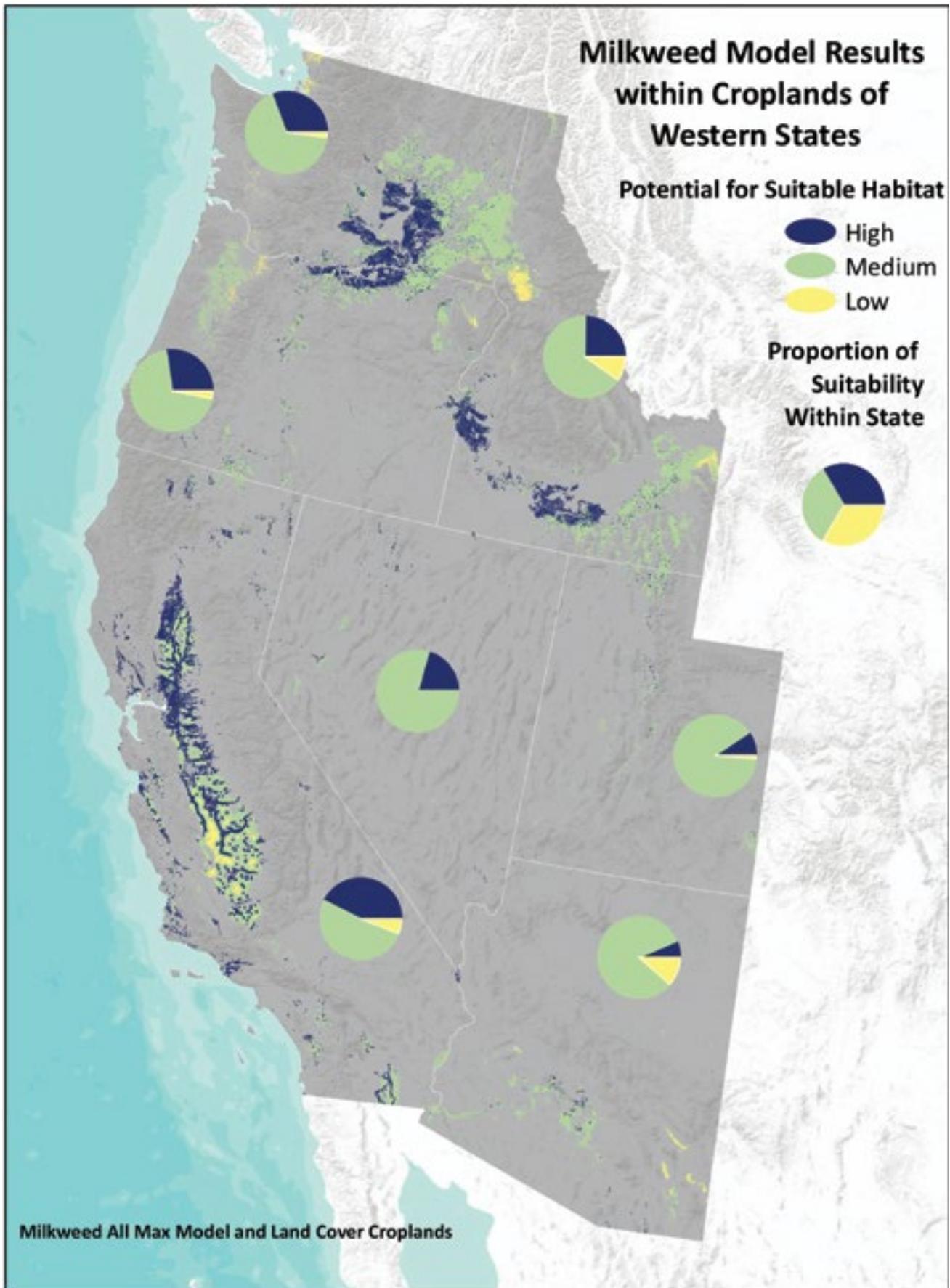
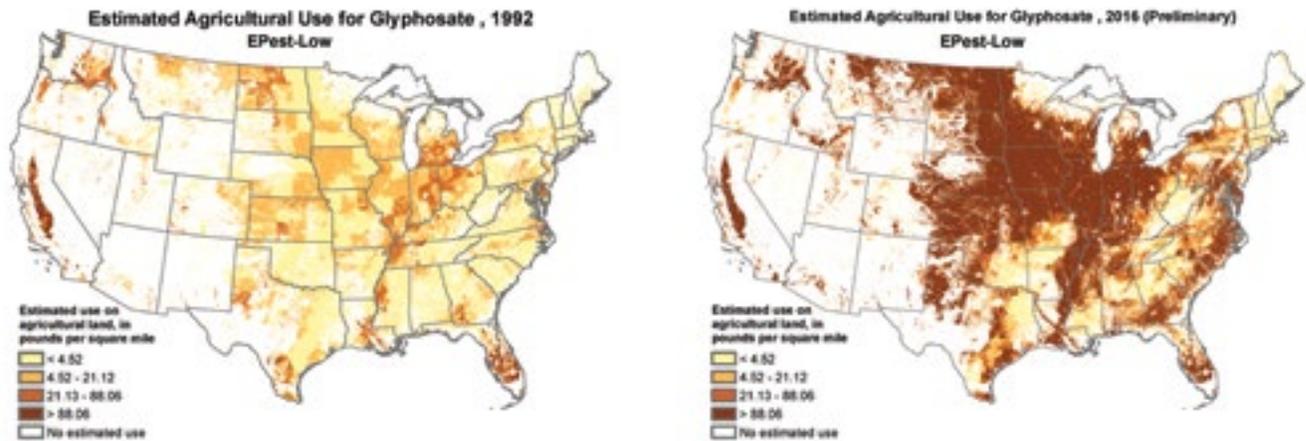


Figure 6. Milkweed model potential for suitable habitat within croplands of the western states and proportion of high, medium, and low milkweed suitability in seven western states. Map produced by CDFW from Dilts et al. (2018).

Figure 7. Increasing glyphosate use on agricultural land in the U.S. in 1992 versus 2016. Data from the USGS Pesticide National Synthesis Project, available from: https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=1995&map=GLYPHOSATE&hilo=H



Other mechanisms potentially influencing loss of monarch breeding and migratory habitat include loss of nectar sources, ostensibly by the same factors affecting milkweed, and widespread drought.

3.3. Insecticides

Insecticides are a category of pesticide formulated to control insect pests. Many commonly used insecticides are broad-spectrum, thus are effective in killing a wide range of insects, including beneficial pollinators. Because monarchs are a highly vagile species, they may be lethally or sublethally exposed to insecticides as they move through or visit urban gardens and parks, farmlands, transportation rights-of-way, and natural areas. Any habitat where monarchs are found may be subject to insecticide use or exposure.

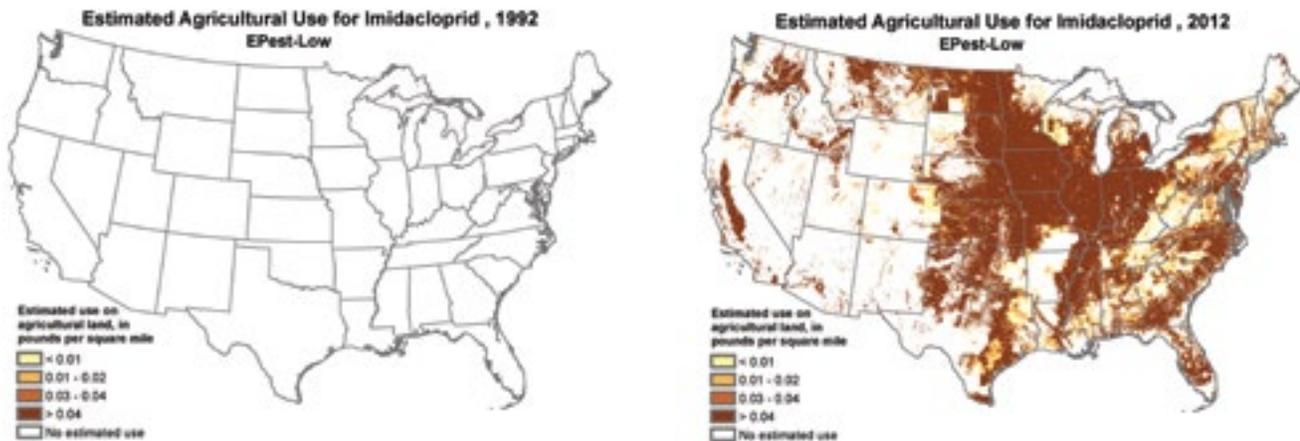
Insecticides are used across a wide range of sectors. Homeowners use insecticides to control pests in yards and gardens or purchase plants from garden centers that sell neonicotinoid-treated ornamentals. Insecticides are frequently employed in forestry to control a variety of seed, foliage, and wood-boring pests. In western rangelands, federal and state agricultural agencies utilize a suite of insecticides to control outbreaks of grasshoppers and crickets over large areas. Vector control districts use insecticides in areas where mosquitoes may spread infectious diseases (i.e., West Nile virus, Zika virus). Insecticides are used by the agricultural sector to reduce crop damage, increase food production, and provide a healthy, safe, and affordable food supply.

The most widely used classes of insecticide include neonicotinoids (Fig. 8), organophosphates, and pyrethroids (EPA 2017). Neonicotinoid insecticides have become the most widely used pesticide class in the world (Goulson 2013; Whitehorn et al. 2018). Neonicotinoid characteristics include high water solubility, systemic transport throughout plant tissues (including pollen and nectar), and a relatively long persistence in the environment. Their low toxicity to vertebrates and systemic plant protection make neonicotinoids appealing for pest control, but cause unintended harm to pollinators. Recent risk assessment studies of neonicotinoid insecticides on monarchs documented sublethal and lethal effects of clothianidin (Pecenká and Lundgren 2015) and imidacloprid (Krischik et al. 2015) on early-instar monarch larvae. These studies indicated neonicotinoids could negatively affect larval monarch populations at seemingly low environmental concentrations and this common agrichemical may be a contributing factor to monarch declines. A recent



Many retail establishments provide advisory labels for plants and seeds treated with neonicotinoids to better inform consumers mindful of pollinator health.

Figure 8. Estimated agricultural use of Imidacloprid, a widely-used neonicotinoid insecticide, in 1992 (left) and 2012 (right). Data from the USGS Pesticide National Synthesis Project, available from: https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2016&map=IMIDACLOPRID&hilo=L&disp=Imidacloprid



threats analysis for western monarchs (Crone et al., *in review*) found a strong negative relationship between neonicotinoid use and western monarch declines.

In many urban and suburban areas across the West, adult and larval mosquito populations are rigorously controlled. Because western monarch breeding and migratory habitat often corresponds to wet areas where mosquitos may occur, mosquito control programs have the potential to impact monarchs. In a monarch breeding habitat study in Idaho and eastern Washington, insecticide application was documented at 21% of milkweed patches where management activity could be identified, and these primarily occurred in areas treated for mosquito control (Waterbury and Potter 2018). Commonly used insecticides for mosquito control (permethrin and resmethrin) cause mortality in monarch larvae and adults when directly exposed to residues of these chemicals on host plants (Oberhauser et al. 2006; Oberhauser et al. 2009).

Grasshopper and cricket suppression programs on federal, state, and private rangelands utilize liquid (spray) and solid (bait) applications depending on timing, location, and intensity of irruptions. Broad-spectrum insecticides are typically used (chlorantraniliprole, malathion, carbaryl), some of which have the potential to produce adverse effects in Lepidoptera, pollinators, beneficial insects, and other non-target terrestrial insect species (EPA 2008).

In addition to these widely used insecticides, various strains of the naturally-occurring soil microbe

Bacillus thuringiensis (*Bt*) are available for application on agricultural, ornamental, and forestry plants to control beetle, butterfly, and moth larvae. Scientific investigations on the sublethal effects of *Bt* on monarchs are lacking.

Insecticides are just one facet of crop protection tools available to growers. Today's farmers combine digital tools, precision application tools, and targeted pesticide solutions as part of Integrated Pest Management (IPM), a well-established farming approach that can minimize pesticide use and maximize grower efficiency, sustainability, and cost savings while reducing risk to pollinators and decreasing pest resistance from repetitive pesticide use. As noted in Section 3.2, to the extent the use of certain insecticides may be detrimental to monarchs, emphasis should be placed on developing scientific understanding of the risks of agrochemicals and how to minimize any such risk while also ensuring growers have adequate crop protection tools available. Furthermore, managing monarch exposure to insecticides means managing risk, and risk management would suggest monarch conservation activities be located in landscapes where compatible and likely to be most effective.

3.4. Climate Change

Climate change over the recent decades has already influenced some pollinator species to shift ranges, seasonal activities, and/or abundance patterns, both positively and negatively (IPBES 2016). Similarly, current habitat used by breeding, migrating, and

overwintering monarchs may be lost and shifts in seasonal movement patterns may occur as monarchs search out new suitable habitats (Batalden et al. 2007; Lemoine 2015; Fisher et al. 2018; Malcolm 2018).

Models for climate change predict an increase in summer (July) maximum temperatures ranging from 3° F to 9° F across the U.S. by mid-century (2050–2074) under a severe emission scenario (RCP8.5) (Alder and Hostetler 2013). This increase in temperature may cause a northward shift in some milkweed species and cause others to become less nutritious or dieback in the summer. Either scenario may result in loss of currently occupied habitat and/or longer migration distances in the fall (Batalden et al. 2007; Lemoine 2015). Predicted longer migration distances would likely have greater impact to the eastern population, as migration distances of the western population are considerably shorter. Also plausible is that longer migration distances as mediated by climate change may result in lower parasite risk (see Section 3.5.1) given the positive association between longer migration distance and lower disease load (Altizer and de Roode 2015). Altered temperatures regimes in combination with altered phenologies of milkweeds and presence of non-native milkweeds may affect the physiology and dynamics of monarch migration (Malcolm 2018). James (2016) noted monarch eggs and larvae experience poor survival at temperatures above 100° F, and heatwaves of similarly high temperatures are becoming increasingly common in the Columbia River Plateau of Washington. Espeset et al. (2016) attributed a decline in western monarch populations in California to changing climatic conditions and resulting declines in milkweed. Similarly, in eastern populations, Thogmartin et al. (2017) identified increased breeding season temperature as a threat to monarchs.

A model predicting climate change scenarios for Santa Barbara County, California overwintering sites suggested that climate change will result in an inland and upslope displacement of suitable overwintering conditions (Fisher et al. 2018). Under plausible and extreme scenarios, respectively, overwintering habitat is predicted to occur away from coastal regions to higher elevation sites, or will be located along ridgelines and mountaintop regions of the county. Implications of this predicted shift include possible centralization of overwintering populations into fewer microsites similar to the highlands of Mexico, need for new habitat suitability models for fire-prone coastal areas, and greater challenges locating and monitoring

cluster sites as suitable habitat increases (Fisher et al. 2018). Droughts, which have already been identified as a primary contributing factor in the decline of the western monarch population (Stevens and Frey 2004; Stevens and Frey 2010), are likely to become more frequent and intense with reduced water availability across much of temperate western North America by 2050 (IPCC 2013; USGCRP 2017). Moisture regimes, as measured by Palmer's drought severity index, act as a strong bottom-up driver of monarch population dynamics. Drought reduces the abundance and quality of milkweed leading to lower monarch populations. Besides reducing germination, survivorship, growth, and seed production in milkweed plants, reduced water availability can cause the latex within milkweed plants to become more viscous and less palatable for developing monarch larvae (as reviewed in Stevens and Frey 2010; Malcolm 2018). Nectar plants are also negatively impacted by drought as reduced rainfall and soil moisture can decrease a plant's ability to produce nectar in the short-term or to survive in the long-term (Xerces 2018).

Increased frequency of severe weather events is expected with climate change and could threaten monarchs concentrated at small overwintering sites (Brower et al. 2012; Pelton et al. 2018). Added and exacerbating stressors of increased human development, cluster tree senescence from drought and disease, and poor silvicultural practices would reduce the buffering effects of tree groves, thereby reducing site suitability for monarchs (Brower et al. 2011; Griffiths and Villablanca 2015; Pelton et al. 2016).

3.5. Disease and Predation

3.5.1. Disease

Monarchs, like most insects, are affected by disease and predation throughout their life cycle. Both phenomena are normal and natural occurrences, however, due to rapid population declines and multiple stressors across their range, these threat factors are amplified and could quickly rise to population-level threats putting the monarch at risk of extinction.

Many disease-causing pathogens are known to attack monarch butterflies, including the protozoan parasite *Ophryocystis elektroscirrha* (OE), the microsporidian *Nosema* spp., and other viral and bacterial pathogens (McLaughlin and Myers 2007). These protozoan



The protozoan parasite OE can cause wing deformities resulting in impaired adult flight ability. Beth Waterbury/IDFG.



A monarch pupa succumbs to *Pseudomonas* bacteria, a ubiquitous pathogen found in water, soil, plants, and animals. Beth Waterbury/IDFG.

microbes can have debilitating effects on survival, mass, fecundity, mobility, and life span of monarchs.

Prevalence of OE in North American wild monarch populations varies from $\leq 10\%$ in the eastern population to 5–30% in the western population (Altizer and de Roode 2015), with parasite risk diminishing with greater migration distance. Migration allows monarch butterflies to escape OE-contaminated habitat and facilitates migratory culling of infected individuals (Satterfield et al. 2018). Resident populations do not undergo these processes and, as a result, may carry higher parasite loads and pose transmission risks to migrants. OE is spread by spores deposited onto milkweed host plants and monarch eggs by infected females. Newly hatched larvae ingest spores, which move into the caterpillar's

gut and then release the parasite. High levels of OE can decrease the survivorship of larvae, decrease wing size, cause wing deformities, impair eclosure, decrease lifetime reproductive fertility, shorten monarch lifespans, and may result in direct mortality (Altizer and Oberhauser 1999; Bradley and Altizer 2005; de Roode et al. 2009).

OE is of high concern where non-native tropical milkweed (*Asclepias curassavica*) is cultivated. Tropical milkweed is widespread and abundant in Florida and southern California, both of which host non-migratory populations of monarchs with high OE burdens. Tropical milkweed does not senesce in fall like most native milkweeds, and can provide food year-round for larval monarchs in warm climates (Satterfield et al. 2016). Year-round breeding sites can induce monarchs to break reproductive diapause, thereby interrupt migration or reduce its success (Satterfield et al. 2018). Alternately, tropical milkweed sites can disproportionately attract OE-infected and reproductively-active migrants, thereby reinfesting their offspring (Satterfield et al. 2018). Either interaction increases the likelihood of debilitating infection of OE in monarchs, leading to higher risk of mortality and reduced reproductive and migratory success.

3.5.2. Predation

Monarchs are very vulnerable in the egg and larval stages and relatively few monarchs reach the adult stage. Based on studies of the eastern population, only 8–12% of monarch eggs survive through metamorphosis (Oberhauser et al. 2001; Prysby 2004), which infers a large population size is needed to maintain population growth. Demographic vital rates, such as fecundity and survival, have not yet been investigated in the western monarch population and may differ from those of the eastern population.

Monarchs incur mortality from a wide variety of predators and parasitoids throughout their life cycle. Monarch eggs and larvae are preyed upon by ants, spiders, true bugs, beetles, and lacewing larvae, while adults are consumed by spiders, lacewings, mantids, yellow jacket wasps, and assassin bugs. Avian predators of monarch adults documented at California overwintering sites include Steller's jay, western scrub-jay, chestnut-backed chickadee, spotted towhee, hermit thrush, and European starling. Eastern fox squirrel is a primary mammalian predator of monarchs reported



A mantid preying on an adult monarch butterfly, Cowiche Canyon Conservancy, Yakima, Washington. Kathy Gregory.



A fifth instar monarch caterpillar with telltale sign of tachinid fly parasitism. Tachinid fly larvae produce a gelatinous filament (seen protruding from the caterpillar) allowing them to drop to the ground. Beth Waterbury/IDFG.

for California overwintering sites. Tachinid fly and wasp parasitoids are responsible for high rates (13%) of parasitism in monarch larvae from the eastern population (Oberhauser 2012); however, parasitoid impacts to the western monarch population are largely unknown. A new threat to the western population is the red imported fire ant (*Solenopsis invicta*), a voracious predator of arthropods. Found throughout the Southeast and Texas, fire ants continue to spread north and west, and now occur in southern California, Arizona, and New Mexico (Korzukhin et al. 2001). The species has the potential to spread as far north as Washington State, although the species is somewhat limited by cold temperatures and dry conditions (Allen et al. 1995; Vinson 1997). Fire ants in Texas have been reported to cause 100% mortality of monarch eggs and larvae (Calvert 1996).

3.6 Other Factors

3.6.1 Wildfire

Wildfire is a concern across all monarch habitats in the West. Fire will not only remove nectar, floral, and roosting resources from the landscape but may directly kill monarchs in all stages of their life cycle. However, there is evidence that fire can stimulate the growth of nectar plants and host plant availability and can have beneficial effects for many butterfly and pollinator species depending on the intensity, timing, and patchiness of the fire (see Xerces 2018). In the western monarch range, there is a paucity of research on potential positive or negative effects of prescribed fire for monarchs and natal habitats. Prescribed fire is recognized as an important management tool in western fire-adapted ecosystems to maintain open plant communities (grasslands, prairies) through suppression of conifer and woody vegetation encroachment (Schultz and Crone 1998; Hamman et al. 2011).

Wildfire is a pervasive threat to overwintering sites. Many sites are located in high fire-risk areas where fire starts could easily ignite decadent trees and dense undergrowth. In November 2018, the Woolsey Fire burned at least four overwintering sites in Ventura and Los Angeles counties (Emma Pelton, Xerces Society, pers. comm.). The Woolsey Fire was unprecedented in its speed, destruction, and massive footprint (100,000 acres). Climate change-mediated drought is expected to increase wildfire frequency and size in western habitats. As a result, public policy will encourage “fire-wise” programs in wildland-urban interface areas to promote vegetation removal within “home ignition zones” to reduce threat of wildfire to homes and communities. Applied research investigating compatibility of fire-wise best management practices (BMP) with overwintering site habitat requirements would provide timely and proactive recommendations for vegetation management.

Anecdotal accounts suggest that wildfire smoke may alter migration of western monarchs in fall and potentially reduce the number of monarchs arriving at overwintering sites. With fall fires increasing in size, frequency, and severity in the West, smoke may be an additive stressor to western monarchs (Pelton et al. 2018).

Climate change may produce larger and more frequent wildfires in the West such as the Woolsey Fire depicted in this satellite image from November 9, 2018. NASA World View.



3.6.2. Mortality at Concentrated Solar Facilities

Solar energy facilities, also known as “Solar Electric Generating Systems” concentrate sunlight with the use of lenses or mirrors and tracking systems, then use the resulting heat to generate electricity from conventional steam-driven turbines. This type of structural arrangement can create a focal point of solar flux with temperatures reaching 800 °F. Studies conducted at solar energy facilities in Southern California showed significant insect mortality, including monarchs. Apparently, insects were attracted to bright light surrounding the boiler at the top of the tower, but actual cause of death of these insects was not clear in the research presented. Reports indicated some singed carcasses, but other insects “seem to have just fallen from the sky.” The authors also noted that insects flying around the tower attracted many insect-eating birds, which were then incapacitated by solar flux injury, falling to the ground (Kagan et al. 2014). These facilities should not be confused with small solar farms, usually found in agricultural or lightly populated areas; or solar panels (single or small arrays) usually found on rooftops in urban areas. There have been no reports of these smaller scale solar arrangements harming insects (monarchs included) and solar farms can provide additional pollinator habitat if identified as an objective of the site plan.

3.6.3. Overutilization for Commercial, Recreational, Educational, or Scientific Purposes

While overutilization of monarch butterflies is likely not a significant risk to their overall population, there are serious concerns about negative effects of captive rearing and release of monarchs on wild monarch populations given their already declining numbers. These concerns include increased disease transmission (e.g., OE) to wild monarch populations, loss of genetic diversity, artificially inflating local monarch populations, and interference with scientific investigation of wild monarch distributions, movement, and population dynamics (Altizer et al. 2014; Young-Isebrand et al. 2015). Limited captive rearing and release of monarchs is recognized as a valuable tool in scientific study and to engage educators and citizen scientists in monarch conservation, however, rearing and releasing monarchs on a large scale is not considered an effective strategy for monarch conservation (Xerces 2018). In 2015, a group of monarch researchers and conservationists from across the U.S. issued a joint statement regarding captive breeding and releasing of monarchs available here: https://monarchlab.org/images/uploads/attachments/Captive_Breeding_and_Releasing_Monarchs_oct2015.pdf.



SECTION 4: Current Conservation Efforts



A white-lined sphinx moth (*Hyles lineata*) and monarch butterfly nectar on showy milkweed. Tom Koerner/USFWS.

4.1. Federal Efforts

On June 20, 2014, President Obama issued a Presidential memorandum entitled *Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators* (Strategy) in response to significant declines in pollinators from the environment. The Strategy (Pollinator Health Task Force 2015), lays out current and planned federal actions to achieve its overarching goals for honey bees, monarch butterflies, and pollinator habitat in general. The Strategy also directed federal entities to increase and improve pollinator habitat and for the U.S. Department of Agriculture (USDA) and Department of the Interior (DOI) to develop BMPs emphasizing pollinator needs in managing for diverse native plant communities. These BMPs were provided in 2015 and federal land management agencies have since been working on pollinator conservation. Federal agencies have researched and collected data for pollinator enhancement work for the last 30 years. Given more

time, federal agencies can further extrapolate from the past data and develop more specific acreage numbers for habitat improvement work on the ground.

USFWS — USFWS became a leading agency for monarch butterfly conservation in 2014. The agency committed \$4 million per year for five years to implement a Monarch Butterfly Conservation Initiative. Of the \$4M per year, \$1.2M was dedicated to the National Fish and Wildlife Foundation Monarch Conservation Fund which leverages multiple funding sources to cost-share on projects that benefit monarchs and other pollinators. However, the current administration declined to fund the final two years. Over the last four years in the western U.S., USFWS has been focused on gathering information to fill data gaps about monarchs west of the Rocky Mountains. This scientific approach was intended to assist partners across the West in targeting conservation efforts in a strategic way.

SECTION 4: Current Conservation Efforts

Partners are now better informed to implement habitat restoration, enhancement, and protection projects for monarchs and pollinators. USFWS and partners initiated the following projects (and many others not listed) over the last four years to address priority information needs (see list below).

USFWS has worked on two large-scale significant efforts to provide predictability to private landowners in the event that the monarch butterfly is listed under the ESA. The first effort is a Conference Report with Natural

Resource Conservation Service (NRCS) and USFWS, which established a process of regulatory assurances for landowners to protect, restore, and enhance monarch habitat in 10 Midwestern states. The second effort is national in scope and is nearing completion (Spring 2019): a Candidate Conservation Agreement with Assurances (CCAA) for energy and transportation rights-of-ways (ROW). The CCAA will ensure ROW entities that are conducting beneficial actions on their lands for monarchs have regulatory predictability in the event that the species is listed. There are multiple tools under the

USFWS Project	Project Partners
Western Monarch and Milkweed Habitat Suitability Assessment and Modeling	USFWS, Xerces Society, University of Nevada-Reno
Formation of the Western Monarch Conservation Science Team	Led by Xerces Society and USFWS
Population Viability Assessment	Washington State University-Vancouver, Tufts University, Xerces Society, USFWS
Addition of the New Years' Count for overwintering monarchs (part of Western Monarch Thanksgiving Count annual volunteer effort)	Xerces Society and citizen scientists
Xerces Society's State of the Overwintering Sites in California report (Pelton et al. 2016)	Xerces Society with support from partners, including USFWS
Completion and implementation of two overwintering grove land management plans with one other in progress	Xerces Society, California State Parks, and USFWS
Xerces Society's Managing for Monarchs in the West (Xerces 2018)	Xerces Society
Protecting California's Butterfly Groves (Xerces 2017)	Xerces Society
Western Monarch Butterfly Threats Analysis (in review)	Washington State University-Vancouver, Tufts University, funded by USFWS
Breeding Phenology and Demography Project primarily funded by Department of Defense Legacy Program	Washington State University-Vancouver, Xerces Society, DoD, some funding from USFWS
Overwintering Habitat Selection Study beginning Fall 2018	Cal Poly-San Luis Obispo, USFWS, and private donor funds
Habitat Restoration Quick Guide for Agricultural Producers (in development)	Xerces Society, funded by USFWS
Western Monarch Milkweed Mapper website	Xerces Society, IDFG, WDFW, NFWF, USFWS
Milkweed and Monarch Distributions and Breeding Ecology in Idaho and Washington	IDFG, WDFW, Xerces Society, partially funded by USFWS (State Wildlife Grant)

ESA to give regulatory flexibility and predictability to landowners willing to implement voluntary conservation actions on their land. Tools include CCAAs, Safe Harbor Agreements, and conservation banks.

The USFWS National Wildlife Refuge System continues to identify and implement opportunities to create, restore, and enhance monarch habitat on USFWS-owned and -managed lands (National Wildlife Refuges, Waterfowl Production Areas, conservation easements) using existing programs and incorporating BMPs. On other federally-owned and -managed lands, BMPs and guidance for incorporating pollinator conservation will be developed and implemented for grassland, rangeland, and riparian systems in the West. New treatments will include restoration using seed mixes with a high diversity of nectar plants and milkweed species.

USDA Forest Service (USFS) — USFS has committed to improving or maintaining 300,000 acres of pollinator habitat annually across all National Forest lands and has done so in fiscal years 2015-17. Specific agency actions include but are not limited to overstory thinning (e.g., increasing understory irradiance and subsequent plant diversity and nectar sources for 3–5 years), prescribed burning, and mechanical treatments to reduce woody components in mid-stories and understories, thereby increasing ground flora diversity and native seed production. Practices can include seeding or planting areas with native forbs and grasses, employing roadside maintenance BMPs to maintain or increase nectar sources for pollinators, early successional habitat management (e.g., mowing, grazing), invasive species treatments, installation and maintenance of pollinator gardens, and public education and outreach. In the western regions, USFS has been actively contributing to creating and improving monarch and pollinator habitat while restoring ecosystem function, composition, and structure to promote native plant diversity.

- In collaboration with Monarch Joint Venture, a 1,000 ft² pollinator garden was installed at the Almanor Ranger Station of Lassen National Forest. Approximately 200 ft² of this garden is devoted to monarchs and other butterflies.
- An interpretive, pollinator-friendly xeriscape project was initiated in 2015 at the Chuchupate Ranger Station of Los Padres National Forest, also with partner Monarch Joint Venture. The planning phase

is complete and the project is proceeding to the planting phase.

Bureau of Land Management (BLM) — BLM and USFS have increased the pace and scale of ecosystem restoration on forested lands, rangelands, and grasslands, which will continue to provide additional habitat for monarchs and pollinators in general. Resource management plans are currently being revised that will reflect this direction. The agencies are also looking for opportunities to increase native seed production regionally for greater use on public lands and to build capacity for partners. USFS and BLM are collaborating with NRCS, The Nature Conservancy, universities, and Chicago Botanic Garden (Seeds for Success program) to develop a variety of opportunities to create genetically appropriate seed sources for milkweed and other nectar plants. In addition, National Seed Labs, seed orchards, and nurseries are all involved in this effort. Contracts with seed producers allow federal agencies to more efficiently collect and produce seed at an increased scale. Given more time, federal agencies can further extrapolate from the past data and develop more specific acreage numbers for habitat improvement work on the ground.

Natural Resources Conservation Service (NRCS) — NRCS, through the USDA, provides farmers, ranchers, and other landowners with the financial and technical assistance to voluntarily put conservation on the ground. Collaborative efforts, such as the Monarch Butterfly Conference Report prepared in 2016, serve as good examples of landscape level partnerships entered into with USFWS and other interested partners (farmers and ranchers) in the Midwest region for the eastern monarch population. Preparation of a Conference Report is recommended when a proposed federal action may affect a proposed candidate species and can provide ESA predictability (long-term, in this case up to 30 years) and clarity that the action will be in compliance with the ESA if and when the monarch butterfly is listed. This process is designed to assist the federal agency in identifying and resolving potential conflicts at an early stage in the planning process. The report contains the USFWS's analysis of all effects (adverse, benign, or beneficial) that are likely to result from the implementation of the proposed action. The proposed actions outlined are for the establishment and enhancement of monarch habitat, mainly through planting milkweed and nectaring forbs in wetlands and marginal agricultural lands. The proposed actions have



The NRCS Plant Materials Center in Aberdeen, Idaho conducts seeding trials to determine best planting methods for establishing showy milkweed. Klamath-Siskiyou Native Seeds.

the potential for modification, depending on the results of continuing research and monitoring results.

National Park Service (NPS) — NPS manages a varied range of monarch and pollinator habitat and continues to be committed to implementing the Strategy. NPS is unique in that it manages overwintering, nectaring, and breeding habitat for the western population. NPS has been active in promoting milkweed cultivation in Arizona and many western park units operate native plant nurseries to propagate plants locally adapted for the area. NPS collaborates with the Southwest Monarch Study to conduct public outreach and citizen science in Arizona and Utah to gain a better understanding of monarch habitat use and movement in these areas. NPS also collaborates with Xerces Society to conduct overwintering population counts of those colonies that reside on NPS lands in California.

U.S. Department of Defense (DoD) — DoD manages its land to provide habitat for many native plant communities and pollinator species, including monarch butterflies. Through the Integrated Natural Resources Management Plan process, DoD creates, enhances, and maintains diverse natural plant communities as integral parts of the training landscape. Native plants not only make up the realistic testing and training landscape on which warfighters depend, but they are resilient to impacts from DoD activities and other stresses such as drought and invasive species. DoD has been involved in promoting pollinators and pollinator habitat conservation on its lands for 15 years. DoD is funding several pollinator projects at the installation level to proactively conserve and protect monarchs and

other key pollinators and their habitats. This is part of their effort to minimize future military operational impacts in the event the monarch becomes an ESA-listed species. DoD Legacy Resource Management Program (Legacy), which funds high priority natural and cultural resource management projects, has competitively awarded several monarch and general pollinator projects. Recently, Legacy funded a wide-ranging project to monitor monarch populations across five installations west of the Rocky Mountains. Legacy has also funded pollinator projects through its participation in National Public Lands Day, which is the nation's largest single-day volunteer effort for public lands. On military installations, volunteers have helped complete monarch and pollinator related projects, including public and interpretive gardens featuring milkweed and other monarch-preferred plants that promote pollinator protection and awareness. A list of projects and other DoD pollinator resources is available at <http://www.dodpollinators.org>. Through the National Military Fish and Wildlife Association, DoD also maintains a chartered pollinator protection working group with participating members on an active listserv.

U.S. Army Corps of Engineers (Corps) — The Corps is actively incorporating conservation practices for pollinator habitat improvement on its 12 million acres of managed lands and waters across the country. Specifically, the Corps is working with partners to promote education and awareness, and implement management practices that provide for improved butterfly, bee, and pollinator populations and habitat. The Corps has and will continue to seek opportunities for habitat improvements specific to monarch butterflies. The Corps, in coordination with partners, continues to implement habitat improvement projects in recognized zones of importance for the monarch butterfly. In addition to butterfly-specific conservation, the Corps supports the utilization of BMPs to include thinning and understory shrub control; removing invasive species to improve pollinator habitat; promoting native plant communities along forest roads for pollinators; and seeding native forb species at restoration sites, rehabilitation, and revegetation efforts.

National Fish and Wildlife Foundation (NFWF) — NFWF awards grants to private and public sectors engaged in creating and sustaining interconnected monarch and pollinator habitats to support annual life cycle needs. Since 2015, NFWF has awarded grants to

the USFS to conserve, restore and monitor restoration success of occupied and suitable western monarch habitat on the San Bernardino National Forest.

4.2. State Efforts

In 2015, the Threatened and Endangered Species Policy Committee of AFWA commissioned a report to summarize state wildlife agency efforts to conserve populations of the monarch butterfly (AFWA 2015). While 45 states and the District of Columbia reported some level of engagement in monarch butterfly conservation efforts, several western states indicated they either lacked explicit management authority over butterflies or they were generally not engaged in monarch-focused efforts. Western states did recognize that their existing land management activities promoting maintenance and expansion of native plant biodiversity likely benefitted monarchs as well. Some western states indicated that the monarch was or would be evaluated for inclusion in SWAPs (see State Authorities above). Updated information for each of the seven western states participating in this Plan is described below.

Arizona — Monarch and pollinator conservation efforts are underway by Arizona state agencies including, but not limited to, Arizona Game and Fish Department (AGFD), Arizona State Parks (State Parks), Arizona Department of Transportation (ADOT), and the Arizona Department of Agriculture (AZDA). AGFD and State Parks are planning monarch and pollinator habitat development and enhancement projects in many State Wildlife Areas and State Parks throughout the state. The Arizona Department of Transportation (ADOT) has used diverse native-only seed mixes for revegetation for over 20 years, providing nectar sources along the highway system throughout the state. ADOT recently updated their roadside vegetation management guidelines to include recommendations on reduced mowing and seasonal mowing strategies to promote flowering species on the roadside. ADOT is a member of the core team developing the Nationwide CCAA for Monarch Butterfly on Energy and Transportation Lands, which is described further below.

AZDA has a vested interest in sustaining agriculture and pollinators. In 2016, AZDA published the *Arizona Management Plan for the Protection of Pollinators*, which is designed to help citizens consider BMPs to ensure abundant, affordable, safe, nutritious, and sustainable



A mix of *Asclepias subverticillata*, fields of nectar-rich sunflowers, and nearby trees for night roosts all in proximity to the Little Colorado River make for ideal monarch habitat at Wenima Wildlife Area in Springerville, Arizona. Southwest Monarch Study.

food production. AZDA plans to reestablish a Bee Advisory Council to provide a forum for issues relating to bees, other pollinators, and pesticides, and to help improve bee and other pollinator health by finding practical solutions for all stakeholders. Though AZDA does not work with butterflies per se, its Plant Services Division provides a state-approved list to the USDA Animal Plant Health Inspection Service, Plant Protection and Quarantine office (PPQ) for butterflies allowed into Arizona from out-of-state suppliers seeking federal permits. The Permits Unit at PPQ pre-emptively denies permit requests for butterfly species objectionable to Arizona.

California — In 2015, California enacted a law (AB 559, Lopez) authorizing the California Department of Fish and Wildlife (CDFW) to take feasible actions to conserve monarch butterflies and the unique habitats they depend upon for successful migration. These actions may include, but are not limited to, habitat restoration on CDFW lands, education programs, and voluntary agreements with private landowners. It also authorizes CDFW to partner with federal agencies, non-profit organizations, academic programs, private landowners, and other entities that undertake actions to conserve monarch butterflies and aid their successful migration. Targeting California's Central Valley, CDFW is evaluating its Wildlife Areas for milkweed and nectar resource enhancement needs for implementation as part of ongoing habitat management for wildlife. In addition, CDFW biologists and participating private landowners are incorporating pollinator and monarch BMPs in cooperatively-prepared wetland management plans as

part of the California Waterfowl Habitat Program, a cost-share and incentives program.

California State Parks protects and manages biological resources in over 270 parks statewide to maximize native biodiversity in all habitat management activities, including 25% of the priority monarch overwintering sites. Specific grove management plans are being prepared or updated for several of the highest priority sites to incorporate the latest information regarding microclimate characteristics and appropriate silvicultural practices.

In 2018, the California Department of Pesticide Regulations (CDPR) published a California Management Plan for the Protection of Pollinators (CDPR 2018). While the plan focuses on “managed pollinators,” many of the strategies to mitigate the risk of pesticides to managed pollinators are expected to reduce risk to native bees and other pollinators as well. CDPR also sponsors symposia and established work groups to foster communication, cooperation, and collaboration among beekeepers, growers, pest control advisers, pesticide applicators, and regulators when pest management decisions are being made.

California Department of Transportation (Caltrans) biologists generally account for the monarch when the species is present, such as by recommending avoidance and minimization measures or incorporating milkweed into revegetation plans. Additionally, Caltrans

is updating some of its roadside planting guidance to include ecoregional-specific pollinator-friendly plants, including milkweed, and is participating in the Nationwide CCAA.

Assemblymember Mark Stone (D-Monterey Bay) introduced legislation to establish the Monarch and Pollinator Rescue Program (MPRP) at the Wildlife Conservation Board, and it was enacted in September 2018 with \$3 million appropriated in the current year’s budget. MPRP will provide grants and technical assistance to applicants to restore monarch habitat (breeding and overwintering) in an effort to recover and sustain populations of monarchs and other pollinators throughout the state.

Idaho — Beginning in 2015, Idaho Department of Fish and Game (IDFG) engaged in multiple efforts to address information gaps on the distribution and status of the monarch butterfly and its key breeding habitats in Idaho. In 2015–2018, IDFG collaborated with Washington Department of Fish and Wildlife and Xerces Society on a USFWS-funded State Wildlife Grant to assess the monarch for inclusion as a SGCN in respective SWAPs, present monarch workshops to key constituencies, develop and launch the Western Monarch Milkweed Mapper, and conduct surveys to establish baseline distributions of milkweeds and breeding monarchs in Idaho and Washington (Waterbury and Potter 2018). The effort contributed to the designation of the monarch as a SGCN in the Idaho and Washington SWAP revisions and spatially delineated the range of monarchs and milkweed species in both states. Survey data from 2016 contributed to refined habitat suitability models for breeding monarchs and milkweed species in the West (Dilts et al. 2018) and development of current and future potential distribution models for monarchs and milkweed in Idaho (Svancara et al., *in review*). Workshops developed and promoted relevant monarch and pollinator conservation tools used as key resources by Wildlife Management Area staff and other land managers. Workshops also created a platform for expanded communication, networking, and information sharing among technical services professionals. This network led to founding of the Idaho Monarch Working Group, an informal partnership of natural resource professionals, academic organizations, and citizens engaged in monarch butterfly and pollinator conservation in Idaho.



Pismo Beach State Park in San Luis Obispo County, California hosts one of the highest priority overwintering sites for the western monarch population.



IDFG conducted surveys in 2016-2017 to determine baseline distributions of milkweeds and breeding monarchs across Idaho. John Neider/IDFG.

IDFG and NRCS habitat biologists are actively promoting the use of pollinator BMPs in Farm Bill programs and petitioned to request inclusion of Idaho in NRCS's national Pollinator Habitat Initiative (CP-42). IDFG's Botany Program is currently developing a guide to the native milkweeds of Idaho in collaboration with USFWS and Xerces Society. The guide will highlight the five species of milkweed native to Idaho, all of which are used as larval host plants for the monarch butterfly. Idaho is also engaged in monarch education and outreach efforts targeting schools, government agencies, agricultural producers, cooperative weed management programs, Master Naturalists, and the general public.

Multiple efforts by several Idaho state agencies are also underway to promote monarch and pollinator habitat conservation across the state. In 2016, the Idaho State Department of Agriculture published the Idaho Pollinator Protection Plan (IP3) to create awareness of the importance of pollinators to the state. The IP3 presents BMPs aimed at reducing risks and increasing the health of pollinators and serves as an important educational and communications tool for Idaho's beekeepers, growers, pesticide applicators, private landowners, and public land managers. The Idaho Transportation Department (ITD) is actively engaged in several roadside vegetation management pilot projects to improve monarch and pollinator habitat in rights-of-ways (ROWs). ITD provides training to its field staff in Integrated Roadside Vegetation Management practices, not only as cost-effective management of ROWs, but to achieve conservation benefits for monarchs and other pollinators.

Nevada — While the Nevada Department of Wildlife (NDOW) does not have statutory authority to manage monarch butterflies, NDOW is participating in WAFWA's development of conservation strategies for the species. Within the Wildlife Diversity Division of NDOW, biologists record incidental sightings of monarch butterflies and/or larvae. NDOW is working on habitat improvement projects throughout the state that address issues such as non-native weeds and pinyon-juniper expansion, and these efforts also benefit monarch butterflies and other pollinators via native habitat enhancement. In the future, NDOW will explore other ways to contribute to monarch conservation including milkweed management on Wildlife Management Areas, working with partners to conduct surveys, tagging of monarchs, and including monarch considerations into habitat restoration projects.

The Nevada Natural Heritage Program (NNHP) continues to monitor, track, and provide data on pollinator species of concern throughout the State. NNHP educates communities about the importance of Nevada's pollinators, including monarchs, and the vital role these species play to support ecosystems.

In Nevada, the USFWS has worked with many partners on projects to tag monarchs, test for parasites, survey for breeding monarchs and milkweed locations, monitor for larvae, contribute to the western habitat suitability modeling and assessment study, engage the public through outreach events, and install pollinator gardens. Biologists have hosted workshops and native plant walks to educate the public about pollinator plants and phenology. There are multiple groups in Nevada that are active in monarch and pollinator conservation, including



Narrow-leaved milkweed (*Asclepias fascicularis*) grows in pinyon-juniper, sagebrush, and mountain brush communities of Nevada's Great Basin. Stephanie McKnight/Xerces Society.

but not limited to, University of Nevada-Reno, Xerces Society, The Nature Conservancy, Eastern Sierra Land Trust, NRCS, BLM, Sierra Club, and local nurseries.

Oregon — In Oregon, dedicated agencies, non-profits, and volunteer groups have been leading monarch butterfly habitat restoration, conservation, and public outreach across the state. Monarch butterfly is a Strategy Species in the Oregon Conservation Strategy. The Oregon Department of Fish and Wildlife (ODFW) operates the Willamette Wildlife Mitigation Program (WWMP) in the Willamette Valley, an ecoregion with a high concentration of suitable habitat for monarchs in Oregon. Many of the Wildlife Areas acquired with funds from WWMP include improving pollinator habitat as goals, and cultivating native forbs, sedges, rushes, and grasses for pollinators. In northeastern Oregon, the Ladd Marsh Wildlife Area includes native milkweed in seed mixes and engages the Friends of Ladd Marsh group to document and attempt to tag monarchs. ODFW biologists across the state get occasional requests for information from private landowners interested in creating monarch habitat. The state refers landowners to existing recommendations such as *Managing for Monarch in The West* (Xerces 2018). ODFW has no formal conservation plans to support monarch butterflies as the agency does not have statutory authority to manage terrestrial invertebrate species.

The Oregon Department of Agriculture has prohibited the importation and release of monarchs from out-of-state sources to allow biogeographical research related to determining why wild monarch populations in Oregon are declining. Oregon Department of Parks and Recreation (OPRD) has a high interest in restoring monarch habitat on park lands, but has not developed comprehensive monarch recommendations due to lack of information about the historical distribution of the species across Oregon. OPRD does have standing recommendations for prioritizing pollinator habitat on park lands, which are ready to be updated upon completion of the biogeographical research referenced above.

The federal land management agencies manage slightly more than 50% of the land in Oregon. The majority of this land is under the stewardship of USFS and BLM. USFWS is engaged in restoring monarch habitat on National Wildlife Refuges and providing educational opportunities for the public. These federal agencies are



Bundles of milkweed and other nectar-bearing plants are prepped for a planting team of 20 volunteers as part of an unprecedented landscape-scale effort to restore monarch habitat on the 5,000-acre Sampson Creek Preserve in southwest Oregon. Southern Oregon Monarch Advocates.

partners to the Monarch Joint Venture and have agency-wide guidance on monarchs and other pollinators. Locally, all of these federal agencies are collaborating with local groups on small-scale projects including creation of native milkweed and pollinator waystations, providing educational materials, tagging adult butterflies, and cultivating milkweed. Additionally, USFWS, through their Partners for Fish and Wildlife and Coastal programs, as well as NRCS, through many of their Farm Bill programs, are supporting monarch and pollinator habitat restoration work on privately-owned lands across the state.

The Southwest Oregon Pollinator Collaborative, based in Ashland, Oregon, is a working group focused on monarch and pollinator conservation. The collaborative, comprised of several NGOs, local/state/federal agencies, and private citizens, developed a locally-led monarch habitat restoration strategy in 2016. In 2017, the collaborative was successfully awarded a ~\$200,000 grant from NFWF and secured another \$260,000 in match for the development of an all-lands (public/private) pollinator habitat restoration strategy. Through the Southwest Oregon Pollinator Habitat Restoration Initiative, nearly 40,000 milkweed and native wildflower plugs were planted into areas previously treated for



Sampson Creek Preserve, south of Ashland, Oregon, is the site of a large-scale monarch habitat restoration effort piloted by the Southwest Oregon Pollinator Collaborative Project. Liam Moriarty/JPR News.

woody plant encroachment and/or noxious weeds. Treatment areas totaled approximately 327 acres, including coastal-influenced mountain meadows, inland valleys, and western portions of the Cascade Range.

Organizations such as the Southern Oregon Monarch Advocates, Brookings Oregon Monarch Advocates, Monarch Advocates of Central Oregon, and the Monarch & Milkweed Network of Eugene-Springfield work with local governments and universities such as Salem, Bend, and Brookings to restore habitat and raise awareness about the decline of the western monarch. These individuals and organizations are developing monarch waystations, implementing monarch habitat restoration projects, working with schools on education and monarch tagging programs, advocating for the creation of pollinator gardens on public property, working with nurseries to increase the availability of native plants, and hosting workshops to educate the public. Many of Oregon's Watershed Councils and Soil & Water Conservation Districts are also implementing larger scale pollinator habitat restoration projects on properties that they manage.

The principle leader in monarch conservation in Oregon is The Xerces Society, which is based in Portland. Xerces Society is leading the key analyses providing information on the status of monarchs in the West, including Oregon. Much of their work has laid the foundation for the conservation actions in the WAFWA Western Monarch Butterfly Conservation Plan. Their extensive work in Oregon and across the U.S. includes workshops and outreach, conducting research with WSU-Vancouver and Tufts University, monitoring at USFWS Refuges, working with USFWS and University of Nevada-Reno to develop habitat suitability models, working with

Bonneville Power Administration to protect and manage pollinator and monarch habitat on their properties, developing the Western Monarch Milkweed Mapper, working with farmers and ranchers to manage and restore pollinator habitat, and publishing reports and BMPs for monarchs.

Utah — There is no state entity in Utah with explicit management authority over butterflies. Despite this, monarchs and many other pollinators have and will continue to incidentally benefit from implementation of the Utah Division of Wildlife Resource's Wildlife Action Plan, which has clear goals of landscape-scale restoration and stewardship of its key habitats (AFWA 2015). Since 2005, locally- and regionally-sourced seed is increasingly requested and available and native milkweed specifically has been utilized in some riparian restoration projects. Demand for additional native pollinator-friendly plants is increasing through these and other restoration projects, thus creating a desirable market for additional suppliers of these species.

Since 2018, Utah has begun to organize and focus citizen science efforts to document milkweed presence and abundance as well as report monarch observations across the state. The western "all milkweeds" habitat suitability model developed by Dilts et al. (2018) identified ~500 potential locations to survey for milkweeds in Utah. Volunteers sign up on the *Monarch Conservation in Utah* website to visit specific sites, survey a 270m x 270m area (model resolution), then use either iNaturalist or Monarch SOS (linked to WMMM) app to report results and upload photos. Despite a late start in 2018,



Pallid milkweed (*Asclepias cryptoceras*) grows on dry, barren slopes and in washes of eastern Utah. Bill Gray.



Monarch tagging at Ouray National Wildlife Refuge in eastern Utah. Southwest Monarch Study.

65 milkweed observations were reported on a newly customized iNaturalist app, and another 65 observations were reported on the Monarch SOS app. In addition, the state wetland mapping team was recruited to map and photograph milkweeds during the course of their work across the state. In September 2018, a group of seven volunteers visited Fish Springs National Wildlife Refuge to tag monarchs. Within a three-hour period, 17 monarchs were tagged and released. A similar tagging effort was conducted in the Uinta Basin. A collaborative program developed by citizen scientists, the University of Utah Biology Department, and Utah Department of Corrections is increasing the availability of native milkweed seed in Utah. Juvenile inmates grow *A. speciosa* for seed production in return for monarch conservation classes. In fall 2018, Utah Department of Natural Resources employees collected *A. incarnata* seed and distributed supplies to growers for future habitat restoration projects.

In 2019, an increased effort to involve more citizen scientists as well as state and federal wildlife agency personnel in surveys for monarchs and milkweeds will be undertaken statewide. Monarch tagging efforts will also be expanded to add to the knowledge base of monarch habitat use, abundance, and migratory movement in Utah. Outreach to private and municipal landowners and managers will be conducted to foster support for monarch habitat conservation.

Washington — The monarch butterfly was recognized in early Washington butterfly guides (Pyle 1974; Christensen 1981) as an “uncommon visitor” to the state. Although monarchs have occasionally been observed in western Washington in spring months, their host plants and breeding habitat occur naturally



Workshop participants at the Lower Crab Creek Unit of WDFW's Columbia Basin Wildlife Area, a milkweed-rich site in central Washington. WDFW.

only in the eastern half of the state, east of the Cascade Mountain Range. In the Washington Department of Fish and Wildlife (WDFW) contracted *Washington Butterfly Conservation Status Report* (Pyle 1989), milkweed control, and the then common practice of roadside vegetation herbicide treatments were recognized as threats to monarchs. WDFW manages over 1 million acres in Washington, and following Pyle's analysis, the Wildlife Diversity Program directed eastern Washington lands managers to protect milkweed habitats. In the 1990s, WDFW also weighed in on the practice of ceremonial and recreational releases of imported, commercially-reared monarchs. Working with Washington Department of Agriculture, the state recognized the activity as potentially harmful to native wildlife and initiated a practice of denying permits for environmental release of commercially-reared butterflies, including monarchs.

In recent years, the decline of western monarchs brought new attention to the butterfly and its habitat. In 2015, WDFW identified monarch as a SGCN and initiated efforts to address knowledge gaps for the species in Washington. WDFW's species lead biologist met with researchers conducting and proposing monarch studies in Washington (James 2016), revisited several historical monarch locales to search for the butterfly and its milkweed hosts, and brought together monarch researchers and key WDFW Wildlife Area managers to discuss monarch status and land management actions. WDFW also joined forces regionally with IDFG and Xerces Society to seek federal funding to address basic and pressing monarch information needs. The group received support from the USFWS Competitive State Wildlife Grant program, and from 2015–2018

engaged in studies to rapidly and systematically begin to determine the distribution, abundance, and characteristics of milkweeds and monarchs in this two-state region (Waterbury and Potter 2018). The project also contributed to monarch and milkweed information gains in additional states, through launching the Western Monarch Milkweed Mapper. WDFW and Xerces Society held monarch training workshops for agency scientists and citizen naturalists. WDFW conducted milkweed and monarchs surveys throughout eastern Washington, collecting data on a total of 741 milkweed patches, and surveyed approximately half of those for monarchs, detecting monarchs in 104 milkweed patches. The project also collected milkweed and monarch site management and threats data, information key to monarch conservation.

WDFW collaborated with the Washington Butterfly Association Spokane Chapter in 2017, to initiate a citizen naturalist survey for five eastern Washington butterfly SGCN, including the monarch. This project is ongoing, with citizen naturalists continuing to conduct and report monarch surveys. Land management practices to protect and manage for monarchs and milkweeds are being incorporated into long-term management plans for WDFW Wildlife Areas.

4.3. Citizen Conservationist Efforts

Due to the appeal of the monarch butterfly, many organizations have been champions for monarch conservation for many years, educating the public on the plight of the monarch and initiating habitat restoration efforts. The work of organizations like Monarch Joint Venture, Monarch Watch, Xerces Society, and National Wildlife Federation (NWF) have led the way nationally, with local NGOs and grass root organizations enthusiastically putting action on the ground. It is impossible to enumerate all the organizations and private individuals in the western U.S. who have invested their time and resources for monarch and pollinator conservation, or to describe all the projects and initiatives they have conducted. Nevertheless, to illustrate the range and innovation of these projects, we provide a few examples of these citizen efforts:

- Establishing Monarch Watch monarch waystations in developed areas.

- Advocating to civic officials to endorse NWF's Mayor's Monarch Pledge
- Holding hometown monarch festivals and land manager workshops
- Assisting golf course managers with habitat through Audubon International and Environmental Defense Fund's "Monarchs in the Rough" program
- Creating butterfly demonstration gardens and increasing awareness of native plants
- Creating home gardens
- Tagging monarchs for research
- Developing educational materials specific to western U.S. regions

Early during plan preparation, the WMWG developed a short survey regarding conservation efforts for monarch butterflies and other insect pollinators to help in the development of this Plan (Appendix D). Respondents included government agencies, non-profit organizations, educational institutions, commercial enterprises, and other private entities. Forty percent of all respondents indicated their organization has a pollinator management or pollinator conservation initiative, the majority of which specifically addresses monarch butterflies, however, responses indicated that not all are being implemented at present. Nearly 60% of respondents indicated they were conducting or planning to conduct various conservation efforts, including maintaining and enhancing habitat and creating new habitat by cultivating both milkweed and nectar plants, whether or not there is a formal plan or initiative. Many NGOs and educational institutions that responded are engaged in education and outreach, including native plant, bird, and butterfly societies, arboretums, museums, and zoos.



Monarch and milkweed workshop for citizen scientists presented by Monarch Joint Venture, Xerces Society, and IDFG in Boise, Idaho in June 2015. Beth Waterbury/IDFG.



Trained and dedicated community scientists count and record observations for Xerces Society's Western Monarch Thanksgiving Count, the longest running effort to monitor overwintering monarchs in California. Carly Voight/Xerces Society.



SECTION 5: Monarch Population and Habitat Goals and Objectives



Ryan Hagerty/USFWS.

The long-term goal of this 50-year Plan is to ensure a self-sustaining population of monarch butterflies in the western U.S. However, given the current population size, environmental variability and natural fluctuations in insect population sizes alone could result in the extirpation of the western monarch population. A recent population viability analysis predicted a 72% chance that the western population will be lost in the next 20 years without intervention (Schultz et al. 2017). The same authors recommend that a population target of 4.5 million wintering monarchs should be pursued. Instead of providing an ultimate population size target at this time, this Plan initially provides near term (10-year) measurable objectives for both population size and habitat targets with the goal of arresting monarch decline and providing for population growth. Additional short-term and long-term goals will be determined and added to the Plan when sufficient information on western monarch vital rates and conservation potential for breeding habitat is available.

5.1. Monarch Population Goals and Objectives

The Western Monarch Thanksgiving Count, initiated in 1997 and conducted annually using standard protocols, represents the most consistent and robust measure of the overwintering population available (see Figure 5 for annual abundance estimates relative to the number

of sites counted). While the number and location of sites visited each year have varied over the course of the organized count, the continuation of this monitoring effort into the future allows comparisons between years and sites to measure changes in the population size in a statistically robust manner. The fewest number of sites visited in any one year was 76 in 2009, and several traditionally large sites were not visited that year. However, between 2010 and 2017 the number of sites visited has increased each year from 114 to 262, with the traditionally larger count sites included. The 75 sites with the highest counts have represented 98–100% of the total count each year throughout the history of the Western Monarch Thanksgiving Count regardless of the number of sites visited. The 10-year average for the 75 highest count sites over the period of 2008-2017 was 193,089 butterflies (SD=73,852). The average for the last five years, a period over which more than 150 sites were visited each year was 243,956 (SD= 46,343). The difference is due to the greater level of effort in recent years and inclusion of a previously inaccessible large private count site. Therefore, to account for annual fluctuations in population size and the total number and location of sites visited, a 5-yr running average of a subset of this count data representing the 75 sites with the highest counts will be used as the population size metric. Committing to annual counts at a minimum of 75 sites including the larger sites would provide a

relatively consistent measure of population status and is feasible to maintain into the future.

A 5-yr average of 500,000 for the western population is 10 times greater than the highest quasi-extinction threshold (50,000) presented in Schultz et al. (2017), and roughly twice the 2013-2017 average. While this is an ambitious target to attain in 10 years, especially given the extreme low numbers counted in 2018 (see Population Status Section 2.6), a population size of 500,000 would mean the decline is reversed and the population is on a trajectory for continued growth.

**Short-term
Population
Objective:**

By 2029, the preceding 5-year average of monarch butterflies counted will be 500,000 as estimated at 75 sites with the highest counts during the Western Monarch Thanksgiving Count.

5.2. Habitat Goals and Objectives

The USFWS proposed monarch butterfly conservation units to help prioritize conservation efforts in the U.S. For the West, four conservation units were identified: the core breeding area, overwintering habitat along the California coast, the Central Valley of California, and the remainder of the western range (Fig. 9).

A short-term objective for the overwintering conservation unit was developed by rolling up the measurable objectives for each of the overwintering strategies found in Appendix A.

For the other three identified conservation units, developing habitat targets was challenging given the lack of fundamental data in the West. Interim objectives have been developed for each of the strategies (Section 6 and Appendix A) that will provide for conservation lift, but the amount of additional habitat required is still unknown. For the Mid-American Monarch Conservation Strategy, the planning team used a hypothesized numerical relationship between the number of milkweed stems in the Midwest and the number of monarchs overwintering in Mexico to calculate the number of additional milkweed stems necessary to reach the established overwintering population goal (Nail et al. 2015; Pleasants 2017). There is no similar metric for the western population, and it is unclear if

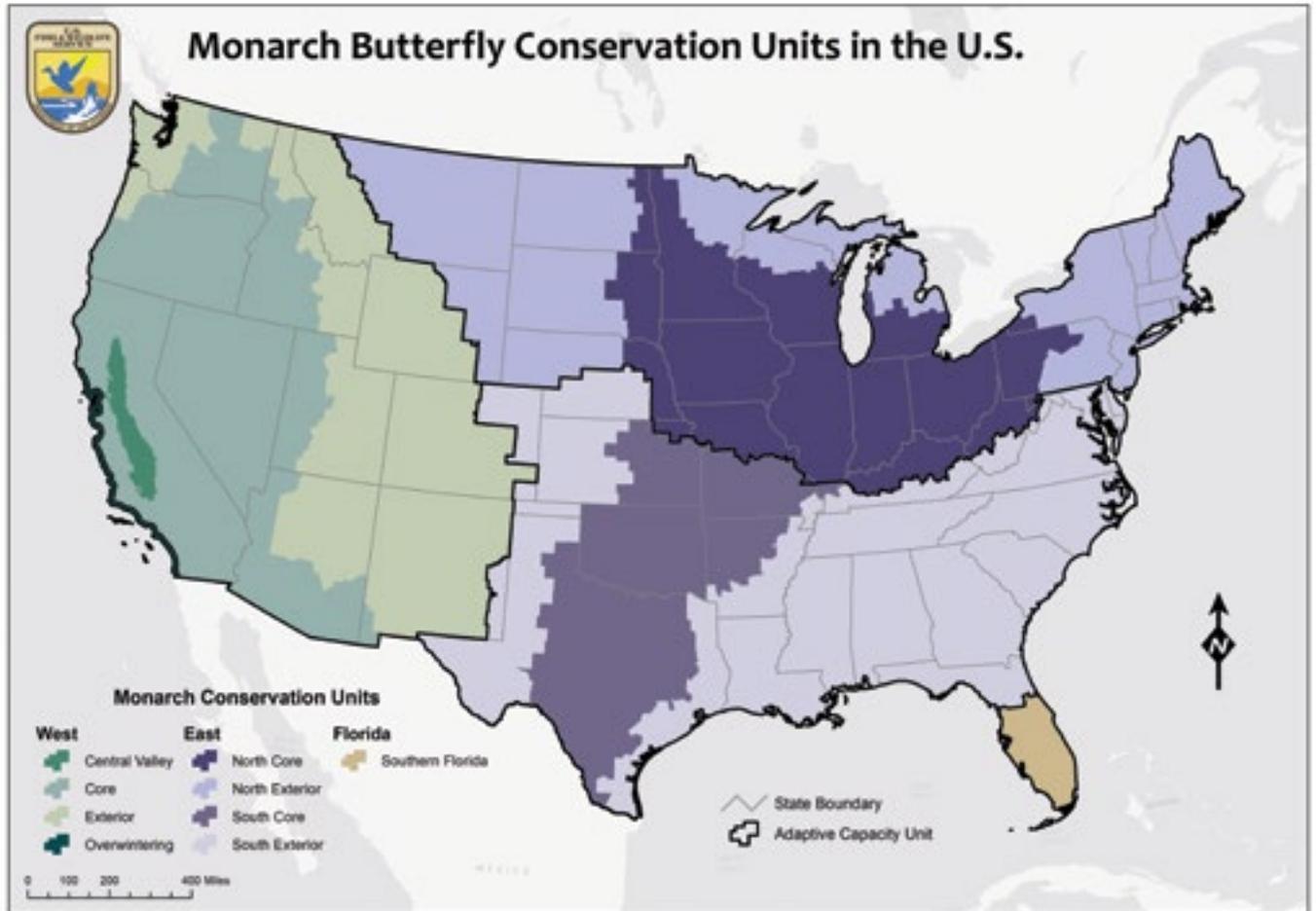
milkweed is a limiting factor throughout the West. As additional observations are reported and the habitat suitability model (Dilts et al. 2018) for the western core conservation unit is ground-truthed and refined, a better understanding will emerge regarding milkweed densities in various habitat types, spatial distribution of milkweed patches on the landscape, the degree to which milkweed and nectar resources are limiting factors, and where to focus conservation efforts. As these knowledge gaps are addressed, more exacting habitat targets can be developed.

Monarch researchers and the USFWS agree that the Central Valley of California is a critical region for immediate habitat improvement efforts, particularly early spring milkweed and nectaring resources to support the crucial first generation. Its juxtaposition to overwintering sites requires monarchs to pass through this region during both spring and fall migrations. Losses of milkweed and nectar plants have been extensive in the Central Valley. Between 1980-2000, the U.S. Geological Survey estimated losses of 1,054 km² (~260,450 acres) of grassland and shrubland habitats in the Central Valley and adjacent foothills to urbanization and conversion to cropland (Sleeter et al. 2010). These losses were contemporaneous with the most significant decline of the western monarch population. According to the most recent statewide California Farmland Conversion Report (FMMP 2015), development in the San Joaquin Valley (southern portion of the Central Valley) increased by 23,838 acres between 2008 and 2012, the second highest region after Southern California. The report also recounts a net loss in irrigated lands over the same time period, primarily due to idling, with the exception of three primary counties. These counties (Madera,



California milkweed (*Asclepias californica*) is an early spring milkweed of California's Central Valley important for first generation monarch reproduction. Joe Decruyenaere/Wikimedia.

Figure 9. Proposed monarch butterfly conservation units in the U.S.



Stanislaus, and Merced), clustered in the northern San Joaquin Valley, had increases in irrigated lands characterized by large plantings of orchards and to a lesser extent vineyards and row crops (collectively 28,638 acres). To mitigate these losses of natural habitat, an initial target for habitat improvements in California's Central Valley and adjacent foothills is provided. It is anticipated efforts will be required in all land use types, natural lands, developed areas, ROWs, and agricultural lands, with landowner approval. Strategy-specific measurable objectives are identified for each strategy to provide accountability for implementation of the Plan. See Section 6 Monarch Conservation Strategies and Appendix A for focusing locations of these additional acres. See Section 7.1 Capacity and Funding and Appendix B for potential sources of funding. Objectives and habitat targets will be evaluated annually by WAFWA Western Monarch Working Group to adapt goals and approaches as necessary based on monitoring and evaluation of implementation progress, monarch population response, and new science. An update to this Plan is envisioned in five years, at which time

additional habitat target objectives will be established for the remaining conservation units as part of the adaptive approach of this Plan. Nevertheless, habitat improvement efforts are encouraged to continue or be initiated in these areas at this time as well.

**Short-term
Overwintering
Habitat Objective:**

By 2029, 50% of all currently known and active monarch overwintering sites will be protected and actively managed for monarchs, including 90% of the most important overwintering sites.

**Short-term
Breeding and
Migratory Habitat
Objective:**

By 2029, a minimum of 50,000 additional acres of monarch-friendly habitat will be provided in California's Central Valley and adjacent foothills.



Edward K. Boggess.



SECTION 6: Monarch Conservation Strategies



Ryan Hagerty/USFWS.

This section describes strategies and associated actions to guide conservation and management of the western population of the monarch butterfly in the states of Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington over the planning period (2019-2069). The strategies and actions herein provide voluntary guidance to support monarch conservation in the West for all interested partners and at multiple scales, from urban gardens to tri-national migration pathways. Implementation of these strategies and actions will take “all hands on deck” to attain the population and habitat objectives, strategies, and actions in this Plan. For context and reference, we reiterate the purpose of this Plan:

The purpose of the Western Monarch Conservation Plan (Plan) is to identify and promote a shared set of conservation strategies for the entire life cycle of the western monarch population, including the overwintering grounds in California and breeding and migratory habitats throughout the western U.S., to achieve the vision of a viable western population of monarch butterflies.

6.1. Overwintering Habitat

Detailed accounts of western monarch overwintering ecology can be found in Jepsen et al. (2015), Pelton et al. (2016), and Xerces (2017).

The overwintering stage is regarded by species experts as the most vulnerable stage of the monarch’s life cycle (Pyle and Monroe 2004) given the majority of the population aggregates within a narrowly-defined area of suitable habitat in coastal California (Fig. 10). Conservation of overwintering sites is crucial for the continuity of the migratory phenomenon and long-term survival of the western population of monarchs.

Monarchs typically arrive at tree groves along the California coast (and a few inland areas) in September-October each year, and many of them stay at the same groves until they depart for breeding grounds in February-March. This overwintering generation of monarchs can live 6–9 months, while the spring-summer generations may only live 2–5 weeks (Xerces 2018). Stressors, including urban development, grove senescence, pests and disease, and incompatible

Figure 10. Distribution of current and historic monarch overwintering sites in California. Green circles represent sites that have hosted >1,000 monarchs in the past decade. Map courtesy of Xerces Society.





An overwintering site management plan developed to conserve and restore monarch habitat at Lighthouse Field State Beach in Santa Cruz, California, is serving as a template for land managers at other overwintering sites. Carly Voight/Xerces Society.

management practices, are considered likely factors in driving western monarch population declines. There are 400+ historic and currently known overwintering sites in California. Since 1991, at least 50 overwintering sites have been lost or destroyed (Sakai and Calvert 1991; Meade 1999; Xerces 2017). Compatible management and conservation of overwintering groves is necessary to ensure the continued suitability and use of these sites by monarchs (Griffiths and Villablanca 2015; Xerces 2017). The following strategies are recommended to manage, restore, and protect overwintering groves for monarchs.

OH-S1: California land use planners and regulatory agencies will endeavor to protect overwintering groves through application of the California Coastal Act and by incorporating protective measures in land use and development plans.

In 1976, the California Legislature found that the permanent protection of the state's natural and scenic resources is a paramount concern to present and future residents of the state and nation, and adopted the California Coastal Act of 1976 (Act) to protect, maintain, and, where feasible, enhance and restore the overall quality of the coastal zone environment and its natural and artificial resources. In partnership with coastal cities and counties, the California Coastal Commission implements the Act by planning and regulating the use of land and water in the coastal zone which on land varies in width inland from the ocean from several hundred feet in highly urbanized areas up to five miles in certain rural areas. Local Coastal Programs (LCPs) are basic planning tools used by local governments to guide development in the coastal zone.



Monarch breeding habitat at C.J. Strike Wildlife Management Area, Owyhee County, Idaho. Beth Waterbury/IDFG.

LCPs contain the ground rules for future development and protection of coastal resources in 76 coastal cities and counties of California. Each LCP includes a land use plan and measures to implement the plan (such as zoning ordinances). Prepared by local governments, these programs govern decisions that determine the short- and long-term conservation and use of coastal resources. Following adoption by a city council or county board of supervisors, an LCP is submitted to the Coastal Commission for review and approval that they are consistent with Act requirements.

Approximately two-thirds of the monarch overwintering groves fall within the legislatively established coastal zone to which the Act applies. Overwintering groves are considered to be Environmentally Sensitive Habitat Areas (ESHA). According to the Act, ESHAs shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas. Furthermore, adjacent development shall be sited and designed to prevent impacts that would significantly degrade those areas (Section 30240 of the California Public Resources Code). Working with local jurisdictions and the California Coastal Commission, a concerted effort can be made to assure that adequate protection measures are in place and being adhered to by local jurisdictions.

Efforts should be undertaken to map the extent of each overwintering site and educate local jurisdictions on the location and appropriate measures to protect these important sites and encourage incorporation into local ordinances or regulations. The goal would be to have all of the groves in Coastal Zone adequately protected under the Coastal Act (i.e., identified with specific protection measures included). Additional means for protecting

overwintering sites can be considered, including fee title acquisition, conservation easements, and other special designations.

OH-S2: Provide guidance for the application of environmental laws and other protection mechanisms (e.g., conservation easements, fee title acquisition, and deed restriction) to protect overwintering groves in California.

In order to facilitate implementation of OH-S1, land use managers and regulatory staff should be provided guidance on the types of potential impacts to look for and appropriate avoidance, minimization, and mitigation measures to address them. Providing specific examples or cases from a regulatory perspective will make it easier for staff to incorporate monarch grove protection into current regulatory land preservation practices. CDFW can provide such guidance on their Monarch webpage and host a recorded webinar as part of their Conservation Lecture Series. Prioritization of at-risk groves not currently protected would identify those sites where acquisition (i.e., fee title or conservation easements) or deed restrictions would be appropriate with the goal of protecting these sites in perpetuity.

OH-S3: Land managers will develop and implement site-specific grove management plans as appropriate and feasible, targeting first the Top 50 sites as identified in Pelton et al. (2016).

USFWS provided funding to Xerces Society to assess California overwinter sites and produce a report on the *State of the Monarch Butterfly Overwintering Sites of California* (Pelton et al. 2016). This report summarized existing overwintering trends and identified the highest priority sites for active management and protection. More than half of the historic ~400 sites are publicly managed. California Department of Parks and Recreation (CPR) manages 47 sites; CDFW manages five sites; DoD manages 37 sites; National Park Service and the University of California system each manage 11 sites, and over 95 sites are managed by local governments. Xerces Society, Groundswell Coastal Ecology, CPR, and USFWS subsequently developed an overwintering site management plan for Lighthouse Field State Beach in Santa Cruz, California, one of the top 10 priority sites. This plan now serves as a template for land managers at other overwintering sites (see

Appendix C for an overwintering site management plan template). Additional guidelines for overwintering grove management were provided in the Xerces Society (2017) publication *Protecting California's Butterfly Groves: Management Guidelines for Overwintering Habitat*. These resources are being provided to land managers of overwintering sites through workshops and targeted outreach. Considerations for grove management should include:

- Habitat site assessment by persons experienced with proper monarch grove management;
- Mapping of monarch habitat boundary map and key habitat features and updating as changes occur;
- Development and implementation of management plans to manage, restore, and enhance habitat within and around groves, including minimizing and eliminating pesticide use;
- Identification of funding and personnel to implement management actions;
- Monitoring management plan actions and butterfly response to actions;
- Adapting the management plan, as need, based upon monitoring results.

Xerces Society is currently working with Pismo Beach State Park and private partners on a site management plan for a top priority site. The City of Goleta in Santa Barbara County, California, is to receive \$3.9 million from the state through the California Coastal Conservancy for implementation of a management plan for a complex of sites they manage as the Ellwood Monarch Butterfly Grove. Additional funds for development and implementation of management plans may be available through other grant programs now and into the future. California now has a grant program administered by the Wildlife Conservation Board (WCB) for the restoration or enhancement of monarch habitat including overwintering habitat on private and public lands.

OH-S4: Formalize and expand a network of land managers for the exchange of information regarding overwintering grove management.

Action OH-S4-A: An online information sharing and dissemination portal or list-serve will be developed for land managers of overwintering groves.

Action OH-S4-B: Annual workshops and/or in-person meetings will be held as time and budgets allow to foster coordination of land managers and share biological outcomes from BMPs and habitat restoration implementation.

Action OH-S4-C: Educate landowners and neighbors of Top 50 priority sites, as well as other important overwintering sites, on the conservation importance of grove management. See Section 8: Education and Outreach regarding messaging for this constituency.

6.2. Natural Lands

Public entities own and administer millions of acres of natural lands throughout the western portion of the monarch butterfly range (Fig. 11). For example, in the seven-state region covered by this Plan, the federal agencies alone manage over 233 million acres, and state fish and wildlife or natural resource agencies manage over 25 million acres. Native American tribes manage another 30 million acres. In addition, certain private lands with and without conservation easements are also managed for their natural resource values. Using the recent habitat suitability model outputs (Dilts et al. 2018), we separated habitat into three categories of predicted suitability (high, medium, and low) and calculated acreage. This resulted in the prediction that about 38.8 million acres (~52%) of natural lands have the potential to be of high (19%) or medium (33%) suitability for monarchs. These acres present potential opportunity for effective implementation and adoption of monarch and pollinator management actions. We define natural lands to include public, tribal, and private lands managed for their natural resource values.

To reach the goal of increasing the western monarch population, more lands need to be restored, enhanced, and maintained to benefit monarchs and other pollinators. Specifically, managers of natural lands

should make strategic and concerted efforts to promote presence of milkweed and/or diverse nectar resources where monarchs are known to occur. Actions necessary for achieving high quality monarch habitat on natural lands will vary by geographic region and existing habitat characteristics and land uses. In general, these actions will include planting native high-diversity forb and grass mixtures that include native milkweed species, interseeding milkweeds into existing suitable habitats, and engaging in management practices that encourage milkweed and nectar plant presence and availability at appropriate times.

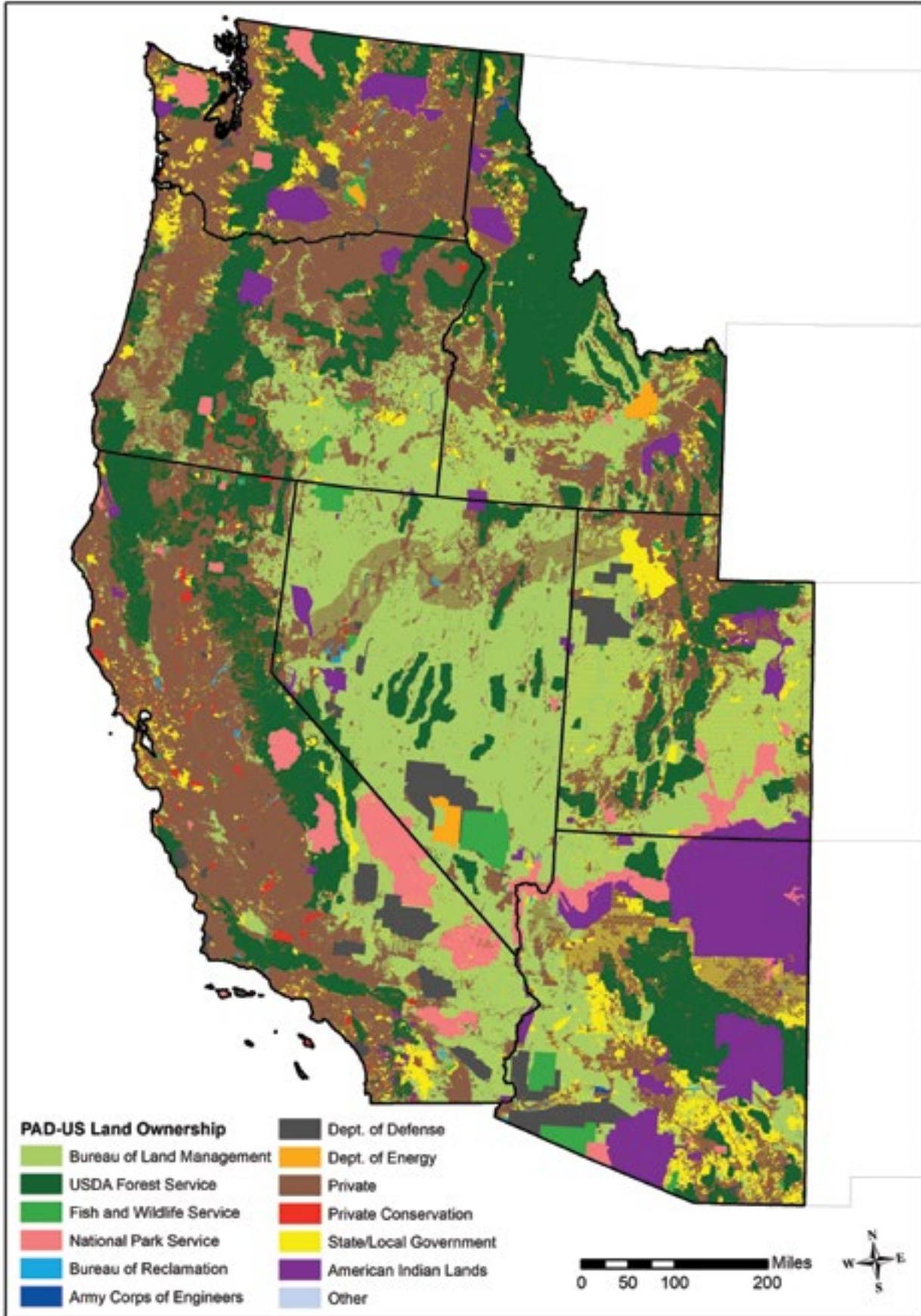
NL-S1: Identify high priority breeding areas for monarch conservation on natural lands throughout the West and promote protection, restoration, and/or enhancement in these areas.

Through implementation of the Federal Strategy to Promote the Health of Honey Bees and Other Pollinators (Pollinator Health Task Force 2015), many of the federal land management agencies (e.g., NRCS, USFWS, BLM, USFS, DoD) including those with the greatest potential acreage, are already engaged in pollinator and monarch conservation activities (see Section 4 Current Conservation Efforts). Federal funding for these efforts is currently committed and is also provided through grant programs (e.g., DoD Legacy). The focus for these federal funds has been on the eastern population to date, but there is an opportunity to expand efforts in the West. With the recent completion of monarch and milkweed habitat suitability models for seven western states (Dilts et al. 2018), these efforts can now better focus where they are most likely to benefit western monarchs.

Action NL-S1-A: Utilize best available science, new research, and citizen-based observations and tagging efforts to identify high-priority breeding areas.

Action NL-S1-B: Provide regionally-tailored guidelines on management techniques for enhancing existing habitat areas. Encourage managers to consider broad conservation goals for each project.

Figure 11. Landownership in the seven-state region comprising the core range of the western monarch butterfly population.



Action Facilitate information exchange and
NL-S1-C: cooperation between land management agencies (federal, state, local municipalities) to encourage and recognize monarch and other pollinator habitat BMPs, monitoring opportunities, resource opportunities, and educational programs.

Action Encourage partnerships and cooperation
NL-S1-D: between public and private programs to maximize reach and efficiency of habitat restoration projects.

NL-S2: Identify high priority migratory pathways and clustering locations and promote protection, restoration, and/or enhancement of these areas, including riparian corridors.

In the western U.S., monarchs are observed traveling along riparian corridors and roosting in trees during the breeding and migration seasons (spring, summer, fall). Dingle et al. (2005) noted that fall migration roosting habitat is likely important for monarchs along rivers. Monarchs are sometimes observed waiting out storms or night-roosting in trees during periods of migration. Tree, shrub, perching, or roosting structure may be necessary for monarchs; however, these habitat features are not well studied for western monarchs (Xerces 2018). Monarch usage of roost sites along some rivers varies by year, plausibly due to weather conditions and resource availability, and some rivers (e.g., Colorado River) appear to have more consistent usage on an annual basis (Gail Morris, pers. comm.). Monarchs travel and roost along the Colorado River in Arizona, Green and Jordan rivers in Utah, and Rio Grande in New Mexico. During fall migration, monarchs have been detected on the Salt, San Pedro, Gila, Agua Fria, Little Colorado, and Verde rivers of Arizona in small clusters within cottonwood, willow, and rabbitbrush (*Ericameria* or *Chrysothamnus* spp.) (Gail Morris, pers. comm.). In the southwestern U.S., most monarchs are detected in the summer breeding season in riparian areas with tall trees that offer shade in close proximity to milkweed and nectar plants (e.g., native thistles, native sunflowers, rabbitbrush, goldenrod [*Solidago* spp.]) (Gail Morris, pers. comm.). Currently, major data gaps exist on western monarch movement patterns, migration stopover areas, and roosting behavior during migration. Once these data are compiled,



Western riparian areas serve as key travel corridors for migratory monarchs. Southwest Monarch Study.

strategic approaches for protection and management of migratory habitat resources can be developed.

Sightings of monarchs in the western range can be submitted to the Western Monarch Milkweed Mapper online portal via the website (www.monarchmilkweedmapper.org) or the Monarch SOS app (currently available for iOS devices, but an Android version is also planned). Monarch Joint Venture and Nature Digger are collaborating to adapt Monarch SOS to connect data collection services with other citizen science program databases including Journey North, Monarch Alert, Monarch Larva Monitoring Project, Monarch Watch, Project Monarch Health, and Southwest Monarch Study. This tool will facilitate reporting and compilation of all types of sightings, including migratory roost areas. Observational data will help researchers and land managers identify migratory corridors and important roosting areas for conservation.

Action Collaborate with State Natural Heritage
NL-S2-A: Program and citizen science-based inventory efforts (e.g., iNaturalist) to funnel observations and photos of western monarchs and milkweeds to the Western Monarch Milkweed Mapper website: <https://www.monarchmilkweedmapper.org/>.

Action Develop a list of priority migratory pathways and non-winter clustering locations for protection, restoration, and/or enhancement projects within each state based on available milkweed suitability modeling information (Dilts et al. 2018) and agency observations and tracking databases (e.g., Western Monarch Milkweed Mapper, Monarch SOS app, iNaturalist, Southwest Monarch Study). See also RBH-S3 & RBH- S4.

Action Provide regionally-tailored guidelines on management techniques for enhancing existing habitat areas. Encourage managers to take into consideration broad conservation goals for each project.

Action Facilitate information exchange and cooperation between land management agencies (federal, state, local municipalities) to encourage and recognize monarch and other pollinator habitat BMPs, monitoring opportunities, resource opportunities, and educational programs.

Action Encourage partnerships and cooperation between public and private programs to maximize reach and efficiency of habitat restoration projects.

NL-S3: Incorporate monarch conservation considerations and measures into land management activities, plans, and projects as outlined in *Managing for Monarchs in the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat* (Xerces 2018), as appropriate.

Many land management agencies strive to maintain native biodiversity on the lands they manage as part of their normal operating practices or for specific species. Managing natural lands to promote biodiversity, native plant communities, and ecosystem function will benefit monarch butterflies and other pollinators as well. For example, conservation plans that have already been developed with goals to maintain high-quality greater sage-grouse (*Centrocercus urophasianus*) habitat may also

improve habitat for monarchs and other pollinators by increasing cover and diversity of forbs. Guidance for managing specific properties (e.g., parks, reserves, Areas of Critical Environmental Concern, forests) is provided in land management plans and focused conservation plans. Natural land managers should add pollinator and monarch-friendly directives to these plans where appropriate, if they are not already incorporated.

A majority of the federal public lands in the West provide for private grazing allotments and leases. Incorporation of milkweed plants, monarch nectar resources, and protection of mesic habitats as management objectives in grazing management plans, as appropriate, can benefit western monarchs. Avoiding high-intensity or long-duration grazing is particularly important in sensitive habitats such as riparian areas, springs, seeps, wetlands, and meadows. These areas support abundant nectar resources, high diversity of pollinators, and provide important breeding and migratory habitat for monarchs. Grazing leases and allotments should be located and conditioned to protect and manage milkweed and nectar resources. See also Agricultural Lands Strategy AL-S4.

Prescribed fire is an important management tool in the West for enhancing habitat values; however, effects of prescribed fire on western monarch habitats have had little study. Consideration should be given to manage fire to increase habitat heterogeneity at multiple scales, both within and between sites, and to minimize negative impacts to milkweed, nectar sources, and monarchs to the degree possible. Land managers should develop standardized language for inclusion in prescribed fire management plans and specific burn plans, including post-burn recovery directives. Following large-scale wildfires, federal and state agencies typically assess property and habitat damage and make recommendations for post-fire recovery efforts. Impacts to monarch and other pollinator habitat and appropriate restoration measures should be considered during preparation of these assessments.

To further guide monarch conservation efforts in the West, the USFS, BLM, USFWS, NFWF, and other private entities funded the Xerces Society to develop and publish *Managing for Monarchs in the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat* (Xerces 2018). This document combines the best available science with land manager



Stephanie McKnight/Xerces Society.

knowledge to provide recommendations for managing monarch breeding and migratory habitat specifically in the western states. Management activities addressed include grazing, mowing, prescribed burning, pesticide use, habitat restoration, and non-native and noxious plant management. BMPs also include ecoregion-specific recommendations for timing of these management activities (Xerces 2018b). These technical guidance and map products now provide the foundational information necessary to determine what, where, and when to take appropriate land management actions on natural lands for the protection and enhancement of the western monarch population. This information can be incorporated into revisions of property-specific resource management plans maintained by land management agencies; USFS and BLM have begun to do so. With these resources and more time, federal agencies can further extrapolate from past data and develop more specific acreage numbers for habitat improvement work on the ground. These resources also benefit state, tribal, local, and private land managers in their monarch and pollinator conservation efforts. Ensuring that availability of this information is communicated to all natural lands

managers, and that technical assistance for adoption of the recommended actions is provided, is the focus of this strategy.

Action Work with land management partners to
NL-S3-A: integrate monarch/pollinator conservation in all new land management plans, as appropriate.

NL-S4: Promote the use of local native plants and seeds for habitat enhancement and restoration projects, particularly for monarch conservation efforts.

Native plants are adapted to the biotic and abiotic conditions under which they evolved. There are multiple ecological benefits for using locally-adapted native plants in restoration work, including: returning to or maintaining more normal fire intervals and fuel loadings; providing food and shelter resources for native fauna; reducing the spread of non-native invasive plants; and reducing soil erosion and sedimentation (USDA Forest Service 2018).

The source of native plant materials can affect the success and value of restoration work for monarchs and other native pollinators. Ideally, local ecotypes of milkweeds and nectar plant species should be used to improve establishment and value to native pollinators, including monarchs. As important as sourcing from local ecotypes, is the selection of appropriate native milkweed and nectar species. Milkweed and nectar-rich forb and shrub species should be selected that are native to the restoration area, and ideally, locally-sourced. Xerces Society created and maintains the Milkweed Seed Finder, an online national directory of milkweed seed vendors to help find sources of seed (<https://xerces.org/milkweed-seed-finder/>). Xerces Society has also published regional monarch nectar plant guides (<https://xerces.org/monarch-nectar-plants/>) to assist conservation practitioners in selecting locally-appropriate nectar plants for restoration work.

Action NL-S4-A: Develop reference materials for land managers that emphasize use of local, native plants free from pesticides (especially neonicotinoids) for native habitat restoration projects.

Action NL-S4-B: Identify nurseries or vendors that can provide native plant materials for restoration projects and post on existing online lists such as Xerces Society’s Milkweed Seed Finder national directory of milkweed seed vendors (<https://xerces.org/milkweed-seed-finder/>) and Monarch Joint Venture’s Monarch Watch Milkweed Market (<http://support.milkweedmarket.org/kb/article/353-about-the-milkweed-market>), and websites of regional and local non-profit monarch groups.



Monarch habitat restoration is optimized by using seed from locally-sourced milkweeds native to the area. Beth Waterbury/IDFG.

6.3. Urban and Industrial Development

Developed areas in the western states covered in this Plan account for >24,000 square miles of land (National Land Cover Database 2011). Not only does 90% of the human population in the American West live in urban areas (U.S. Census Bureau 2017), many of these urban areas are in suitable habitat and/or potentially suitable habitat for monarchs and other pollinators. Given both natural and financial resource availability in these areas, suitable habitat creation and management is exceedingly feasible. Furthermore, monarch butterflies present an unequalled opportunity to engage a wide variety of individuals, groups, and corporations in conservation activities. The high level of interest can be attributed to the extraordinary life history and beauty of this species. As a result, public education and engagement about threats to monarchs and pollinators, as well as opportunities to support their recovery needs, can be achieved through a multitude of outlets. For example, recent research suggests that monarch reproduction in residential gardens may provide increased recruitment when compared to natural areas, and that isolated patches of milkweed distributed at low densities on the landscape, such as in gardens, could significantly increase the number of eggs an individual monarch lays in her lifetime (Cutting and Tallamy 2015).

Monarch and pollinator conservation strategies in the sectors of urban and industrial development and education and outreach coincide well in that similar strategies can be effective for each, thus these two sections overlap in the Plan. Monarch and pollinator conservation strategies can be initiated with the urban/ industrial development sectors through careful and targeted communication and education regarding new or different policies for land management. The origination and/or modification of land management policy can affect areas the size of a yard, thousands of acres of municipally owned and operated open space, a new housing or industrial development, or reclamation goals for mines or energy generation sites. The strategies and actions proposed here include approaches that involve these entities prior to development, such as BMPs or Land Use Planning, as well as after land development projects have been completed, such as habitat creation and restoration projects.

UID-S1 During project development and/or review, provide guidance for the incorporation of conservation actions that minimize impacts and provide benefits to monarch butterflies.

Urban and industrial areas can be important contributors to monarch butterfly and pollinator habitat as well as champions for their conservation. Key approaches to monarch conservation in urban/industrial environments include identifying, protecting, and managing known and potentially suitable monarch habitats and engaging with urban/industrial constituencies to increase awareness and knowledge of monarch and pollinator BMPs. Guidance contained in the publication *Managing for Monarchs in the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat* (Xerces 2018) can be easily incorporated into municipal and state land use planning and development projects.

Action Identify target areas for monarch habitat
UID-S1-A: restoration, enhancement, and creation at a scale appropriate for each partner.

Work with representatives from municipalities and corporations to help locate appropriate and feasible areas for habitat creation and restoration with consideration of their respective planning documents



The Mayor of Salem, Chuck Bennett (on left), was the first mayor in the state of Oregon to take the Mayor's Monarch Pledge to make the capitol city's urban habitat friendlier to pollinators, including monarchs. USFWS, SOMA, Xerces Society.

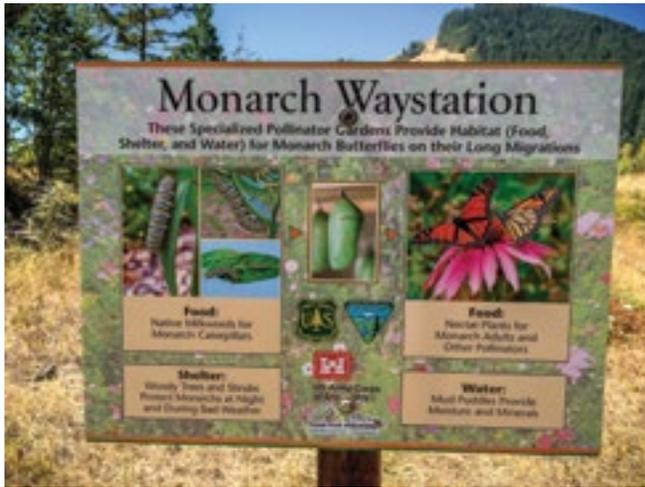
(e.g., General Plan for Open Space or a Business Plan for a corporation). Using the Dilts et al. (2018) western monarch and milkweed habitat suitability models in combination with the Critical Habitat Assessment Tool (CHAT) developed by WAFWA, suitable habitat can be appropriately targeted for habitat enhancement, restoration, and creation. Targeted areas should be shared with all potential partners to help create coordinated and meaningful habitat connectivity throughout the West. Adaptation of the Field Museum's Urban Monarch Conservation Guidebook (see Appendix B), and social and spatial planning tools could be explored in the West.

Action Identify, and then encourage 25 key
UID-S1-B: municipalities to take on-the-ground action.

Following the work of ascertaining areas suitable for habitat creation and restoration, monarch conservation advocates should identify 25 key municipalities for participation in monarch conservation activities. Criteria for identifying municipalities could include amount of suitable habitat, number of potential partners, and willingness to participate. A coordinated approach from a lead entity in each state should be established for program consistency. Regular communications within and between states will be needed to ensure program activity. The Mayors' Monarch Pledge sponsored by the National Wildlife Federation can be used as a prototype for commitments and actions in each municipality (<https://www.nwf.org/Garden-for-Wildlife/About/National-Initiatives/Mayors-Monarch-Pledge>).

Action Encourage (and reward through
UID-S1-C: official recognition) pollinator-friendly landscapes.

Individual, municipal, and corporate entities often appreciate positive recognition for their conservation efforts. Positive recognition often fosters sharing experiences and lessons learned with others interested in similar efforts. The Monarch Waystation Guidelines published by Monarch Watch serve as a template for monarch habitat creation and restoration. Entities can claim and publish the number of acres in certified Monarch Waystations and share information—from monarch use to plant survivorship to milkweed and nectar plant seed availability—with other interested parties. Waystations are posted with signage to educate



BLM Oregon.

the public about the purpose and importance of these projects. Communication support by state agencies highlighting achievements in publications, online, and in social media helps to build a sense of community and ownership of conservation projects, aiding their longevity and effectiveness.

Action Utilize technical service providers such as NRCS, USFWS (Partners for Fish and Wildlife), extension agents, U.S. Army Corps of Engineers that work with private landowners.

UID-S1-D:

Monarch NGOs and state and federal agency staff are highly experienced and trained in skills such as taxa identification, habitat restoration and creation, and data collection and analysis. Workshops, trainings, and webinars in these skills can aid urban groups in conservation efforts. State agencies and conservation groups commonly develop educational products as well as monarch displays that would enhance education and outreach efforts by urban groups (see Section 6.6 for messaging). State and federal agencies can support state or local grant programs and/or may be able to provide cash or in-kind match to groups seeking grants to fund urban/industrial monarch conservation.

Action Engage landscaping companies and native plant propagators to grow and plant native and locally-sourced milkweed and nectar plants.

UID-S1-E:

As interest and participation in monarch and pollinator conservation increases, it is of high importance to have the ability to provide appropriate plant species that are

locally-sourced for improved survivorship and persistence in these ‘new’ landscapes. Landscaping companies and native plant propagators are often willing to specify new species that can be successfully propagated at local nurseries. Coordination and regular communication between habitat restoration NGOs, municipalities, corporations, and federal agencies (e.g., BLM’s Seeds of Success Program) should occur. Discussions regarding supply and demand of milkweed seed and seed from other nectar plants for monarch and pollinator habitat projects can help assure appropriate and adequate species availability.

Action Engage irrigation companies, water and irrigation districts, the Corps, and municipalities to encourage monarch and pollinator habitat creation and enhancement in water conservation and management projects, wetland mitigation projects, and stormwater management.

UID-S1-F:

The entities mentioned in this action have responsibilities for wetlands that may be associated with water delivery, natural hydrology, or human-induced hydrology. Monarch butterflies in the West are strongly attracted to and regularly use areas with surplus moisture. Engaging each of these entities in possible opportunities for monarch and pollinator habitat restoration and creation could result in highly effective habitat in the arid West. As mentioned above, the Corps is incorporating conservation practices for pollinator habitat improvement on millions of acres of lands and waters at resource development projects across the country. However, increased communication with local Corps offices and their project proponents regarding pollinator habitat in all wetland mitigation projects can be yet another opportunity to improve monarch and pollinator habitat.

Action Engage land development corporations, mining operations, and energy development projects in conserving and managing existing monarch and pollinator habitat, and creating new habitat.

UID-S1-G:

Following successful outreach to the above entities, regular communication should be maintained to follow up with opportunities and incentives for monarch

habitat creation and/or restoration on corporate/ industrial lands. These opportunities can be proposed, discussed, and planned prior to breaking ground on anticipated projects or can be planned in and around current land holdings and/or infrastructure under their control.

Action Encourage cooperation between local, state, and federal regulatory agencies and mining and other land development operations to create, restore, and/or maintain monarch and pollinator habitat on industry lands.

In permitting processes for mining operations and energy generation projects, opportunities exist to help direct best choices for project site location and bond surety flexibility in terms of seed mixes and landscape planning. Permittees must meet bond release criteria outlined in the regulations prior to bond monies returning to the company. In highly-suitable habitat, these bond surety criteria could be flexible to allow for alternative post-mining land uses. Creation of partnerships among conservation groups and those responsible for mined land reclamation would likely provide benefits in terms of fostering education and cost-sharing (e.g., for seed mixes or alternative post mining land uses). State regulatory agencies could encourage, promote, and provide incentives for voluntary adoption of specific species in accordance with state or federally recognized conservation programs. It should be noted that while power companies have management responsibility, they may not always have full control to manage their sites. However, some power companies may be able to include monarch protection provisions in their property lease agreements to farmers and ranchers. There are likely cases where property management would need to be modified to support the monarch, the costs of which would have to be approved by company boards, shareholders, and in some cases regulatory commissions.

Action Encourage partners to enter actions into the USFWS Monarch Conservation Database or WAFWA Monarch CHAT database.

The USFWS Monarch Conservation Database is the central repository for all on-the-ground projects implemented with the intent of protecting, enhancing,

or creating monarch habitat. See Section 7.3 for discussion regarding interface of the USFWS database with the western CHAT conservation action tracking system. As such, all partners must agree to enter their projects into the database to ensure the USFWS and conservation partners have all information available to assess conditions for the monarch now and into the future.

UID-S2 Target outreach and education to municipalities, local land use agencies, landscape businesses, and private landowners within historic breeding range regarding the simplest and best ways to incorporate pollinator habitat in their activities.

Education and outreach must be carefully messaged, coordinated, and delivered to be most effective. Section 6.6 of this Plan addresses outreach and education for multiple audiences to increase awareness of the monarch butterfly. However, since more populated urban areas offer a deeper pool of potential volunteers, the following actions provide more detail on how to address outreach and education strategies targeted to specific organizations or groups that would likely be involved with land development projects as well as home and urban gardens. For example, municipal park and open space staff can contribute to monarch and pollinator habitat by incorporating milkweed and nectar plants into their projects and landscaping. These efforts should include signage and outreach efforts to inform the visiting public about the purpose and benefits of these plantings. Further, conversations with municipal planning and



Showy milkweed starts grown from seed through the Institute for Applied Ecology's Sustainability in Prisons Project active in six western states. Institute for Applied Ecology.



Xerces Society.

engineering staff should encourage flexibility and creativity in implementing monarch and pollinator habitat projects on lands within their jurisdiction. For example, storm water management can potentially be ‘stacked’ with monarch conservation efforts, as these green spaces can achieve goals for both needs. As every city or municipality will differ in the types of monarch conservation efforts it chooses to pursue, the actions that follow take a high-level view of potential strategies for monarch habitat conservation in a variety of settings within developed areas.

Action Create a simple western monarch
UID-S2-A: brochure (1 to 2 pages) for each participating state with clear messages for collective action to restore monarch populations and habitat. Distribute brochure to communities and decision makers (see EO-S2).

A concise, regionally-based brochure that explains monarch butterfly issues and highlights current local conservation efforts would help convey how

municipalities and corporations can improve conditions for monarchs locally and nationally. The brochure should provide contact information for local resources and potential partners in monarch conservation efforts (see Appendix B, Monarch Joint Venture brochure *Why Grow and Sell Native Milkweed?*).

Action Foster networking between outreach
UID-S2-B: champions (NGOs, government liaisons, academic institutions, citizens) within and among municipalities and anchor corporations by establishing and maintaining a structure that facilitates communication.

Citizen monarch champions and state and federal government liaisons can help lead urban/industrial monarch conservation efforts without over-burdening local government resources and personnel. Creating a program with an organizational structure that sets published goals and objectives (e.g., timelines, regular meetings and/or presentations, a series of projects) can be most effective to assure all involved are regularly

updated and can showcase results. It is important to let participants know or let them witness that their actions do make a difference on a regular basis.

Action Engage K-12 schools, conservation corps, and faith-based groups in monarch conservation programs to encourage interest in monarch and pollinator issues in the next generation. Interested youth will become the future leaders in these and other efforts.

UID-S2-C:



Each October since 1939, Pacific Grove, California celebrates the arrival of overwintering monarchs with a welcoming Butterfly Parade featuring K-5 students. Pacific Grove Chamber of Commerce.

Meet with community group leaders to identify and discuss the focus of issues and concerns of the various groups to discover probable corresponding alignment with monarch conservation goals. From these common goals, jointly develop structured programs with botanic gardens, municipal open space programs, zoos, Master Gardeners, Master Naturalists, and natural history museums to help prioritize potential habitat creation and restoration projects, while at the same time encourage cross-pollination of groups. Regular participation of these various groups in other year-round community events (e.g., farmer's markets, county fairs) and a strong social media presence are key to reaching as many people as possible and keeping those involved informed of the results of their efforts and upcoming events. This action strongly coincides with strategies in Section 6.6 Education and Outreach.

Action Educate and coordinate with local planning and zoning commissions, storm water managers, water and irrigation districts, and the Corps to engage private development within their jurisdictions in monarch conservation opportunities.

UID-S2-D:

Many opportunities exist to engage municipalities and interested industries and corporations in monarch and pollinator conservation. Planning and zoning commissions, municipal governments, as well as public relations personnel, have the ability to suggest changes or additions to large-scale industrial, commercial, or housing developments in their jurisdiction. For example, educating city and county councils and municipal engineers about additional opportunities to 'stack' uses of municipal property in areas such as storm water basins, utility corridors, or wildlife corridors could result in monarch and pollinator habitat creation or restoration. Similar discussions between pollinator and monarch champions and state and local regulatory agencies could lead to flexible and creative land use plans while meeting or exceeding regulatory obligations. This could include changing terms and conditions in regulatory obligations that adjust vegetation management specifications to benefit monarchs or revising regulatory documents to include monarch- and pollinator-friendly BMPs. Effort should be made to engage local Corps offices in monarch and pollinator habitat restoration and/or improvement. The Corps could include milkweed, nectar plants, and other monarch and pollinator habitat improvement strategies in their mitigation guidelines for all project proponents to consider.

Action Work with local, state, and federal regulatory agencies regulating mining, corporations, and land development operations to educate operators on monarch issues and opportunities.

UID-S2-E:

Regulatory agencies could be encouraged to include monarch and pollinator enhancement language in existing or in developing guidance to mining or other land development operations. The actions in the guidance document could be expressed as a value-added proposition to enhance otherwise required business expenses. Education and outreach on monarch and pollinator issues should be directed toward applicable industry trade associations, professional technical societies and associations, and/or equipment manufacturing organizations and suppliers that may work in any land development or management operation. This increase in awareness of monarch and pollinator issues could reach numerous industry sectors which could be encouraged to actively participate in monarch and pollinator conservation actions. Additional

outreach efforts could be aimed at post-secondary education in select disciplines (e.g., engineering, life sciences, environmental studies), which could boost long-term government and industry-specific understanding and awareness of monarch issues and conservation actions.

Action Promote and facilitate citizen science
UID-S2-F: projects to further goals and objectives of this Plan.

Citizen science projects across the nation have been successful at carrying out a wide variety of tasks in order to generate the scientific data required to further the development of conservation strategy planning. This action is addressed in more detail in Section 6.6 Education and Outreach, Strategy EO-S1.

UID-S3 Educate homeowners, land developers, and energy producers on issues associated with insecticides and herbicides, and provide BMPs and alternatives to their use.

Pesticides have increasingly been shown to be factors in the declines of pollinators, including the monarch butterfly. About a third of all pesticide use in the U.S. is attributed to non-agricultural use, such as in landscaping, yards, and gardens in developed areas.

Action Follow recommended guidelines in
UID-S3-A: Xerces Society's publication *Managing for Monarchs in the West – Best Management Practices for Conserving the Monarch Butterfly and its Habitat* (Xerces 2018) for proper herbicide and pesticide practices in relation to land management needs.

This publication provides actionable guidance on monarch-friendly land management for all sectors, including farmers, ranchers, homeowners, and public land managers. Guidance includes appropriate windows for herbicide and/or insecticide application (if needed) and precautions during application to avoid or minimize direct and indirect harm to all monarch life stages. State liaisons, municipalities, and state and federal regulators are encouraged to practice these pesticide BMPs in lands under their jurisdictions.

Action Provide insecticide/herbicide BMP
UID-S3-B: training to technical service providers working with private landowners, water and irrigation districts, and municipalities.

State Departments of Agriculture, monarch/pollinator NGOs, university extension agents, and other government liaisons are encouraged to provide technical assistance to municipal maintenance and parks departments and land development corporations (resource extraction, energy generation, suburban planners) on integrated pest management for insect pests and integrated vegetation management for invasive plants. Training should include alternatives and BMPs for pesticide use that avoids or minimizes risks to non-target organisms.

Action Encourage big box stores (e.g., Home
UID-S3-C: Depot, Walmart) to purchase native nectar plants and milkweed host plants from vendors that do not treat nursery stock with neonicotinoids, and encourage sales of local milkweed species rather than tropical milkweed.

The regionally-based brochure to be created should be distributed to garden centers and nurseries to demonstrate public demand for native plants, including milkweeds and nectar-rich flowers and shrubs. Demand will likely increase as more monarch conservation efforts get underway. Also encourage big box stores to refrain from selling non-native milkweeds.

6.4. Rights-of-Way

Transportation and utility ROWs are present throughout the western U.S. landscape through every type of land use and habitat, from mountains to the lower deserts. While there are many types of ROWs in the western U.S., transportation and energy/utility ROWs are among the largest and most extensive networks. Utility ROWs comprise about 12 million acres of land in North America (Peterson et al. 2015). Transportation ROWs, including roads and railroads, represent even more potential acres of wildlife habitat; in 1995, Cook and Daggett (1995) estimated that 0.8% of the U.S. land surface area was occupied by roadways that have associated ROWs.



Rennett Stowe/Flickr.

Vegetation within these ROWs are typically managed to prevent the growth of trees and other large woody vegetation, resulting in land that is in a perpetual state of arrested succession such as grassland, meadow, or shrub-scrub type habitats (MAFWA 2018). This successional management presents a unique opportunity for land managers and transportation and utility ROW holders to create habitat for species that depend on successional vegetation, such as the monarch butterfly (MAFWA 2018), especially in areas that already have moderate to high suitability for habitat, as indicated on the habitat suitability models developed by the Xerces Society, USFWS, and other partners (Dilts et al. 2018). The most common types of ROWs and their associated habitat opportunity areas include (MAFWA 2018):

Transportation:

- Highways (e.g., U.S. or state-marked routes)
- County and township roadways
- Urban roadways
- Railroad ROW
- Stormwater runoff and retention areas
- Other managed lands

Utilities:

- Electric ROW
- Transmission power line ROW (≥ 69 kV)
- Substation ROW
- Distribution power line ROW
- Oil and gas ROW

Maintenance within the ROWs is typically accomplished using a combination of mechanical, chemical, cultural, physical, biological, and ecological techniques (McLaughlin 1997, 2002 as cited in Nowak and Ballard 2005); commonly, two or more of these treatments are applied to any given site at any given time (Nowak and Ballard 2005). Mechanical treatments typically include vegetation removal using mowers or other mechanical equipment. Chemical treatment techniques typically employ the use of a variety of herbicides. Mowing is frequently used to maintain roadside vegetation, reducing invasive weeds and encroaching woody plants. However, mowing can have a significant impact on pollinating insects through direct mortality, vegetation structural changes, and removal of floral resources for foraging pollinators and butterfly host plants (Hopwood et al. 2015a). Widespread mowing can lead to a reduction in host plants and foraging resources, thereby reducing pollinator reproduction and survivorship, and forcing pollinators to seek alternative habitat (Hopwood et al. 2015a). Herbicides can be a valuable management tool to control woody vegetation as well as invasive weed species on roadsides; however, herbicide use has both indirect and direct effects on pollinators, including

changes to the composition of the plant community, removal of nectar source plants, and toxicity to the butterflies (Hopwood et al. 2015a).

A number of initiatives to improve monarch habitat within ROWs are currently underway. The U.S. Department of Transportation Federal Highway Administration (FHWA), in collaboration with Xerces Society, recently published two guidance documents for the creation and management of monarch and pollinator habitat within roadside ROWs (see ROW-S1 strategy below). Additionally, a CCAA for energy and transportation lands is being developed by a group of ROW management entities, including utilities, oil and gas companies, state departments of transportation, the FHWA and the Federal Railroad Administration.

Strategies to improve monarch habitat within ROWs include extensive coordination among agencies and ROW holders, developing and disseminating guidelines and BMPs for developing and maintaining monarch habitat within ROWs, including developing more detailed regionally-specific guidance, and continued education and collaboration among the partners to maintain and improve upon monarch initiatives. Strategies for increasing or improving monarch and pollinator habitat along ROWs will vary depending on the ownership, safety concerns and regulations, and competing vegetation management objectives in any particular location.

ROW-S1 Encourage the use of BMPs to promote monarch-friendly habitat within ROWs.



Showy milkweed flourishes in the median along I-82 near Prosser, Washington, after Washington State Department of Transportation revised mowing practices to be more pollinator friendly. WSDOT.

Given the multiple jurisdictions, landownerships, and management requirements and restrictions that extensive ROWs holders must navigate, it is essential to have cohesive strategies and guidance for monarch and pollinator habitat that cross jurisdictional boundaries and are recognized by multiple land management agencies. This coordination team would be tasked with the following actions:

Action ROW-S1-A: Encourage ROW managers for transportation, as well as public and private utility programs and surrounding private landowners (i.e., solar, pipeline, electric) to adopt monarch-friendly management practices (see Proposed Nationwide Candidate Conservation Agreement with Assurances [CCAA] for Monarch Butterfly on Energy and Transportation Lands for appropriate measures).

As seen in the Monarch Conservation Implementation Plan (Monarch Joint Venture 2018; see Appendix B), there are many resources available for information and guidance on monarch and other pollinator habitat, and many land management agency initiatives that have been or are currently being developed. The Monarch Conservation Implementation Plan identifies a number of resources specific to ROWs within Section 1 (H-3) of their Strategy table.

Monarch Joint Venture’s *Roadsides as Monarch Habitat* project partnered with Oklahoma State University and Xerces Society to provide tools to support transportation managers who want to enhance or maintain monarch habitat in roadside corridors. The project incorporates GIS prioritization modeling to predict high-quality areas for habitat development, habitat assessment protocols, a habitat calculator, and decision support tools for regionally-specific and context-dependent BMPs (see Appendix B).

As stated above, the FHWA recently contracted Xerces Society to produce two documents offering specific guidance for roadside vegetation management. While these guidance documents are specifically designed for roadside ROWs, many of the management recommendations are applicable to railway, utility, transmission, pipeline, and other ROWs, as many

different types of ROWs have similar vegetation requirements and management practices:

- *Roadside Best Management Practices that Benefit Pollinators: Handbook for Supporting Pollinators through Roadside Maintenance and Landscape Design* (Hopwood et. al. 2015b). http://www.xerces.org/wp-content/uploads/2016/08/BMPs_pollinators_landscapes.pdf
- *Pollinators and Roadsides: Best Management Practices for Managers and Decision Makers* (Hopwood et.al. 2016). http://www.xerces.org/wp-content/uploads/2016/07/BMPs_pollinators_roadsides.pdf

The Xerces Society also prepared a guidance document for monarchs specific to the western U.S. This is an important resource given the vastly different landscapes, abundance of public lands, and behavioral differences of the western U.S. population of monarchs.

- *Managing Monarchs for the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat* (Xerces 2018) https://xerces.org/wp-content/uploads/2018/04/18-009_01-Monarch_BMPs_Final_Web.pdf

Action ROW-S1-B: Apprise ROW management authorities about existing and emerging legislation, policies, and commitments at the national, state, and local level that could affect their operations or underlying landowners.

A large part of managing a network of ROWs is navigating the jurisdictional, legal, and political landscape through which the ROWs run. In order to ensure that ROW holders have the most up-to-date information regarding monarch and pollinator legislation, policies, and commitments at the national, state, and local levels, the multi-agency coordination team should disseminate this information annually, or as soon as new legislation, policies, or commitments are in place. An example of upcoming conservation commitments of interest is the Nationwide CCAA for Monarch Butterfly on Energy and Transportation Lands, which was submitted to the USFWS for review in December 2018. A discussion of this CCAA follows under Strategy ROW-S3.

ROW-S2 Promote the use of regionally-appropriate native milkweeds, forbs, grasses, and other native plant materials for habitat restoration and other vegetation management actions within ROWs.

Some of the state/county DOTs and larger utilities already have established native plant nurseries for conducting habitat restoration within their ROWs. These established nurseries should be encouraged to collect seed from local populations of milkweed and nectar sources in order to establish sources of monarch-friendly plants for future seeding or habitat restoration. The state/county DOTs and larger utilities that do not already have nurseries in place for habitat restoration should be encouraged to establish native plant nurseries in order to have a ready stock of monarch- and pollinator-friendly species. For geographically-large agencies and utilities, multiple native plant nurseries may be necessary to service ecologically distinct regions. Maintaining a native plant nursery may not be feasible for many smaller DOTs and utilities, so encouraging use of a network of local native plant nurseries is critical to ensure that ecologically-appropriate materials are used within ROW habitat restoration and maintenance. Native plant nurseries should be encouraged to collaborate with ROWs holders to host workshops on integrating monarch habitat into their vegetation management tools and guidelines.

Action ROW-S2-A: See NL-S4-A

Recommendation should include resources for native milkweed and nectar species that are regionally-appropriate. Examples of available resources include:

- The Xerces Society has accessible resources online to identify milkweed species and nectar species that are local to an area, including a seed finder tool and nursery recommendations.
<https://xerces.org/milkweed-seed-finder/>
<https://xerces.org/monarch-nectar-plants/>
- In the southwestern U.S. the Southwest Monarch Study is also a valuable resource to identify appropriate milkweed and nectar plants, and find local native plant nurseries growing milkweed.
<https://www.swmonarchs.org/index.php>

- An online native plant selection tool for roadside managers is available here:
<http://www.nativerivegetation.org/era/>

ROW-S3 Create and/or maintain collaborative partnerships (e.g., between DOTs and utilities) to promote monarch conservation and exchange information.

There is opportunity for agencies and utilities to engage in more focused collaboration to achieve specific goals and objectives. As an example, preparation is underway for a Nationwide Monarch CCAA for Energy and Transportation Lands by the ‘Rights-of-Way as Habitat’ Working Group, a group of ROW management entities, including utilities, oil and gas companies, railroads, and state departments of transportation. Active participants include several western entities. This CCAA provides incentives for non-federal property owners to engage in voluntary conservation activities that provide a net conservation benefit to the species. This agreement then provides participating property owners with a permit containing assurances that if they engage in certain conservation actions for species included in the agreement, they will not be required to implement additional conservation measures beyond those in the CCAA if the monarch butterfly is federally listed. A draft of the completed CCAA and associated Environmental Assessment was submitted to the USFWS in December 2018.

Another excellent example of partner collaboration is the current effort by Xerces Society and Electric Power Research Institute to evaluate opportunities for power companies to contribute to monarch butterfly conservation. The draft guidance, which will include specific conservation actions that power companies can implement to help monarchs, is anticipated to be completed in November 2018.

The Mid-America Monarch Conservation Strategy provides additional recommendations for collaboration with ROW management entities (MAFWA 2018):

- Continue to foster information sharing and supportive partnerships through the Rights-of-Way as Habitat Working Group, a nationwide group representing more than 200 organizations from



Energy transmission corridors offer good opportunities to create continuous monarch habitat across larger landscapes. Xcel Energy.

across private industry, government agencies, non-profit organizations and academia;

- Support research that will help make the business case for investing in monarch and pollinator habitat establishment and management in ROW environments;
- Work to begin engaging contracting companies (i.e., not just DOTs and utilities) in monarch and pollinator habitat discussions since these are often the “boots on the ground” for vegetation work in ROWs;
- Build networks or partnerships that will aid in tracking monarch habitat accomplishments and progress towards habitat goals on ROWs, including better data on milkweed baseline conditions and response. Include communication between USFWS, current participants of the Rights-of-Way as Habitat Working Group, and state and local agencies;
- Influence policy change to allow for or incentivize increased conservation practices in ROW and utility areas.

Action ROW-S3-A: Encourage participation of ROW management authorities in the Rights of Way as Habitat Working Group (<https://monarchjointventure.org/news-events/news/rights-of-way-as-habitat-working-group-aims-to-help-create-preserve-monarch>)

Action ROW-S3-B: Promote industry initiatives for pollinator habitat conservation (e.g., Electric Power Research Institute’s Power-in-Pollinators Initiative).



In the arid West, milkweeds often colonize the edges of irrigated croplands or irrigation canals, creating hedgerows of productive monarch breeding habitat. Beth Waterbury/IDFG.

6.5. Agricultural Lands

Agricultural lands are as diverse as the ecoregions found in the western states, forming mosaics of xeric and mesic landscapes developed from volcanic, glacial, and alluvial processes. The West's arid basins and rangelands support grasses and forbs commonly used for livestock grazing. Such areas are generally unsuitable for cultivation because they are too cool, too hot, too arid, or have soils too shallow or infertile to raise crops. Intense agriculture, dryland farming, and irrigated crops occur in some of the key breeding areas for monarch butterflies in the West, located in the alluvial valleys within the Central Valley of California, the Snake River Plain in Idaho, and the Columbia River Plateau in southeastern Washington and northeastern Oregon.

Monarch butterfly breeding habitat consists of native milkweed and often includes flowers for nectar and trees and shrubs for cover. Native milkweeds serve as the obligate larval food plants for monarch butterflies.

Milkweed species richness varies greatly across the seven western states due to latitude and local variability in topographic and edaphic characteristics. At a statewide spatial scale, three to six milkweed species occur in Idaho, Nevada, Oregon, and Washington while Arizona, California, and Utah had 29, 15, and 17 species, respectively. Only seven species have growing seasons that extend into August and September (*Asclepias californica*, *A. eriocarpa*, *A. erosa*, *A. fascicularis*, *A. linaria*, *A. speciosa*, *A. tuberosa*) (Stevens and Frey 2010). A suspected factor of western monarch decline is the loss or degradation of breeding and migratory habitat due to intensive agriculture. Impacts of agricultural intensification can include clean farming practices that eliminate weedy edges or hedgerows that formerly provided milkweed and nectaring habitat, and excessive pesticide use, mowing, or grazing which can decrease milkweed and nectar plant availability.

AL-S1 Encourage landowners to voluntarily maintain diversified agricultural landscapes to benefit monarchs.

Creating a more diversified agricultural landscape has the potential to provide monarch breeding and migratory habitat, maintain rich pollinator communities, promote connectivity, and increase pollination of crops and wild plants. The production of over 75% of the world’s most important crops that feed humanity and 35% of the food produced is dependent upon animal pollination (Klein et al. 2007). Bees comprise the dominant taxa providing crop pollination services, but birds, bats, moths, flies, and other insects can also be important. Wild pollinators can nest within fields (e.g., ground nesting bees) or fly from nesting sites in nearby habitats to pollinate crops (Ricketts 2004).

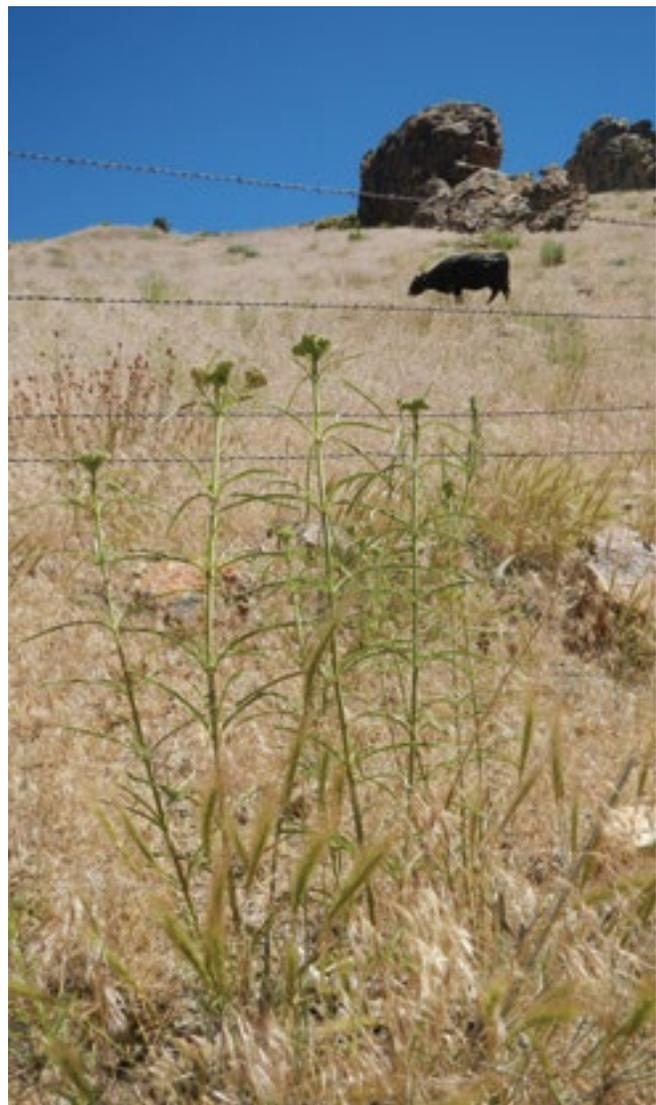
There has been increasing evidence that conserving wild pollinators in habitats adjacent to agriculture improves both the level and stability of pollination, leading to increased yields and income (Klein et al., 2003). Diversified agricultural landscapes containing flowers in bloom throughout the growing season hold the potential for increasing monarch habitat and facilitating crop pollination. Landowners may consider:

- Planting and maintaining nectar flowers, including native milkweeds, which bloom from March through October along field edges, riparian areas, irrigation canals, etc.
- Allowing native milkweeds to grow in areas that are naturally conducive to milkweed (e.g., margins of fields, runoff collection areas, wet meadows, riparian areas, etc.).
- Synchronizing flower phenologies with pollinator phenologies to facilitate crop pollination. Work with USFWS, NRCS, and cooperative extensions to adjust species lists that optimize flowering periods with crop production schedules. Prioritize native plants that bloom before and after crop bloom (Vaughan et al. 2007).
- Minimizing drift of all herbicides and insecticides used, especially systemic insecticides such as neonicotinoids to areas that provide breeding monarch sites.

Action Develop and distribute brochures/ educational materials highlighting the benefits (increased seed/fruit set) of increased pollinator visitation achieved by providing and maintaining pollinator habitat along field edges, riparian areas, ditches, fencerows, etc.

Action Develop and distribute flowering plant species lists formulated to optimize flowering periods with crop production schedules.

Action Develop materials and provide training on proper pesticide application to minimize drift, especially in areas providing monarch breeding habitat.



Stephanie McKnight/Xerces Society.



Hedgerows of flowering plants, including woolleypod milkweed (*Asclepias eriocarpa*), enhance pollination and pest control services for almond growers in California's Central Valley. Xerces Society.

Action Create and utilize demonstration sites
AL-S1-D: in agricultural areas to encourage on- or near-farm/ranch habitat installation or enhancement.

AL-S2 Promote incentive and easement programs and grants to increase volunteer landowner efforts to add or maintain breeding and migratory habitat on private agricultural lands for the monarch butterfly and other pollinators.

The costs of setting aside a portion of agricultural operations and the potential for affecting production yield and profits may make it cost prohibitive for landowners to volunteer to establish habitat for monarch butterfly and pollinators. Initial expenditures to create habitat containing native milkweed and other native forbs may be high. However, once established, landowners incur minimal annual maintenance costs that they can incorporate into their operational expenses. Therefore, a critical need exists for financial assistance for landowners that allows them to afford the initial enhancement, restoration, or creation of monarch habitat. The 2014 Farm Bill provides multiple funding programs to assist in the affordability of establishing monarch and pollinator habitat on private lands.

The USDA, NRCS, and Xerces Society produced Biology Technical Note No. 78, 2nd Ed, *Using 2014 Farm Bill Programs for Pollinator Conservation* (USDA 2015), which encourages landowners to enhance their farm management to better benefit monarchs, pollinators, and beneficial insects. Incentive-based

programs present good opportunities for financial assistance (Appendix B), and in many cases, they also provide technical assistance to implement a successful project and ensure ongoing habitat quality.

Action Promote collaboration between public and private groups and programs to identify incentive and easement programs on agricultural lands, and collaborate with private landowners regarding these options.
AL-S2-A:

Action Increase participation in existing funding programs by sharing information presented in Appendix B. Incentive-based programs offer viable opportunities for financial and technical assistance to implement successful projects.
AL-S2-B:

Action Provide landowners with information regarding the various options for obtaining regulatory assurance when participating in voluntary conservation.
AL-S2-C:

Action Work with NRCS in the West to identify relevant western neonic-related programs similar to "CSP Enhancement E595116Z2: Reducing routine neonicotinoid seed treatments on corn and soybean crops."
AL-S2-D:

AL-S3 Prioritize areas to focus monarch conservation that facilitate habitat connectivity through agricultural landscapes.

Action Support research to identify migratory routes and habitat suitability in agricultural areas to determine priority areas to focus conservation efforts in the agricultural landscape.
AL-S3-A:

Action Use connectivity models being developed for California's Central Valley (e.g., NRCS, Xerces/UNR/industry partners) to guide efforts for creating monarch habitat within agricultural areas, with intent to expand to other large agricultural areas in the West.
AL-S3-B:



With technical assistance and financial incentives provided by NRCS, the owners of Illahe Winery in Oregon's Willamette Valley established pollinator habitat between rows of grapes. Robert Hathorne/NRCS.

Action Engage private hunting ranches/clubs
AL-S3-C: to incorporate monarch-friendly BMPs in their management plans for wildlife and crop production in partnership with organizations such as Pheasants Forever, Quail Forever, Ducks Unlimited, and National Wild Turkey Federation.

AL-S4 Encourage BMPs for grazing operations that maintain native milkweed, native forbs, and native grasses that serve as nectar and breeding habitat for the monarch butterfly and other pollinators.

Approximately 70% of all lands (public and private) are grazed by livestock. Therefore, rangeland managers can play an important role in monarch butterfly conservation. Monarch butterfly conservation will not require a complete shift in how managers work in these landscapes but may require adjustments to timing, intensity, and scale. If managers consider all components of these ecosystems, monarch butterflies, pollinators, and the flowering plants that depend on them will benefit.

The Monarch Joint Venture, NRCS (USDA CSP Activity E528136Z3 Prescribed Grazing), and Xerces Society (Xerces 2018) support compatible grazing strategies that will increase milkweed and nectar plant persistence and robustness in the monarch butterfly breeding range. The primary strategy for rangelands in the western states is to identify, protect, and manage existing milkweed populations, as well as promote monarch- and pollinator-compatible land stewardship practices. Active restoration of monarch habitat in rangelands is not likely to be a primary strategy, as management activities for establishment may not align with rangeland managers' management practices. Irrigation may be required during the first year after planting and rangelands, especially in arid regions of California, Nevada, and the Southwest, may not have the infrastructure or water supply to accommodate this need.

Managers may consider planting monarch breeding and migratory habitat in areas protected from grazing, such as areas around ponds, streams, riparian areas, or wetlands. These mesic areas allow for diversification of vegetation, including milkweed and other pollinator resources.

The Xerces Society's *Managing for Monarchs in the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat*, provides an excellent summary on grazing. However, variations among sites over time and in grazing habits of different livestock require consideration. Ranchers should also consult with rangeland management specialists from cooperative extensions or NRCS about strategies likely to be successful on their properties or leased lands to promote milkweed as well as plants that provide nectar and cover for monarch butterflies.

Action Identify and encourage protection of
AL-S4-A: areas containing milkweed on rangelands through application of BMPs compatible with grazing operations.

Action Develop BMPs for grazing on public lands,
AL-S4-B: and implement these through the lease/contract process.

- Depending on location, avoid grazing during the spring and summer when butterfly larvae are active on host plants to reduce larval mortality or removal of milkweed and nectar resources.
- Avoid known monarch breeding areas. Do not graze areas that contain milkweed and nectar habitat during the active breeding and migratory timeframe for farm's latitude (see Xerces 2018, p. 24 for recommended management timing for monarch breeding habitat in the West).
- Consider rotational grazing to minimize overgrazing potential during the monarch breeding and migration period. Move cattle to allow recovery of native vegetation.

Action Utilize or customize available grazing/
AL-S4-C: pollinator habitat information:

- <http://www.xerces.org/guidelines-pollinators-in-natural-areas/>
- <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/pollinate/?cid=nrcseprd402207>

6.6. Education and Outreach

Monarch butterflies are an iconic species that many people can easily identify. The recent decline in the western population of this species is an opportunity to involve the broader public and many specific groups in conservation efforts to benefit not only the monarch butterfly, but all pollinators, as well as other wildlife dependent on the same habitat.

Education and Outreach Strategies are listed below. The remainder of this section is organized in sections describing specific goals, messages, and opportunities to engage eight different audiences about monarch butterfly conservation. These groups are not exclusive and are likely to overlap. Some of these groups are also likely to be helpful messengers to some of the other identified audiences. A first step will be to develop easy reference fact sheets for each of these audiences that can be distributed or referenced before interacting with these audiences.

EO-S1 Partner with target-audience experts to develop easy reference fact sheets or brochures specifically targeting each of the eight identified audiences.

Action Convene breakout sessions targeting
EO-S1-A: the eight audiences at the 2019 Western Monarch Meeting to initiate development of content consistent with the Plan's goals for each audience, and elicit volunteers to help produce brochures.

EO-S2 Develop state brochures that integrate audience-targeted information from EO-S1 with state-specific information for distribution within each of the western states.



Dusty Perkins/CWI

Action Each state will work with their partners
EO-S2-A: to develop their state-specific brochure consistent with the messaging as outlined in the Plan and the target-audience brochures.

EO-S3 Organize, encourage, and facilitate citizen science projects to collect information on the most important regional information needs (e.g., populating the Western Monarch Milkweed Mapper) to fill information gaps.

Action Use state outreach tools (e.g., social
EO-S3-A: media, press releases, etc.) to direct attention to each state's information needs and reporting to identified westwide or statewide databases (e.g., Western Monarch Milkweed Mapper, Monarch Health Project). See Research Strategies for priority information gaps.

EO-S4 Encourage and help facilitate the outreach efforts of local NGOs and grass roots organizations helping to implement this Plan.

6.6.1 General Public

Goal Raise public awareness about recent declines in monarch butterfly populations and encourage citizen involvement in local efforts to survey for monarchs and milkweed and to support and create monarch habitat on their land and with local governments.

Action Use WAFWA member agency outreach
EO-6.6.1-A: tools (e.g., social media, press releases, etc.) to communicate identified messages. Also See EO-S3-A.

Action Provide state specific brochures at
EO-6.6.1-B: public use areas such as wildlife areas, parks, nature centers, etc. to inform the visiting public.

Messages:

- Habitat loss and degradation are the main threats to monarchs followed by pesticide use and climate change.



Participants in a Monarch Conservation for Land Managers workshop in Boise, Idaho head to the field. Beth Waterbury/IDFG.

- You can help study and conserve monarch by taking these actions:
 - › Participate in any of a variety of monarch-focused citizen science projects (see Appendix B);
 - › Create monarch habitat at home using important nectar plants in your garden (<https://xerces.org/monarch-nectar-plants/>);
 - › Encourage local government to support habitat creation and maintenance projects (e.g., Mayors for Monarchs campaign; see Appendix B);
 - › Reduce use of insecticides and pesticides in your garden;
 - › Refrain from planting non-native milkweed;
 - › Keep monarchs wild! Refrain from large-scale captive rearing of monarchs. Focus instead on protecting and improving monarch habitat (i.e., planting native milkweed and nectar plants);
 - › Do not buy monarch stock online or elsewhere, which can introduce parasites and disease to wild monarchs.

Opportunities:

- WAFWA member agency social media.
- WAFWA member agency wildlife areas, parks, and other opportunities to provide materials to the interested public.

6.6.2 Natural Resource Land Managers

Goal Exchange information between natural land managers regarding successful practices that benefit multiple species including monarch butterflies and other pollinators.

Action Provide opportunities for exchange of information during WAFWA meetings.
EO-6.6.2-A:

Action Request inclusion of monarch/pollinator issues as agenda items during meetings of existing land management coordination groups, forums, and meetings.
EO-6.6.2-B:

Messages:

- Xerces (2018) provides science-based and up-to-date BMPs specific to western land management, available here: <https://xerces.org/managing-monarchs-in-the-west/>.
- Benefits to monarch butterflies can be achieved through minor modification of existing land management programs and activities.
 - › Focus first on identifying, protecting, and managing existing habitat to maintain its value for monarchs.
 - › Include milkweed and temporally-diverse nectar sources in planting palettes for restoration and enhancement projects, including post-fire rehabilitation efforts, in priority areas that historically supported milkweed.
 - › Avoid using management practices such as mowing or burning in habitat suitable for monarch life stages during times when monarch immature stages (eggs, larvae, pupae) are present.

- › Include retention of regional milkweed species and protection of mesic sites as management objectives in grazing management plans.
- › While milkweed is sometimes toxic to livestock, conserving milkweed is compatible with livestock grazing, if basic precautions are taken as outlined in Xerces (2018).
- Restoring habitat for monarchs benefits other pollinators, greater sage-grouse, and other wildlife.
- Considering monarchs in management decisions does not necessarily mean higher costs.

Opportunities:

- WMWG.
- Existing multi-agency land management coordination and communication efforts.

6.6.3 Agricultural Land Managers

Goal Share information with agricultural land managers about the broader benefits of conservation practices that incorporate monarch habitat and share existing BMPs in useful formats.

Action Provide agricultural extensions and agricultural associations (e.g., Cattlemen’s Associations, Farm Bureaus, etc.) with existing guidance documents, reports, quick guides, and other information for communication with landowners.

EO-6.6.3-A:



A pollinator habitat demonstration area at the Scatter Creek Safety Rest Area north of Centralia, Washington. WSDOT.

Messages:

- Agricultural landowners are important stewards of natural resources and can serve a vital role in monarch recovery efforts.
- Integrating monarch butterfly breeding and nectar habitat into existing operations can have cascading benefits for the landowner.
- Best management practices have been developed and conservation staff is available to help you.
 - › Xerces (2018); <https://xerces.org/managing-monarchs-in-the-west/>
 - › Use Farm Bill programs for pollinator conservation publication; <https://xerces.org/guidelines/using-farm-bill-programs-for-pollinator-conservation/>
 - › NRCS monarch initiative and working lands for wildlife; www.nrcs.gov.

Opportunities:

- Agricultural extension staff trained in the above materials and empowered to share them with landowners.
- Existing associations that represent agricultural interests (e.g., Cattlemen’s Associations, Farm Bureaus, etc.) provide opportunities to connect with landowners and operators.
- USFWS funded development of *A Quick Guide* for farmers with different scales of investment outlined for providing monarch habitat on farm lands.

6.6.4 Rights-of-Way Managers

Goal Share information with ROWs managers about the broader benefits of conservation practices that incorporate monarch habitat and share existing BMPs and outreach materials in useful formats.

Action See ROW-S3-A and B.

EO-6.6.4-A:



Ryan Hagerty/USFWS.

Action
EO-6.6.4-B: Explore and encourage providing monarch/pollinator information in DOT Adopt-a-Highway Programs and at rest areas, especially in association with demonstration habitat.

Messages:

- BMPs specific to various types of ROWs are available (see Strategy ROW-S1).
- If approved by USFWS, ROWs managers can enroll in a CCAA to gain regulatory assurances in case the monarch becomes listed.

Opportunities:

- Encourage participation in the Rights-of-Way as Habitat Working Group organized by the Energy Resources Center at the University of Illinois-Chicago.

- Support industry initiatives, such as Electric Power Research Institute's Power-in-Pollinators Initiative.
- Public communication opportunities such as DOT Adopt-a-Highway and rest areas with pollinator Waystations.
- The Monarch Highway initiative can provide inspiration and reference for connected conservation efforts among DOTs in the West; <https://monarchjointventure.org/i-am-a/departement-of-transportation/>

6.6.5 Landowners Adjacent to Overwintering Sites

Goal Encourage landowners adjacent to overwintering sites to appreciate the unique natural phenomenon in their backyard and support existing conservation efforts.

Action
EO-6.6.5-A: Develop a mailer or handout that grove site managers can provide to adjacent landowners that informs them of the importance of the site and voluntary actions they can take to help conserve it.

Messages:

- The overwintering behavior you get to observe is a globally unique phenomenon!
- This stage of the western population's life cycle is a vital part of a complicated journey.
- As property owners in the vicinity of overwintering sites, you are included as stewards of the site and should consider needs of the monarchs in your landscape decisions.
- There are things you can do to support conservation at this location:
 - › Work with conservation teams to implement site-specific grove management plans.
 - › *Protecting California's Butterfly Groves: Management Guidelines for Monarch Butterfly Overwintering Habitat* (<https://xerces.org/protecting-californias-butterfly-groves/>).

- You can spread the word about this unique event and encourage your friends to reduce threats to monarchs throughout their migratory pathway.
- You can participate in monitoring the overwintering population of monarchs through the Western Monarch Thanksgiving Count (<https://www.westernmonarchcount.org/>).

Opportunities:

- Communicate directly with landowners related to the Top 50 priority overwintering sites.
- One-on-one engagements between conservationists in the field and landowners.
- Engaging landowners through public meetings and workshops.

6.6.6 State and Local Political Leadership

Goal Raise awareness of state and local political leaders about recent declines in monarch butterfly populations and encourage action to mitigate threats to the species.

Action Empower citizens with accurate and consistent messaging regarding the plight of monarchs and pollinators and provide citizens with effective strategies for communicating with their government representatives.

EO-6.6.6-A:

Messages:

- A species beloved by the public is in serious decline and conservation efforts for this species are popular with the public.
- The main threats to monarch are loss and degradation of habitat, followed by pesticide use and climate change.
- You can help conserve monarch by taking these actions:
 - › Include pollinator habitat considerations in General Plans and other jurisdictional decisions.

- › Limit or time insecticide applications within jurisdictional operations.
- › Enact policies and ordinances that protect pollinator and monarch habitat.
- › Dedicate financial resources to protecting monarch habitat and identified research priorities.
- › Join Mayors for Monarchs Campaign (see Strategy UID-S1).
- › Consider implementing incentive-based programs and outreach materials (e.g., public service announcements) to encourage reduction in pesticide use, and maintenance of pollinator habitat.
- › Participate in local habitat projects and share your experience with the public.

Opportunities:

- Public popularity of monarchs and gardening for butterflies.
- Incorporation of pollinator considerations in existing local programs, planning, and policy making processes.
- Many national initiatives exist to join on the state and local level.

6.6.7 Monarch Enthusiasts

Goal Encourage and inspire monarch enthusiasts (local monarch conservation groups) to take action in ways that align with this Plan.

Action Leverage the extensive network of monarch groups and enthusiasts by communicating consistent messaging through agency media tools, especially social media.

EO-6.6.7-A:

Messages:

- Thank you for appreciating and loving monarch butterflies.
- Please help by:



Monarchs inspire and sustain a rich array of citizen science programs supported by dedicated volunteers. Dusty Perkins/CWI.

- › Spreading the message about the recent declines in the western monarch population and how people can help (see general public messages).
- › Sharing resources from this Plan with your contacts in natural lands management, private lands management, local government, and your community.
- › Focusing on citizen science efforts to monitor the western monarch population and identifying and protecting existing monarch butterfly habitats.
- › Creating pollinator gardens that include vital native nectar plants and native milkweed for monarchs.
- › Working with local schools on curriculum related to monarch conservation.
- › Advocating for planting native milkweed over non-native milkweed and keeping monarchs wild.
- › Discouraging milkweed planting in coastal California so as to not encourage the disruption of reproductive diapause.

Opportunities:

- Existing coordination and cross-organizational communication of the various monarch and pollinator-focused conservation groups and activists.
- Directed outreach by preparers of this Plan to communicate the adopted strategies.
- Local public meetings, workshops, webinars, press releases, social media.

6.6.8 Teachers and Non-Classroom Educators

Goal Encourage educators to use monarchs as a study organism to understand conservation and teach students about habitat. Encourage educators to focus on habitat and tagging individual wild butterflies rather than rearing.

Action Work with western state coordinators and educators to promote use of Project WILD's Monarch Marathon curriculum (<https://www.fishwildlife.org/projectwild/step-stem-and-wild-work/monarch-marathon>).

Messages:

- The recent decline in monarch butterflies is an opportunity to teach about the value of habitat and how science can inform management.
- Rearing and releasing butterflies is a great educational tool for metamorphosis and life cycles, but building habitat is a better tool for contributing to monarch conservation.
- If you want to rear monarchs in the classroom, capture them from the wild where permitted and raise/release them locally to avoid transmitting disease to wild monarchs.
- There are many existing curricula related to monarchs you are encouraged to incorporate while meeting state educational standards:



Educators use monarchs to engage students of all ages in basic organismal biology, environmental conservation, and connections between humans and nature. The Monarch Butterfly Crusader.

- › Monarch Joint Venture for educators, <https://monarchjointventure.org/i-am-a/educator>
- › USFWS Schoolyard Habitat Program, <https://www.fws.gov/cno/conservation/Schoolyard.html>

Opportunities:

- Connect with local Project WILD coordinators to find interested educators: <https://www.fishwildlife.org/projectwild>
- Connect with local monarch advocates to make sure they know where to send educators who are looking for information.
- Incorporate monarch conservation into existing Project WILD curricula.

6.7. Research and Monitoring Priorities

This section includes prioritized research needs for successful implementation and future adaption of the Plan. These research priorities were developed, in part, by the Western Monarch Conservation Science Team and the WMWG. The overarching goal of this section of the Plan is to address the primary data gaps for the western



: Ryan Hagerty/USFWS.

monarch population as timely as possible. Great strides have been made by many partners over the last few years to assess overwintering sites, population viability, milkweed and breeding monarch locations, and threats; however, there is still much to learn in order to translate current information into conservation actions that reverse the population decline. Specific strategies, actions and timelines are outlined in Appendix A.

6.7.1. Overwintering Life Stage

Researchers and land managers have identified hundreds of tree groves along the California coast and a few inland sites where monarchs spend the winter each year. It is understood that monarchs need trees for roosting and protection from the elements at these sites, however, there are still information needs regarding the more nuanced set of microclimate or microhabitat variables that make a site suitable. The following list of research needs is intended to fill key data gaps regarding overwintering sites, habitat selection by monarchs within groves, and movement between sites. The data collected will be used to develop management plans for overwintering groves, and to tailor habitat restoration and protection projects for monarchs at individual groves.

ROH-S1: Improve understanding of microhabitat and landscape-scale habitat requirements for overwintering monarchs.

Action Expand the 2018 within-grove
ROH-S1-A: Overwintering Habitat Selection Study to include additional groves and more years of study using common protocols to inform OH-S3.

An Overwintering Habitat Selection Study (within groves) was initiated in 2018 by Cal Poly San Luis Obispo, USFWS, and Xerces Society. This project should be expanded to cover multiple years and more groves. Protocols and some equipment are available for other sites to use and to incorporate into the overall study. Results should ultimately be used to create a land management tool for overwintering groves.



Edward K. Boggess.

Action
ROH-S1-B: Starting with the Top 25 sites (Pelton et al. 2016), map the functional extent, assess grove health, and ascertain landowner willingness to develop and implement management plans in support of OH-S3 and OH-S4.

As part of development grove management plans, the extent and features of each site are mapped, and grove health assessed. However, having this information for the priority sites in advance of land management planning could be used to further research into microhabitat and landscape-scale requirements and provide information for conducting outreach to landowners and neighbors, and to assess landowner interest in developing land management plans for the sites.

Action
ROH-S1-C: Initiate a study of importance of overwintering in low desert riparian/urban areas and the relative contribution of those areas to the overall population.

More and more overwintering sites are being reported in desert and urban locations far inland from the coast (e.g., Southwest Monarch Study). However, it is unknown if this is a new phenomenon related to environmental changes or just previously unreported. While many of these consist of relatively small numbers of individuals, their relative contribution to the overall population is unknown. Studying microclimate and landscape-scale conditions at these sites could provide valuable information.

ROH-S2: Improve understanding of overwintering mortality, including normal rates and causes of mortality and how to minimize excessive mortality at overwintering sites.

Action
ROH-S2-A: Expand overwintering site mortality study to include multiple other grove sites using common protocols developed at Lighthouse Field State Park to inform OH-S3.

A site-specific mortality study is in progress at Lighthouse Field in Santa Cruz by Groundswell Coastal

Ecology, Xerces Society, CA State Parks, and USFWS. This study should be expanded to multiple sites along the coast. Protocols are available to share with other sites, and no equipment is needed to collect and assess mortalities of monarchs during the overwintering season.

Action Encourage participation in the Western
ROH-S2-B: Monarch New Year Count to help inform overwintering population size changes.

In winter of 2016/2017 the Western Monarch Thanksgiving Count added a follow-up New Year Count as a way of beginning to measure overwintering mortality and/or movement. The first two years of this effort revealed a 40-50% decline from the Thanksgiving counts. While it is possible that some of this decline is attributed to movement between sites, the increase in number of sites visited the second year provided evidence that mortality was likely the cause of the observed decline. Continuation of the New Year counts at the same sites counted during the Thanksgiving Count will provide valuable data for assessing overwinter mortality and movement relative to environmental and other factors.

Action Gather more information and analyze
ROH-S2-C: the relative effects of parasites and diseases such as OE on western monarch fitness and mortality rates during the overwintering season.

Ophryocystis elektroscirrha (OE) can have debilitating effects on survival, mass, fecundity, mobility, and life span of monarchs. Research is continuing nationwide to better understand the impacts of this disease on monarch populations. Focusing sampling at western overwintering sites could provide significant contributions to the state of knowledge. This effort can be coordinated with University of Georgia (UGA) when tagging studies are conducted at overwintering sites and monarchs are already in-hand. UGA provides free OE testing kits, protocols, and analyses.

ROH-S3: Determine which nectar species are most important for overwintering monarchs in different areas of the coast and for inland sites.

Action Expand nectar usage study in
ROH-S3-A: progress at Lighthouse Field in Santa Cruz (2017-2019) to additional overwintering sites to help inform overwintering habitat restoration projects and land management plans.

A nectar usage study is being conducted at Lighthouse Field in Santa Cruz (2017-2019). This type of study should be expanded to other overwintering groves to assess which plants yield the greatest benefits for monarchs in different regions. The information will directly translate into habitat restoration projects and land management plan development for overwintering sites. Protocols are available to be shared from the Lighthouse Field study.

ROH-S4: Improve understanding of how climate change will affect monarchs relative to overwintering site conditions and locations.

Action Building off of the recent climate
ROH-S4-A: niche model (Fisher et al. 2018), develop future scenarios and potential locations where monarchs may establish overwintering clusters when adapting to climate change.

Fisher et al. (2018) provided an initial effort to model possible future scenarios and locations for overwintering groves. However, more climate niche modeling is needed to direct future management decisions to protect overwintering groves.

6.7.2. Breeding/Migration Life Stages

The scientific community has gained valuable information on some important breeding and migration areas in the western U.S. over the last few years, however, there is still much to learn in order to focus conservation efforts in a meaningful way. The Central Valley of California and the Snake River Plain and Columbia River Plateau in the Pacific Northwest are considered significant breeding areas for monarchs. There are likely other areas that are vital for monarchs that have yet to be evaluated. Monarchs have been detected migrating and roosting in riparian areas of the West, but there is still much to learn and assess for these habitats and migratory



An early instar monarch larva on pallid milkweed (*Asclepias cryptoceras*). Stephanie McKnight/Xerces Society.

pathways. The following list of research priorities are intended to address data gaps for breeding and migration of western monarchs in order focus conservation actions.

RBH-S1: Determine which part of the monarch’s life cycle is limiting population growth.

There is anecdotal evidence to indicate that there may be heavy mortality and low fecundity rates immediately following the overwintering season. With the current population estimate being so low, it is important to determine where the greatest mortality is occurring and how to promptly reverse this declining trend.

Action
RBH-S1-A: Issue an “all-points bulletin” to report monarch observations between February and April, including evidence of breeding, to the Western Monarch Milkweed Mapper to help inform where monarchs go when they leave the overwintering sites. Emphasis should be in California.

Action
RBH-S1-B: Continue to develop a demographic model of western monarchs for the full annual life cycle and conduct sensitivity analyses, expanding upon the Breeding Phenology Project with Washington State University, Xerces Society, Tufts University, DoD, and USFWS.

RBH-S2: Determine the characteristics of “good” monarch breeding and migratory habitat (i.e., habitat that promotes reproductive performance and survivorship).

Habitat types utilized by monarchs throughout the West are highly variable, from the Pacific coast to the inland valleys, from the Cascades and Sierras to the Rocky Mountains, from the Great Basin to the Mojave and Sonoran deserts. The relative importance of habitat types to the monarch butterfly within and across this broad array of ecosystems is still relatively unknown. There is a pressing need to better characterize what makes “good” breeding and migratory habitat in the various habitat types throughout the West and to translate this information into refined geographic-specific management and restoration guidelines.

Action
RBH-S2-A: Design and conduct a study to assess productive and suitable monarch breeding and migratory habitat based on monarch vital rates in various habitats, including urban gardens. Use results to refine habitat management and restoration targets and guidelines.

RBH-S3: Determine geographic areas and habitat types most beneficial to monarchs in the West in order to prioritize conservation actions.

This strategy is similar to RBH-S2 but is meant to assess where “good” habitat exists and where there is potential to improve habitat at specific geographic areas on the landscape.

Action
RBH-S3-A: Incorporate land cover data into habitat suitability models and estimate acres and location of potential high-suitability habitat occurring on public lands by agency jurisdiction.

Action
RBH-S3-B: Ground-truth habitat suitability models using a systematic research approach to help refine models and determine habitat improvement potential.

Action Update and expand habitat suitability
RBH-S3-C: modeling work to include new data and additional western states (i.e., Montana, Wyoming, Colorado, and New Mexico.)

RBH-S4: Improve understanding of monarch movements throughout the life cycle, including interchange between overwintering sites within the West, major movement and migration routes, and interchange between the western and eastern populations.

Tagging studies are key to assessing movement and migration routes of monarch butterflies, and several targeted efforts are underway in the West (e.g., Monarch Alert-Cal Poly San Luis Obispo, Washington State University, Southwest Monarch Study) to assess movement of monarchs during the breeding and migratory seasons and between overwintering sites. Information obtained from these studies may elucidate where some monarchs go when they depart transitional or autumnal overwintering sites, provide more information on which sites are most suitable throughout the entire overwintering season, and indicate how inland sites may contribute to the western and/or eastern populations. Additionally, large knowledge gaps exist regarding where monarchs go when they leave the overwintering grounds at the end of the season, presumably en route to breeding areas. Tagging is also done by backyard enthusiasts in an ad hoc manner. Tagging data and recoveries should be shared and evaluated on an annual basis.

Action Continue and expand upon current
RBH-S4-A: tagging studies (Monarch Alert-Cal Poly San Luis Obispo, Washington State University, and Southwest Monarch Study, etc.) to assess movement of monarchs among overwintering sites (both coastal and inland).

Action Identify where movement data is lacking
RBH-S4-B: in key areas of the interior West and increase tagging efforts in those areas.

Action Add ability to report and promote
RBH-S4-C: reporting of stopover roosting clusters to Western Monarch Milkweed Mapper to help determine migration corridors.

Action Synthesize and share data from tagging
RBH-S4-D: efforts, observation databases, and focused studies annually to identify migration and habitat connectivity patterns to help determine priority areas to focus additional research (e.g., corridor studies, mortalities at alternative energy facilities), and target habitat protection and restoration efforts (RBH-S3).

RBH-S5: Increase understanding of effects of pesticides on monarchs and other pollinators.

There is a lack of or disagreement in information regarding the extent to which the use of certain insecticides maybe harming monarchs. Research should be focused on developing scientific understanding of how to minimize any such risk while also ensuring crops are adequately protected and efficient vegetation and forest management practices can continue.

Action Initiate project to identify the types of
RBH-S5-A: data (including types of treated seed, application rates, etc.) and study designs necessary to better evaluate the effects of pesticides on monarchs and other pollinators in both agricultural and nonagricultural settings.

Action Collect identified key data and conduct
RBH-S5-B: studies that assess how pesticides (particularly insecticides) are affecting monarch populations (e.g., mortality and fitness impacts, habitat values).

RBH-S6: Increase knowledge of best practices to implement monarch/pollinator conservation on working lands.

Action Work with agricultural cooperative extensions and similar organizations to identify appropriate research needed to develop effective BMPs on working lands.

RBH-S6-A:

RBH-S7: Increase knowledge regarding predation, parasites, and disease affecting monarchs in the West.

Action Encourage researchers involved in monarch tagging and other studies, as well as citizen scientists involved in handling live monarchs, to collect OE samples in coordination with the University of Georgia, and report the setting where monarchs were captured (e.g., native garden, non-native garden, classroom, wild, etc.).

RBH-S7-A:

This effort can be coordinated with University of Georgia (UGA) while people are conducting tagging studies and already have monarchs in-hand. UGA provides free OE testing kits, protocols and analyses.

RBH-S8: Improve understanding of how climate change may affect monarchs relative to breeding and migratory habitat, behavior and distribution, and multi-trophic interactions (e.g., predators, parasites).

Action Once information is acquired on what constitutes “good” monarch breeding and migratory habitat in the West (RBH-S-2), conduct potential future distribution models for each of the western states using current climate change models, similar to Idaho’s recent effort.

RBH-S8-A:

Climate change impact studies to predict future scenarios for habitat and species range shifts and population level declines are underway for many species and geographic areas. One such study has been recently completed by IDFG and University of Idaho on future potential distributions of milkweed and monarch in Idaho (Svancara et al., *in review*).

6.7.3. Monitoring Strategies

This section includes the key monitoring efforts needed to track the status of the western monarch butterfly population, of threat reduction efforts, and progress towards achievement of Plan goals and objectives.

M-S1: Continue the Western Monarch Counts, both Thanksgiving and New Year counts (www.westernmonarchcount.org).

The Western Monarch Count is a citizen science project, managed by the Xerces Society, and is currently the primary way of tracking trends in the western population. The count is an annual effort of volunteer citizen scientists to collect data on the status of monarch populations along the California coast during the overwintering season, which occurs from approximately October through March. The height of this volunteer effort occurs during the Thanksgiving Count in November/December and the New Year’s Count in December/January.

Action Promote volunteer involvement in western monarch counts.

M-S1-A:

Action Provide training to agency biologists to assist in filling gaps in count coverage for key sites when necessary to count most Top 75 sites.

M-S1-B:

Action Analyze data using both summary and modeled statistics to provide indices for tracking population trends (i.e., 5-year running average of Top 75 sites and MARSS [Schultz et. al. 2017] or similar model).

M-S1-C:



Tagged monarch from the Southwest Monarch Study based in Arizona. Southwest Monarch Study.



Sampling a monarch butterfly for the disease *Ophryocystis elektroscirrha* at Stillwater National Wildlife Refuge, Nevada. Stephanie McKnight/Xerces Society

M-S2: Evaluate habitat restoration projects, techniques, successes, and failures to adaptively manage monarch and pollinator projects.

In order to adaptively manage the objectives and strategies of this Plan, the success of habitat restoration and enhancement projects needs to be measured, reported, and evaluated to the degree possible. This means conducting three types of monitoring: 1) implementation monitoring to determine if a project was installed as planned; 2) effectiveness monitoring to determine if a project is being used by monarchs and thus providing habitat as planned; and 3) validation monitoring to determine numbers of monarchs using sites, if there is breeding (as applicable), to indicate overall biological response of monarchs to the restoration actions. This information is then used to evaluate techniques, successes, and failures to adaptively manage monarch and pollinator projects so that practitioners are conducting actions and developing management plans that effectively increase and protect suitable habitat. Monitoring of individual monarch habitat restoration projects is important to determine: 1) if a project was implemented correctly (e.g., are plants alive?); 2) if a project is providing quality habitat (e.g., does the plant species diversity provide both breeding and migratory habitat or overwintering habitat, as applicable?); and 3) if the project area is being used by monarchs post-restoration (and if so, how much?). Important to these monitoring efforts is use of consistent, standardized metrics for site-level evaluation of habitat. Available methodologies need to be evaluated and most effective approaches should be shared and promoted among partners. Monitoring plans and reporting requirements should be required by the entities funding the effort and the results submitted to the WAFWA Critical

Habitat Areas Tool (CHAT) and USFWS Monarch Conservation Database, as appropriate. See Section 7.2 Implementation regarding tracking of conservation efforts.

Action M-S2-A: Implementation monitoring on all habitat restoration projects should be required or conducted by all funding entities to determine if a project was installed as planned.

Action M-S2-B: Conduct effectiveness monitoring for restoration projects when possible to determine if a project area is being used by monarchs and thus providing habitat as planned.

Action M-S2-C: Conduct validation monitoring for projects pre- and post-restoration when possible to determine numbers of monarchs using sites and to indicate overall biological response of monarchs to restoration actions.

Action M-S2-D: Monitoring plans and reports should be required by entities funding the effort and results should be submitted to the WAFWA Critical Habitat Areas Tool (CHAT) and USFWS Monarch Conservation Database, as appropriate. See Implementation Section regarding tracking of conservation efforts.

M-S3: Monitor changes in breeding and migratory patterns across the western landscape over time.

The Western Monarch Milkweed Mapper (www.monarchmilkweedmapper.org) tool is a collaborative effort to map and better understand monarch butterflies and their host plants across the western U.S. Data compiled through this project aims to: 1) improve the understanding of distribution and phenology of monarchs and milkweeds; 2) identify important breeding areas and movement corridors; 3) identify migratory cluster locations; and 4) improve understanding of monarch conservation needs. This information will benefit future updates of habitat suitability models for the West and can be shared and integrated with national efforts. Additionally, there are national monitoring



Beth Waterbury/IDFG.

programs which can be expanded in the West to accommodate western population monitoring needs.

Action Continue crowd-sourcing the collection of western monarch and milkweed observations over time using the Western Monarch Milkweed Mapper (www.monarchmilkweedmapper.org) and expand effort to include entire western U.S. region. Use appropriate statistical models for crowd-sourced data to extract trend information.

M-S3-A:

Action Encourage citizen scientists and professional biologists in western states to participate in the national Integrated Monarch Monitoring Program (IMMP) (<https://monarchjointventure.org/get-involved/mcsp-monitoring>).

M-S3-B:

The Integrated Monarch Monitoring Program (IMMP), also referred to as the Integrated Monitoring Strategy, is a national initiative developed by the Monarch Conservation Science Partnership to monitor monarch populations and habitat throughout the breeding range. The IMMP uses a spatially-balanced sampling scheme and draws from existing citizen science programs to deliver a suite of protocols that capture many aspects of habitat quality, threats, and monarch use of habitat. Data gathered through the IMMP contribute to existing population and habitat models that inform broad-scale monarch conservation. There is a need to better incorporate the western U.S. into the national strategy.

Action Seek volunteers or funding sources to establish regional or state coordinators to implement IMMP in the West.

M-S3-C:



Becky Hansis O'Neill.

M-S4: Track the long-term trends of the monarch butterfly relative to multiple butterfly or other pollinator species.

Action Continue and build upon the long-term datasets of Art Shapiro's Butterfly Project and North American Butterfly Association annual counts to track the long-term trends of the monarch butterfly relative to multiple butterfly species in western regions.

In 1972 Art Shapiro, a professor at UC Davis, began monitoring butterflies on 10 transects along an elevational gradient spanning 0–2,775 m through California's Central Valley and Sierra Nevada Mountains, conducting bi-weekly presence/absence site monitoring. This data set of over 159 species of butterflies represents the longest continually running butterfly monitoring project in the world. This valuable data set has been analyzed (Forister et al. 2010; Forister et.al. 2011) to detect trends in butterfly species richness and range shifts correlated with changes in land use and climatic conditions. It also corroborates the decline in monarchs as observed at the overwintering sites and identifies the Central Valley as an area of priority conservation need. Continuation of this effort, and other long-term monitoring efforts (e.g., North American Butterfly Association annual counts) into the future would allow detection of changes in relative abundance and phenology of monarchs and other butterflies in relation to changes in threats and conservation efforts. The University of Nevada-Reno is currently attempting to find support for continuation of the Shapiro project.

Action Explore opportunities with butterfly and insect societies, museums, and others to establish or collate similar long-term studies elsewhere in the range of the western monarch.



SECTION 7: Capacity, Funding and Implementation



Edward K. Boggess.

7.1. Capacity and Funding

The Working Group member state agencies currently do not have biologists or funding specifically dedicated for monarchs. However, it is envisioned that existing wildlife agency habitat and public outreach programs will incorporate considerations of monarchs and actions described in the strategy sections into their normal business practices. In addition, they will leverage programs, funding, and activities of other state, federal, and local entities. The capacity of the private sector, however, to effect monarch conservation is immense. With the monarch butterfly being so popular and accessible to the public, many local and non-government entities are already engaged in its conservation, and have mobilized voluntary grass-root efforts for some time. To accomplish the actions outlined in this plan and meet conservation targets, the WAFWA Working Group will be largely relying on the tremendous capacity of the vast

number of organizations, partner agencies, and interested citizens throughout the West.

To date, funding for western monarchs has largely been provided by USFWS, BLM, NRCS, NFWF, Monarch Joint Venture, Xerces Society, and private foundations with in-kind contributions from academia, state fish and wildlife agencies, and private individuals. Many of these funding sources and in-kind support are anticipated to be available in the future as well.

Recently in California, two important pieces of legislation have passed which establish funding mechanisms that are either specifically for monarch conservation or can be used to further monarch conservation goals. These are AB 2421 (Stone-D) WCB: Monarch Butterfly and Pollinator Rescue Program and AB 2697 (Gallagher-R) Nesting Bird Habitat Incentive Program: idled agricultural lands. AB 2421 established the Monarch Butterfly and Pollinator

Rescue Fund Account in the California State Treasury as well as a grant and technical assistance program to be administered by the WCB for the purpose of recovering and sustaining populations of monarch butterflies and other pollinators. In addition to state funds, donations and other grant monies can be deposited into this account, and an effort should be made to solicit donations and apply for grants. The new law specifically allows WCB to provide grants for the restoration or enhancement of monarch breeding habitat as well as overwintering monarch butterfly habitat on private and public lands. Three million dollars was appropriated in 2018 for grants.

AB 2697 requires CFW to establish the Nesting Bird Habitat Incentive Program if funding allows, which may include direct payments or other incentives, to encourage landowners to voluntarily cultivate or retain upland cover crops or other upland vegetation on idled lands to provide waterfowl, upland game bird, and other wildlife habitat cover for purposes, including, but not limited to, encouraging the use of idle agricultural lands for wildlife habitat. The bill authorizes CFW to develop guidelines and criteria for the program as it deems appropriate, and CFW intends to include habitat criteria that would be beneficial for monarchs and other pollinators. Funding for this program, however, has not yet been identified. Proposition 3, an \$8.87 billion water bond measure which would have included funding of this program, was narrowly defeated on the November 2018 statewide ballot.

Potential sources of funds for western efforts could include grant monies from Farm Bill programs, USFWS State Wildlife Grant and Wildlife Restoration Grant programs. The Recovering America's Wildlife Act (H.R. 4647), introduced by Representatives Debbie Dingell (D-Michigan) and Jeff Fortenberry (R-Nebraska) in late 2017, would provide \$1.3 billion in dedicated annual funding to state fish and wildlife agencies. The funding would largely go toward conserving and monitoring state-identified at-risk species (SGCNs). Dedicated funds would come from revenue generated by energy and mineral extraction royalties currently collected by the federal government at about \$5 billion to \$12 billion annually. This has the potential to provide funding for actions in this Plan in states where the monarch butterfly is listed as a SGCN in their State Wildlife Action Plans.

7.2. Implementation

WAFWA was founded in 1922. It currently consists of 23 member-states and Canadian provinces and territories that have primary responsibility and authority for protecting and managing fish and wildlife in the western U.S. and Canada. The 19 member-states encompass over 2.5 million square miles. The chief executive officer of each fish and wildlife agency is on the WAFWA Board of Directors.

The WAFWA Board of Directors will establish the Western Monarch Population Initiative Council (WMPIC). The directors of the state fish and wildlife agencies, or their designees, within the western monarch population range (AZ, CA, ID, NV, OR, UT, WA) will comprise the WMPIC along with a member of the Executive Committee appointed by the President. It may also include up to seven ex-officio (non-voting) members representing key sector and/or agency partners at the discretion of the Board. This relationship will ensure decision-making roles regarding how and where funds are spent for the state agencies, as well as coordination with other WAFWA conservation efforts.

The WMPIC oversees the decision-making elements of the Western Monarch Butterfly Conservation Plan 2019-2069, including organization and guidance. It will have final approval authority for the Plan and will communicate with USFWS regarding implementation of the Plan, including commitments for conservation actions. The WMPIC will also play an important role in obtaining and allocating funds and resources to accomplish conservation tasks. This structure will ensure decision-making roles regarding how and where funds are spent for the state agencies, accountability to legal requirements and outcomes, as well as coordination with other agency and organization conservation efforts. It will establish any needed standing committees and will meet annually to review activities, provide direction, and report decisions for the conservation plan.

In July 2017, the WAFWA Board of Directors created the Western Monarch Working Group (WMWG). The WMWG consists of technical or science staff from state agencies and may also include up to seven ex-officio (non-voting) members representing key sector and/or agency partners at the discretion of the WMWG to develop a conservation plan and prioritize and implement actions needed to conserve the western

monarch butterfly under the direction of the Board. It took the primary role in drafting the Plan, and will continue that role in Plan implementation, as well as tracking accomplishments, leading evaluation, and making recommendations for adaptive changes in implementation, and updating the Plan.

This structure will allow the WMWG to identify and promote coordinated, ecosystem-based management approaches at the landscape-level for the western population of the monarch butterfly and pollinators in general, across all agencies and partners. While the WMWG is envisioned to support monarch and other pollinator conservation across the western states into the foreseeable future, there was a need for near-term objectives that can be accomplished to address the short timeline for contributing to the Monarch Species SSA being conducted by the USFWS.

Therefore, the WMWG, in establishing the enabling charter identified, has established several near-term objectives specifically to inform the SSA, including the development of this Western Monarch Conservation Plan. Future objectives will focus on implementation of actions contained within this Plan with the long-term overarching goal of improving status and maintaining persistence for the monarch throughout the western portion of the species range into the foreseeable future (50 years). In addition, this WMWG will track progress of conservation actions and report to the WMPIC.

Near-term objectives included in WMWG Charter:

1. Work with western monarch experts to identify priority research and conservation needs to address priority threats in the West (accomplished April 2018).
2. Facilitate the capture of currently implemented and proposed western states' monarch butterfly conservation efforts into the FWS Monarch Conservation Database (accomplished March-September 2018).
3. Develop and present a draft Western Monarch Conservation Plan to the WAFWA Directors at the Annual Meeting in Eugene, OR, for their approval to proceed (accomplished July 2018).

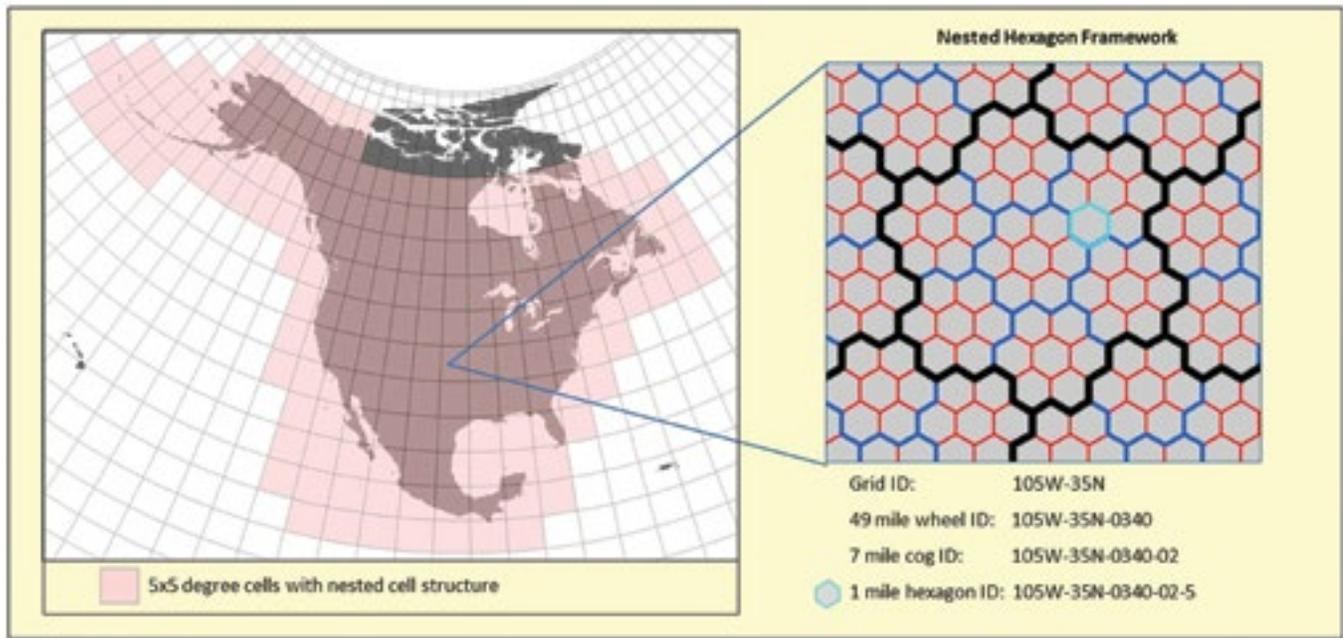
4. Present a final draft of a western Monarch Conservation Plan for approval by the WAFWA Directors at the 2019 Mid-Winter meeting in Tucson, AZ (January 2019).

Long-term objectives included in WMWG Charter:

1. Identify and promote coordinated, ecosystem-based management approaches for the western population of the monarch butterfly, and pollinators in general, across all partner agencies.
1. Identify and promote common conservation targeting efforts for the western monarch across state and federal boundaries in accordance with the adopted conservation plan.
1. Identify science and data gaps for western monarch butterfly conservation and find and direct resources to fill those gaps.
1. Facilitate conservation partnerships for western monarch butterfly management.

As with developing different components of this Plan, implementation may occur at a state or regional level. Conservation actions may dictate the establishment of various implementation teams which will play an important role in helping achieve the goals of the Plan. While composition of the implementation teams will vary among states and regions, they are usually composed of the NRCS state resource conservationist, the affected area resource conservationist(s), the state biologist, the state range conservationist, the affected regional range conservationist(s), and a GIS professional. Other entities typically included on the teams are Farm Services Agency (FSA) conservation program personnel, affected USFWS biologist(s), numerous representatives from the state fish and wildlife agencies, representatives from land trusts that deliver easements in western monarch population range, and NGOs representing interested parties. These groups will be encouraged to meet at least annually and will likely be initially facilitated by a WMWG member, which will allow for reporting and tracking of conservation actions.

Figure 12. Spatial extent of the Nested Hexagon Framework where hexagons can be ranked with CHAT scores.



7.3. CHAT: A Tool for Western Monarch Conservation Work

The Crucial Habitat Assessment Tool (CHAT) and the underlying Nested Hexagon Framework provide a mechanism for integrating multiple data sets across the landscape so informed plans and decisions can be made (Fig. 12). For the WAFWA’s western monarch effort, state wildlife agencies worked with USFWS Region 1, Xerces Society, university researchers, and other parties to create and bring together a range of data sets and ideas to help guide monarch conservation.

The monarch ranking generated by Xerces Society and processed into the hexagons represents a preliminary ranking that states can consider in the context of additional information integrated into the hexagons (Fig. 13). Additional layers that states will use to create the final ranking may include cells containing known overwintering areas, the proportion of cropland in a cell, and proportions of public/private land in a cell as these can have an influence on the potential for effective conservation actions. It is important to note that the CHAT mapping approach serves to leverage this natural resource data while safeguarding landowner privacy.

Figure 13. A diagram depicting how raw data sets are aggregated into hexagons and used to inform the identification of monarch priority rankings and in a separate but similar process conservation efforts can be associated with hexagons/cogs/wheels (depending on the spatial sensitivity) and then these will be relatable back to the monarch priority areas for reference.

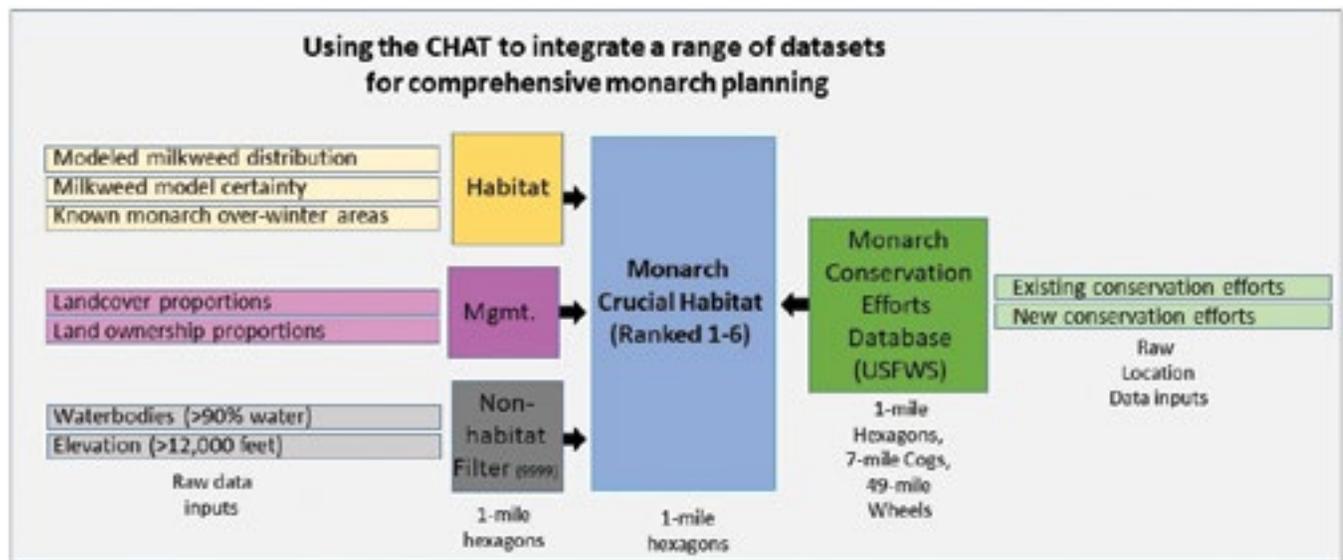


Table 2. Intersection of the high-medium-low categorized suitability and uncertainty maps for each model results in a 3x3 matrix. Below are initial suggested CHAT scores for the All_Milkweed_Max Habitat Suitability Model matrix. Recreated from draft habitat suitability report by Butts, Pelton, and Craver.

Combining milkweed probability and model confidence data to create a preliminary monarch priority ranking		Suitability		
		Low	Medium	High
Uncertainty	Low	6	2	1
	Medium	5	3	2
	High	6	5	4

Table 3. Hypothetical fields in a data table related to the CHAT and the Nested Hexagon Framework.

Mean milkweed potential	Mean milkweed certainty	Xerces rank (majority)	Known over-winter area	% large waterbody	Mean elevation	% cropland	% public	Final CHAT rank
85%	high	1	1	10%	100	5%	95%	1

Once all the data layers are integrated into the CHAT hexagons, state personnel will review the data and identify a rule set for ranking monarch habitat priority using a scale of 1–6 where 1 represents the most crucial areas for monarchs. Across the project’s extent, each 1-mile hexagon cell will be related to an attribute table similar to Table 2 that will provide a comprehensive overview of the monarch data layers.

After monarch habitat has been ranked and mapped, the task of targeting and tracking conservation efforts begins. As depicted in Table 3, the framework also allows for the integration of individual conservation efforts to be summarized into and spatially displayed using one of the three framework cell sizes. The ability of the framework cells to convey information about the effort and its general location (while not revealing its exact location) is very important, especially for efforts done on private land. Depending on the sensitivity of the dataset, efforts can be associated with 1-mile hexagons, 7-mile cogs, or 49-mile wheels. Hexagons and cogs will likely be used for most of the efforts, but some efforts through federal programs like the NRCS or the FSA that have strong Farm Bill privacy restrictions may use the 49-mile wheel to better hide the precise locations of landowner conservation efforts.

Additionally, since the framework extent covers all of the U.S. plus Mexico and Canada, monarch efforts entered into the conservation efforts database operated by the USFWS can be summarized in the framework to provide a complete view of monarch conservation efforts across the U.S.

7.4. Adaptive Management of the Western Monarch Conservation Effort

Adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resource management, using the experience of management and the results of research as an ongoing feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when deemed appropriate within the guidelines of the Western Monarch Conservation Plan.

Adaptive management is a dynamic process that helps reduce uncertainty in natural resource management by incorporating into flexible conservation plans new information as it becomes available. Adaptive management strategies allow for mutually agreed-upon changes to the conservation measures to occur in response to changing conditions or new information, including those identified during monitoring. The primary reason for using adaptive management in the Plan is to allow for changes in the conservation measures that may be necessary to reach the stated long-term goals. Under adaptive management, the conservation activities implemented under the Plan will be monitored by the WMWG to identify whether they are producing the required results (see Table 4). Additionally, adaptive management activities affecting the implementation of

Table 4. Identified activities or situations that will trigger the adaptive management process or a specific conservation action.

Evaluated element	Utilized information	Trigger(s)	Evaluation frequency	Primary corrective action(s) considered	Spatial scale	Anticipated response
Population size	5-year average population estimates derived from roost survey	5-year moving average less than predicted growth required to achieve population goal	Annually	A discussion would be triggered with working group to identify the cause of the low population. Potential corrective actions that could be taken starting in 2020 could include reprioritization of conservation actions.	Overwinter sites	Populations display growth and are in sufficient numbers to reach or exceed goals after 10 years of Plan implementation
Emerging science	Peer-reviewed literature	New peer-reviewed articles pertaining to aspects of the Plan, or conservation become available	Annually	Science team reviews materials and recommends changes if necessary	Ecoregion and range-wide	Plan and/or conservation practices modified to conform with the best available science
Habitat restoration goals	Restoration acreages presented in WAFWA Habitat Report based on CHAT	Restored acreage not on pace to achieve overall restoration	Annually	Increase prioritization of restoration practices ; modify incentive-based approach	Focal Areas and range-wide	Factors preventing maintenance at habitat goal or progress toward it are reduced or eliminated
Roost management plans	Management plans for monarch roost	Participation rate not on pace to achieve plan preparation goal	5 Years	Adjust plan preparation rates	Roost areas	Participation in long-term management plan preparation becomes sufficient to achieve 10-year goals
Avoidance of loss in high priority habitat areas	Status of high priority habitat acreage presented in WAFWA Habitat Report based on CHAT	Proportion of high priority acreage affected by new impacts does not decrease	5 Years	Reprioritize outreach efforts	Regional	Proportionally less development occurs in higher priority habitat areas

the Plan will be influenced by emerging science that fills existing knowledge gaps. Those two types of information will be used to guide adjustments in implementation of the Plan.

Some of the factors that will be evaluated regularly (at least annually) by the various committees include estimating population sizes from roost areas, establishing additional habitat goals, progress toward habitat goals, conservation practice costs, avoidance of loss or degradation of high priority conservation areas, management prescriptions, etc. Among the items being evaluated, breeding population sizes will be annually assessed by drawing comparisons between five-year averages. The five-year average is being utilized to smooth out the erratic annual fluctuations that commonly occur within populations of insects that are due solely to weather variations. Comparisons for the first five years will be drawn to an exponential growth curve between the 2019 population estimate and the population goal, because insect populations are capable of exponential growth. After the fifth evaluation, a science subcommittee will re-evaluate that portion of the trigger to determine if adjustments are necessary. All Plan cooperators will take action to identify and address the factor(s) limiting population growth if the current trigger is eclipsed.

Every five years, a more rigorous review will occur to assess each WAFWA-prescribed conservation practice relative to measurable objectives in Appendix A, the status of efforts as documented in CHAT, and progress towards achieving the stated population and habitat goals of the Plan. The conservation practices prescribed during the previous five years will be evaluated by WAFWA committees based on their ability to achieve the desired habitat improvements.

I-S1: Facilitate the exchange of information among monarch conservation partners necessary for implementation of this Plan.

Action Nevada Department of Wildlife will take
I-S1-A: lead in organizing a Western Monarch Conservation Plan Implementation Summit in 2019.

Action Promote or participate in regional
I-S1-B: coordination efforts, as appropriate, to advance plan implementation (e.g., Environmental Defense Fund's planned California Central Valley meeting in Spring 2019).

Action Establish state or regional implementation
I-S1-C: teams, as necessary.

Action Prepare and post Annual Reports on the
I-S1-D: WAFWA Monarch webpage.

I-S2: Monitor and adaptively adjust Plan goals, strategies, and actions, as warranted.

Action Monitor conservation activities implemented
I-S2-A: under the Plan, review action items and conservation targets for additions and modifications, and produce annual reports (e.g., CHAT status reports, plan addendums, etc.).

I-S3: Seek funding for monitoring, Plan implementation, and conservation actions.

Action WAFWA Monarch Working Group member
I-S3-A: states will collaborate as appropriate on grant proposals to implement actions identified in the Plan.

Action Explore possible establishment of additional
I-S3-B: funding mechanisms (e.g., California's Monarch Butterfly and Pollinator Rescue Program).



Ryan Hagerty/USFWS.



LITERATURE CITED

- Alder, J. R. and S. W. Hostetler. 2013. USGS national climate change viewer. U.S. Geological Survey. <http://www.usgs.gov/climate_landuse/clu_rd/nccv.asp>. Accessed 9 Dec 2018.
- Allen, C. R., R. S. Lutz, and S. Demarais. 1995. Red imported fire ant impacts on northern bobwhite populations. *Ecological Applications* 5:632–638.
- Altizer, S. M., and K. S. Oberhauser. 1999. Effects of the protozoan parasite *Ophryocystis elektroscirrha* on the fitness of monarch butterflies (*Danaus plexippus*). *Journal of Invertebrate Pathology* 74:76–88.
- Altizer, S., and J. C. de Roode. 2015. Monarchs and their debilitating parasites. Pages 83–93 in K. S. Oberhauser, K. R. Nail, and S. Altizer, editors. *Monarchs in a changing world: biology and conservation of an iconic butterfly*. Cornell University Press, Ithaca, New York, USA.
- Altizer, S., L. Brower, E. Howard, and K. Oberhauser. 2014. Concerns about mass-rearing and selling of monarchs. <http://learner.org/jnorth/tm/monarch/conservation_action_release.html>. Accessed 10 Dec 2018.
- Altizer, S., and A. K. Davis. 2010. Populations of monarch butterflies with different migratory behaviors show divergence in wing morphology. *Evolution* 64:1018–1028.
- Association of Fish and Wildlife Agencies (AFWA). 2015. State fish and wildlife agency activities to benefit the monarch butterfly. Association of Fish and Wildlife Agencies, Washington, D.C., USA.
- Association of Fish and Wildlife Agencies and U.S. Fish and Wildlife Service (AFWA and USFWS) 2015. Joint memorandum regarding collaborative efforts to conserve the monarch butterfly and other pollinators. <https://wsfrprograms.fws.gov/subpages/pollinators/FWS_AFWA%20Letter%20Supporting%20Monarch%20and%20Pollinator%20Conservation_10March2015.pdf>. Accessed 30 Oct 2018.
- Batalden, R. V., K. Oberhauser, and A. T. Peterson. 2007. Ecological niches in sequential generations of eastern North American monarch butterflies (Lepidoptera: Danaidae): the ecology of migration and likely climate change implications. *Environmental Entomology* 36:1365–1373.
- Boutin, C., B. Strandberg, D. Carpenter, S. K. Mathiassen, and P. J. Thomas. 2014. Herbicide impact on non-target plant reproduction: what are the toxicological and ecological implications? *Environmental Pollution* 185:295–306.
- Bradley, C. A., and S. Altizer. 2005. Parasites hinder monarch butterfly flight: implications for disease spread in migratory hosts. *Ecology Letters* 8:290–300.
- Brower, L. P. 1984. Chemical defence in butterflies. Pages 109–134 in R. I. Vane-Wright, and P. R. Ackery, editors. *The Biology of Butterflies*. Academic Press, London, United Kingdom.
- Brower L. P., and R. M. Pyle. 2004. The interchange of migratory monarchs between Mexico and the western United States, and the importance of floral corridors to the fall and spring migrations. Pages 144–166 in G. Nabhan, editor. *Conserving migratory pollinators and nectar corridors in western North America*. University of Arizona Press, Tucson, USA.
- Brower, L. P., O. R. Taylor, E. H. Williams, D. A. Slayback, R. R. Zubieta, and M. I. Ramírez. 2012. Decline of monarch butterflies overwintering in Mexico: is the migratory phenomenon at risk? *Insect Conservation and Diversity* 5:95–100.
- Brower, L. P., E. H. Williams, L. S. Fink, D. A. Slayback, M. I. Ramirez, M. V. L. Garcia, R. R. Zubieta, S. B. Weiss, W. H. Calvert, and W. Zuchowski. 2011. Overwintering clusters of the monarch butterfly coincide with the least hazardous vertical temperatures in the oyamel forest. *Journal of the Lepidopterists' Society* 65:27–46.
- California Department of Pesticide Regulation (CDPR). 2016. Summary of pesticide use report data 2016 indexed by chemical. California Department of Pesticide Regulation, Sacramento, USA. <<https://www.cdpr.ca.gov/docs/pur/pur16rep/chmrpt16.pdf>>. Accessed 1 Aug 2018.
- California Department of Pesticide Regulation (CDPR). 2018. California's managed pollinator protection plan – MP3. California Department of Pesticide Regulation, Sacramento, USA. <https://www.cdpr.ca.gov/docs/enforce/pollinators/ca_managed_pollinator_protection_plan.pdf>. Accessed 31 Oct 2018.
- Calvert, W. H. 1996. Fire ant predation on monarch larvae (Nymphalidae: Danainae) in a central Texas prairie. *Journal of the Lepidopterists' Society* 50:149–151.

- Center for Biological Diversity, Center for Food Safety, Xerces Society for Invertebrate Conservation, and Dr. L. Brower. 2014. Petition to protect the monarch butterfly (*Danaus plexippus plexippus*) under the Endangered Species Act. Report submitted to the U.S. Secretary of the Interior, Washington, DC, 26 August 2014.
<https://www.biologicaldiversity.org/species/invertebrates/pdfs/Monarch_ESA_Petition.pdf>. Accessed 28 Oct 2018.
- Chaplin, S., and P. Wells. 1982. Energy reserves and metabolic expenditures of monarch butterflies overwintering in southern California. *Ecological Entomology* 7:249–256.
- Christensen, J. 1981. A field guide to the butterflies of the Pacific Northwest. University Press of Idaho. Moscow, Idaho.
- Cook, K. E., and P-M. Dagget, 1995. Highway roadkill, associated issues of safety and impact on highway ecotones. Task Force on Natural Resources (A1 F52), Transportation Research Board, National Research Council, Washington, D.C., USA.
- Commission for Environmental Cooperation. 2008. North American monarch conservation plan. Communications Department of the CEC Secretariat, Montréal, Québec.
<<http://purl.access.gpo.gov/GPO/LPS96018> (accessed June 11, 2013)>. Accessed 10 Dec 2018.
- Cutting, B. T., and D. W. Tallamy. 2015. An evaluation of butterfly gardens for restoring habitat for the monarch butterfly (Lepidoptera: Danaidae). *Environmental Entomology* 44:1328–1335.
- De Roode, J. C., J. Chi, R. M. Rarick, and S. Altizer. 2009. Strength in numbers: high parasite burdens increase transmission of a protozoan parasite of monarch butterflies (*Danaus plexippus*). *Oecologia* 161:67–75.
- Dilts, T. D., M. Steele, S. Black, D. Craver, E. Cruz, J. Engler, S. Jepsen, A. Jones, S. McKnight, E. Pelton, A. Taylor, and M. Forister. 2018. Western monarch and milkweed habitat suitability modeling project version 2 – Maxent model outputs. Xerces Society, Portland, Oregon, U.S. Fish and Wildlife Society [sic], University of Nevada Reno, USA.
<<https://www.monarchmilkweedmapper.org/habitatsuitabilitymodels>>. Accessed 31 Oct 2018.
- Dingle, H., M. P. Zalucki, W. A. Rochester, and T. Armijo-Prewitt. 2005. Distribution of the monarch butterfly, *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in western North America. *Biological Journal of the Linnean Society* 85(4):491–500.
- Espeset, A. E., J. G. Harrison, A. M. Shapiro, C. C. Nice, J. H. Thorne, D. P. Waetjen, J. A. Fordyce, and M. L. Forister. 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* 181:819–830.
- Farmland Mapping and Monitoring Program (FMMP). 2015. California farmland conversion report (2010–2012). Farmland Mapping and Monitoring Program, Division of Land Resource Protection, California Department of Conservation, Sacramento, USA.
- Fisher, A., K. Saniee, C. van der Heide, J. Griffiths, D. Meade, and F. Villablanca. 2018. Climatic niche model for overwintering monarch butterflies in a topographically complex region of California. *Insects* 2018, 9, 167; DOI:10.3390/insects9040167.
- Flockhart, D. T. T., L. I. Wassenaar, T. G. Martin, K. A. Hobson, M. B. Wunder, and D. R. Norris. 2013. Tracking multi-generational colonization of the breeding grounds by monarch butterflies in eastern North America. *Proceedings of the Royal Society B: Biological Sciences* 280:20131087–20131087.
- Flockhart, D. T. T., J. B. Pichancourt, D. R. Norris, and T. G. Martin. 2015. Unraveling the annual cycle in a migratory animal: breeding-season habitat loss drives population declines of monarch butterflies. *Journal of Animal Ecology* 84:155–165.
- Forister, M. L., A. C. McCall, N. J. Sanders, J. A. Fordyce, J. H. Thorne, J. O'Brien, D. P. Waetjen, and A. M. Shapiro. 2010. Compounded effects of climate change and habitat alteration shift patterns of butterfly diversity. *Proceedings of the National Academy of Sciences of the United States of America* 107:2088–2092.
- Forister, M. L., J. P. Jahner, K. L. Casner, J. S. Wilson, and A. M. Shapiro. 2011. The race is not to the swift: long-term data reveal pervasive declines in California's low-elevation butterfly fauna. *Ecology* 92:2222–2235.
- Goulson, D. 2013. An overview of the environmental risks posed by neonicotinoid insecticides. *Journal of Applied Ecology* 50:977–987. <DOI: 10.1111/1365-2664.12111>.
- Griffiths, J., and F. Villablanca. 2015. Managing monarch butterfly overwintering groves: making room among the eucalyptus. *California Fish and Game* 101(1):40–50.
- Hamman, S. T., P. W. Dunwiddie, J. L. Nuckols, and M. McKinley. 2011. Fire as a restoration tool in Pacific Northwest prairies and oak woodlands: challenges, successes, and future directions. *Northwest Science* 85:317–328.
- Herman, W. S., L. P. Brower, and W. H. Calvert. 1989. Reproductive tract development in monarch butterflies overwintering in California and Mexico. *Journal of the Lepidopterists' Society* 43(1):50–58.
- Hopwood, J., S. Black, and S. Fleury 2015*b*. Roadside best management practices that benefit pollinators: handbook for supporting pollinators through roadside maintenance and landscape design. The Xerces Society, Portland, Oregon and ICF International, Fairfax, Virginia, USA. <https://www.environment.fhwa.dot.gov/env_topics/ecosystems/Pollinators_Roadsides/BMPs_pollinators_landscapes.aspx>. Accessed 31 Oct 2018.

- Hopwood, J., S. Black, and S. Fleury 2016. Pollinators and roadsides: best management practices for managers and decision makers. The Xerces Society, Portland, Oregon and ICF International, Fairfax, Virginia, USA. <http://www.xerces.org/wp-content/uploads/2016/07/BMPs_pollinators_roadsides.pdf>. Accessed 31 Oct 2018.
- Hopwood, J., S. H. Black, E. Lee-Mäder, A. Charlap, R. Preston, K. Mozumder, and S. Fleury. 2015a. Literature review: pollinator habitat enhancement and best management practices in highway rights-of-way. The Xerces Society, Portland, Oregon and ICF International, Fairfax, Virginia, USA. <http://www.xerces.org/wp-content/uploads/2015/12/pollinators_BMPs_in_highway_ROW.pdf>. Accessed 31 Oct 2018.
- Intergovernmental Panel on Climate Change (IPCC). 2013. Climate change 2013: the physical science basis. Contribution of Working group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change T. F. Stocker, D. Qin, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, editors. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA.
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2016. The assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production. S. G. Potts, V. L. Imperatriz-Fonseca, and H. T. Ngo, editors. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.
- James, D. 2016. Population biology of monarch butterflies, *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae), at a milkweed-rich summer breeding site in central Washington. *Journal of the Lepidopterists' Society* 70:182–193.
- James, D. G., T. S. James, L. Seymour, L. Kappen, T. Russell, B. Harryman, and C. Bly. 2018. Citizen scientist tagging reveals destinations of migrating monarch butterflies, *Danaus plexippus* (L.) from the Pacific Northwest. *Journal of the Lepidopterists' Society* 72(2):127–144.
- Jepsen, S., D. F. Schweitzer, B. Young, N. Sears, M. Ormes, and S. H. Black. 2015. Conservation status and ecology of monarchs in the United States. NatureServe, Arlington, Virginia, and the Xerces Society for Invertebrate Conservation, Portland, Oregon, USA.
- Kagan, R. A., T. C. Viner, P. W. Trail, and E. O. Espinoza. 2014. Avian mortality at solar energy facilities in southern California: a preliminary analysis. National Fish and Wildlife Forensics Laboratory. <<http://alternativeenergy.procon.org/sourcefiles/avian-mortality-solar-energy-ivanpah-apr-2014.pdf>>. Accessed 20 Aug 2014.
- Klein, A.-M., I. Steffan-Dewenter, and T. Tscharntke. 2003. Fruit set of highland coffee increases with the diversity of pollinating bees. *Proceedings of the Royal Society B: Biological Sciences* 270(1518):955–961.
- Klein, A.-M., B. E. Vaissière, J. H. Cane, I. Steffan-Dewenter, S. A. Cunningham, C. Kremen, and T. Tscharntke. 2007. Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society B: Biological Sciences* 274(1608):303–313.
- Korzukhin, M. D., S. D. Porter, L. C. Thompson, and S. Wiley. 2001. Modeling temperature-dependent range limits for the fire ant *Solenopsis invicta* (Hymenoptera: Formicidae) in the United States. *Environmental Entomology* 30:645–655.
- Krischik, V., M. Rogers, G. Gupta, and A. Varshney. 2015. Soil-applied imidacloprid translocates to ornamental flowers and reduced survival of adult *Coleomegilla maculata*, *Harmonia axyridis*, and *Hippodamia convergens* lady beetles, and larval *Danaus plexippus* and *Vanessa cardui* butterflies. *PloS ONE* 10(3):e0119133.
- Lane, J. 1993. Overwintering monarch butterflies in California: past and present. Pages 335–344 in S. B. Malcolm and M. P. Zalucki, editors. *Biology and Conservation of the Monarch Butterfly*. Natural History Museum of Los Angeles County, Los Angeles, California, USA.
- Lemoine, N. P. 2015. Climate change may alter breeding ground distributions of eastern migratory monarchs (*Danaus plexippus*) via range expansion of *Asclepias* host plants. *PloS ONE* 10(2):e0118614.
- Leong, K. L. H., W. H. Sakai, W. Bremer, D. Feuerstein, and G. Yoshimura. 2004. Analysis of the pattern of distribution and abundance of monarch overwintering sites along the California coastline. Pages 177–185 in K. S. Oberhauser and M. J. Solensky, editors. *Monarch Butterfly: Biology and Conservation*. Cornell University Press, Ithaca, New York, USA.
- Lyons, J. I., A. A. Pierce, S. M. Barribeau, E. D. Sternberg, A. J. Mongue, and J. C. De Roode. 2012. Lack of genetic differentiation between monarch butterflies with divergent migration destinations. *Molecular Ecology* 21:3433–3444.
- Malcolm, S. B. 2018. Anthropogenic impacts on mortality and population viability of the monarch butterfly. *Annual Review of Entomology* 63:277–302.
- McGarigal, K., S. Cushman, and C. Regan. 2005. Quantifying terrestrial habitat loss and fragmentation: a protocol. Department of Natural Resources Conservation, University of Massachusetts, Amherst, USA. <http://www.umass.edu/landeco/teaching/landscape_ecology/labs/fragprotocol.pdf>. Accessed 7 Dec 2018.
- McLaughlin, R. E., and J. Myers. 2007. *Ophryocystis elektroscirrha* sp. N., a Neogregarine pathogen of the monarch butterfly *Danaus plexippus* (L.) and the Florida queen butterfly *D. gilippus berenice* Cramer. *Journal of Eukaryotic Microbiology* 17(2):300–305.

- Meade, D. E. 1999. Monarch butterfly overwintering sites in Santa Barbara County California. Althouse and Meade, Paso Robles, California, USA.
- Midwest Association of Fish and Wildlife Agencies (MAFWA). 2018. Midwest Association of Fish and Wildlife Agencies. 2018. Mid-America Monarch Conservation Strategy, 2018-2038, Version 1.0.
- Monarch Joint Venture. 2018. 2018 monarch conservation implementation plan. <https://monarchjointventure.org/images/uploads/documents/2018_Monarch_Conservation_Implementation_Plan_FINAL_2.pdf>. Accessed 31 Oct 2018.
- Morris, G. M., C. Kline, and S. M. Morris. 2015. Status of *Danaus plexippus* population in Arizona. *Journal of the Lepidopterists' Society* 69:91–107.
- Nagano, C. D., and C. Freese. 1987. A world safe for monarchs. *New Scientist* 1554:43–47.
- Nagano, C. D., and J. Lane. 1985. A survey of the location of monarch butterfly (*Danaus plexippus* [L.]) overwintering roosts in the state of California, U.S.A.: first year 1984/1985. Report to the World Wildlife Fund, U.S.
- Nail, K. R., C. Stenoien, and K. S. Oberhauser. 2015. Immature monarch survival: effects of site characteristics, density, and time. *Annals of the Entomological Society of America* 108:680–690.
- National Land Cover Database. 2011. Multi-resolution Land Characteristics Consortium <<https://www.mrlc.gov/>>. Accessed 8 Aug 2018.
- National Wildlife Federation. 2018. Mayors' monarch pledge. <<https://www.nwf.org/garden-for-wildlife/about/national-initiatives/mayors-monarch-pledge>>. Accessed 31 Oct 2018.
- Nowak, C. A., and B. D. Ballard. 2005. A framework for applying integrated vegetation management on rights-of-way. *Journal of Arboriculture* 31(1):28–37.
- Oberhauser, K. S. 2012. Tachinid flies and monarch butterflies: citizen scientists document parasitism patterns over broad spatial and temporal scales. *American Entomologist* 58:19–22.
- Oberhauser, K. S., S. J. Brinda, S. Weaver, R. D. Moon, S. A. Manweiler, and N. Read. 2006. Growth and survival of monarch butterflies (Lepidoptera: Danaidae) after exposure to permethrin barrier treatments. *Environmental Entomology* 35:1626–1634.
- Oberhauser, K. S., S. A. Manweiler, R. Lelich, M. Blank, R. V. Batalden, and A. De Anda. 2009. Impacts of ultra-low volume resmethrin applications on non-target insects. *Journal of the American Mosquito Control Association* 25:83–93.
- Oberhauser, K. S., M. D. Prysby, H. R. Mattila, D. E. Stanley-Horn, M. K. Sears, G. Dively, E. Olson, J. M. Pleasants, W. F. Lam, and R. Hellmich. 2001. Temporal and spatial overlap between monarch larvae and corn pollen. *Proceedings of the National Academy of Sciences* 98:11913–11918.
- Pecenka, J. R., and J. G. Lundgren. 2015. Non-target effects of clothianidin on monarch butterflies. *Natural Resource Management Faculty Publications*. 61. <http://openprairie.sdstate.edu/nrm_pubs/61>. Accessed 11 Dec 2018.
- Pelton, E., S. Jepsen, C. Schultz, C. Fallon, and S. H. Black. 2016. State of the monarch butterfly overwintering sites in California. Xerces Society for Invertebrate Conservation, Portland, Oregon, USA. <http://www.xerces.org/wp-content/uploads/2016/07/StateOfMonarchOverwinteringSitesInCA_XercesSoc_web.pdf>. Accessed 5 Dec 2018.
- Peterson, W., Johnstone, R., Ellsworth, D., Colopy, M., and IVM Partners. 2015. Pollinators and rights-of-way. <http://www.ivmpartners.org/wp-content/uploads/2015/05/ArbNews_2015_04_Pages_38_41.pdf>. Accessed 29 Oct 2018.
- Pleasants, J. 2017. Milkweed restoration in the Midwest for monarch butterfly recovery: estimates of milkweeds lost, milkweeds remaining and milkweeds that must be added to increase the monarch population. *Insect Conservation and Diversity* 10:42–53.
- Pleasants, J. M., and K. S. Oberhauser. 2012. Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population. *Insect Conservation and Diversity* 6:135–144. <<http://DOI.wiley.com/10.1111/j.1752-4598.2012.00196.x>>. Accessed 15 Oct 2018.
- Pollinator Health Task Force. 2015. National strategy to promote the health of honey bees and other pollinators. <<https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf>>. Accessed 15 Oct 2018.
- Prysby, M. D. 2004. Natural enemies and survival of monarch eggs and larvae. Pages 27–37 in K. S. Oberhauser and M. J. Solensky, editors. *The Monarch Butterfly: Biology and Conservation*. Cornell University Press, Ithaca, New York, USA.
- Pyle, R. M. 2015. Monarchs in the mist: new perspectives on monarch distribution in the Pacific Northwest. Pages 236–247 in K. S. Oberhauser, K. R. Nail, and S. Altizer, editors. *Monarchs in a changing world: biology and conservation of an iconic butterfly*. Cornell University Press, Ithaca, New York, USA.
- Pyle, R. 1974. *Watching Washington butterflies*. Seattle Audubon Society. Seattle, Washington.
- Pyle, R. 1989. *Washington butterfly conservation status report and plan*. Washington Department of Fish and Wildlife, Olympia.
- Pyle, R. 1999. *Chasing monarchs: migrating with the butterflies of passage*. Houghton Mifflin Company, New York, USA.
- Pyle, R. M., and M. Monroe. 2004. Conservation of western monarchs. *Wings* 27:13–17.

- Rendón-Salinas, E., F. Martínez-Meza, A. Martínez-Pacheco, and M. Cruz-Piña. 2018. Superficie forestal ocupada por las colonias de hibernación de la mariposa monarca en México durante Diciembre de 2017. World Wildlife Fund-México, unedited report. <http://d2ouvy59p0dg6k.cloudfront.net/downloads/2017_Monitoreo_Mariposa_Monarca_en_Mexico_2017-2018.pdf>. Accessed 10 Mar 2018.
- Ricketts, T. H., 2004. Tropical forest fragments enhance pollinator activity in nearby coffee crops. *Conservation Biology* 18:1262–1271.
- Sakai, W. H., and W. C. Calvert. 1991. Statewide monarch butterfly management plan for the State of California Department of Parks and Recreation. Final Report. Interagency Agreement Number 88-11-050, Santa Monica College, California, USA.
- Satterfield, D. A., J. C. Maerz, M. D. Hunter, D. T. T. Flockhart, K. A. Hobson, D. R. Norris, H. Streit, J. C. de Roode, and S. Altizer. 2018. Migratory monarchs that encounter resident monarchs show life-history differences and higher rates of parasite infection. *Ecology Letters* 21.11:1670-1680. < DOI:10.1111/ele.13144 >.
- Satterfield, D. A., F. X. Villablanca, J. C. Maerz, and S. Altizer. 2016. Migratory monarchs wintering in California experience low infection risk compared to monarchs breeding year round on non-native milkweed. *Integrative and Comparative Biology* 56:343–352.
- Schultz, C., and E. E. Crone. 1998. Burning prairie to restore butterfly habitat: a modeling approach to management tradeoffs for the Fender's Blue. *Restoration Ecology* 6:244–252.
- 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* 214:343–346.
- Semmens, B. X., D. J. Semmens, W. E. Thogmartin, R. Wiederholt, L. Lopez-Hoffman, J. E. Diffendorfer, J. M. Pleasants, K. S. Oberhauser, and O. R. Taylor. 2016. Quasi-extinction risk and population targets for the Eastern, migratory population of monarch butterflies (*Danaus plexippus*). *Scientific Reports* 6:23265.
- Sleeter, B. M. 2016. Land cover trends project: Central Valley report. U.S. Geological Survey, Western Geographic Science Center, Menlo Park, California, USA. <<https://landcover trends.usgs.gov/west/eco7Report.html>> Accessed 6 Dec 2018.
- Sleeter, B., T. Wilson, C. Soulard, and J. Liu. 2010. Estimation of late twentieth century land-cover change in California. *Environmental Monitoring and Assessment* 173:251–66. DOI 10.1007/s10661-010-1385-8.
- Stevens, S., and D. Frey. 2004. How the other half lives: monarch population trends west of the Great Divide. Unpublished report. Biological Sciences Department, California Polytechnic State University, San Luis Obispo, USA.
- Stevens, S. R., and D. F. Frey. 2010. Host plant pattern and variation in climate predict the location of natal grounds for migratory monarch butterflies in western North America. *Journal of Insect Conservation* 14:731–744.
- Thogmartin W., R. Wiederholt, K. Oberhauser, R. Drum, J. Diffendorfer, S. Altizer, O. Taylor, J. Pleasants, D. Semmens, B. Semmens, R. Erickson, K. Libby, and L. Lopez-Hoffman. 2017. Monarch butterfly population decline in North America: identifying the threatening processes. *Royal Society Open Science*:1–16. DOI 10.1098/rsos.170760.
- U.S. Census Bureau. 2017. United States Census by region 2017. <https://www.census.gov/popclock/data_tables.php?component=growth>. Accessed 2 Aug 2018.
- U.S. Census Bureau. 2018. United States population estimates: Vintage 2017. <http://www.census.gov/population/www/documentation/twps0100/E2%20County%20Totals_FINAL.pdf>. Accessed 11 Dec 2018.
- U.S. Department of Agriculture (USDA). 2015. Using 2014 Farm Bill programs for pollinator conservation. *Biology Technical Note Number 78*, second edition. <<https://www.xerces.org/wp-content/uploads/2013/04/using-farmbill-programs-for-pollinator-conservation-2ndEd.pdf>> Accessed 31 Oct 2018.
- U.S. Department of Agriculture (USDA) Forest Service. 2018. Why use native plant materials? <https://www.fs.fed.us/wildflowers/Native_Plant_Materials/whyuse.shtml>. Accessed 12 Sep 2018.
- U.S. Geological Survey (USGS). 2018. National Water-Quality Assessment Project, Pesticide National Synthesis Project. <<https://water.usgs.gov/nawqa/pnsp/>>. Accessed 2 Dec 2018.
- U.S. Global Change Research Program (USGCRP). 2017. Climate Science Special Report: Fourth National Climate Assessment. Volume 1. U.S. Global Change Research Program, Washington, D.C., DOI:10.7930/J0J964J6.
- University of California Agricultural Issues Center. 2012. The measure of California agriculture highlights. University of California Regents. <<http://aic.ucdavis.edu/publications/moca/MOCABrochure2013.pdf>>. Accessed 31 Oct 2018.
- Vandenbosch, R. 2007. What do monarch population time series data tell us about eastern and western population mixing? *Journal of the Lepidopterists' Society* 61:28–31.

- Vaughan, M., M. Shepherd, C. Kremen, and S. H. Black. 2007. Farming for bees, guidelines for providing native bee habitat on farms. The Xerces Society for Invertebrate Conservation. Portland, Oregon, USA. <http://www.xerces.org/wp-content/uploads/2008/11/farming_for_bees_guidelines_xerces_society.pdf>.
- Vinson, S. B. 1997. Insect life: invasion of the red imported fire ant (Hymenoptera: Formicidae). *American Entomologist* 43:23–39.
- Wang, M., and D. Rautmann. 2008. A simple probabilistic estimation of spray drift – factors determining spray drift and development of a model. *Environmental Toxicology and Chemistry* 27(12):2617–2626.
- Waterbury, B., and A. Potter. 2018. Integrating strategic conservation approaches for the monarch butterfly in the State Wildlife Action Plans of Idaho and Washington. Idaho Department of Fish and Game, Salmon, USA.
- Whitehorn, P., G. Norville, A. Gilburn, and D. Goulson. 2018. Larval exposure to the neonicotinoid imidacloprid impacts adult size in the farmland butterfly *Pieris brassicae*. *PeerJ*. 6: e4772. <DOI: 10.7717/peerj.4772>.
- Xerces Society (Xerces). 2017. Protecting California’s butterfly groves: management guidelines for monarch butterfly overwintering habitat. The Xerces Society for Invertebrate Conservation, Portland, Oregon, USA.
- Xerces Society (Xerces). 2018. Managing monarchs for the West: best management practices for conserving the monarch butterfly and its habitat. Xerces Society for Invertebrate Conservation, Portland, Oregon, USA.
- Xerces Society (Xerces). 2018a. Western monarch Thanksgiving count data, 1997–2017. <www.westernmonarchcount.org>. Accessed 10 Mar 2018.
- Xerces Society (Xerces). 2018b. Timing management in monarch breeding habitat. <https://xerces.org/wp-content/uploads/2018/04/18-010_Timing-Management-in-Western-Monarch-Habitat_XercesSoc.pdf>. Accessed 31 Oct 2018.
- Yang, L. H., D. Ostrovsky, M. C. Rogers, and J. M. Welker. 2015. Intra-population variation in the natal origins and wing morphology of overwintering western monarch butterflies *Danaus plexippus*. *Ecography* 39:998–1007. DOI:10.1111/ecog.01994.
- Young-Isebrand, E., K. S. Oberhauser, K. Bailey, S. Charest, B. Hayes, E. Howard, J. Lovett, S. Meyers, E. Mollenhauer, E. B. Montesinos-Patino, A. Ryan, O. R. Taylor, R. Treviño Ulloa. 2015. Environmental education and monarchs: reaching across disciplines, generations, and nations. Pages 5–12 *in* K. S. Oberhauser, K. R. Nail, and S. Altizer, editors. *Monarchs in a changing world: biology and conservation of an iconic butterfly*. Cornell University Press, Ithaca, New York, USA.

APPENDIX A.

Summary of Strategies, Actions, and Timelines for Implementation

The following strategies and actions are for the entire western monarch conservation community to voluntarily pursue, unless specific entities are named. Timeframes indicated are for action initiation within a period of time as opposed to an exact time. Projects may be initiated earlier than indicated.

Strategies	Actions	Timeline (initiate within)
SECTION 6: MONARCH CONSERVATION STRATEGIES		
6.1. Overwintering Habitat Conservation Strategies		
<p>OH-S1: California land use planners and regulatory agencies will endeavor to protect overwintering groves through application of the California Coastal Act and by incorporating protective measures in land use and development plans.</p>	<p>OH-S1-A: CDFW in consultation with California Coastal Commission staff will develop and disseminate written guidance to LCP planners regarding appropriate protective measures for CA monarch overwintering sites under the Coastal Act.</p>	1 Year
<p>OH-S2: Provide guidance for the application of environmental laws and other protection mechanisms (e.g., conservation easements, fee title acquisition, and deed restriction) to protect overwintering groves in California.</p>	<p>OH-S2-A: CDFW in consultation with the California Wildlife Conservation Board will develop written guidance regarding legal mechanisms for protecting CA monarch overwintering sites.</p>	1 Year
<p>OH-S3: Land managers will develop and implement site-specific grove management plans as appropriate and feasible, targeting first the Top 50 sites as identified in Pelton et al. 2016.</p>	<p>OH-S3-A: USFWS, CDFW and Xerces Society will continue to provide grove management planning guidance to overwintering site managers, and assist in seeking funds to develop and implement plans.</p>	Continue
<p>OH-S4: Formalize and expand a network of land managers for the exchange of information regarding overwintering grove management (e.g., list-serve, workshops, etc.).</p>	<p>OH-S4-A: An online information sharing and dissemination portal or list-serve will be developed for land managers of overwintering groves.</p>	1 Year
	<p>OH-S4-B: Annual workshops and/or in-person meetings will be held as time and budget allow to foster coordination of land managers and share biological outcomes from BMPs and habitat restoration implementation.</p>	2 Years
	<p>OH-S4-C: Educate landowners and neighbors of Top 50 priority sites, as well as other important overwintering sites, on the conservation importance of grove management. See Section 8: Education and Outreach regarding messaging for this constituency.</p>	2 Years
6.2. Natural Lands		
<p>NL-S1: Identify high-priority breeding areas for monarch conservation on natural lands and promote protection, restoration, and/or enhancement in these areas.</p>	<p>NL-S1-A: Utilize best available science, new research, and citizen-based observations and tagging efforts to identify high-priority breeding areas.</p>	Continue
	<p>NL-S1-B: Provide regionally-tailored guidelines on management techniques for enhancing existing habitat areas. Encourage managers to consider broad conservation goals for each project.</p>	5 Years
	<p>NL-S1-C: Facilitate information exchange and cooperation between land management agencies (federal, state, and local municipalities) to encourage and recognize monarch and other pollinator habitat BMPs, monitoring opportunities, resource opportunities, and educational programs.</p>	1 Year
	<p>NL-S1-D: Encourage partnerships and cooperation between public and private programs to maximize reach and efficiency of habitat restoration projects.</p>	Continue

Strategies	Actions	Timeline (initiate within)
NL-S2: Identify high-priority migratory pathways and clustering locations and promote protection, restoration and/or enhancement of these areas, including riparian corridors.	NL-S2-A: Collaborate with State Natural Heritage Program and citizen science-based inventory efforts (e.g., iNaturalist) to funnel observations and photos of western monarchs and milkweeds to the Western Monarch Milkweed Mapper website: https://www.monarchmilkweedmapper.org/	1 Year
	NL-S2-B: Develop a list of priority migratory pathways and clustering locations for protection, restoration, and/or enhancement projects within each state based on agency observations and tracking databases (e.g., Western Monarch Milkweed Mapper, Monarch SOS app, iNaturalist, Southwest Monarch Study). Also See RBH-S3 & RBH- S4	5 Years
	NL-S2-C: Provide regionally-tailored guidelines on management techniques for enhancing existing habitat areas. Encourage managers to take into consideration broad conservation goals for each project.	5 Years
	NL-S2-D: Facilitate information exchange and cooperation between land management agencies (federal, state, and local municipalities) to encourage and recognize monarch and other pollinator habitat BMPs, monitoring opportunities, resource opportunities, and educational programs.	Continue
	NL-S2-E: Encourage partnerships and cooperation between public and private programs to maximize reach and efficiency of habitat restoration projects.	Continue
NL-S3: Incorporate monarch conservation considerations and measures into land management activities, plans, and projects as outlined in Managing for Monarchs in the West: Best Management Practices for Conserving the Monarch Butterfly and its Habitat (Xerces 2018), as appropriate.	NL-S3-A: Work with land management partners to integrate monarch/pollinator conservation in all new land management plans, as appropriate.	1 Year
NL-S4: Promote the use and availability of local native plants and seeds for habitat enhancement and restoration projects, particularly for monarch conservation efforts.	NL-S4-A: Develop reference materials for land managers that emphasize use of local, native plants free from pesticides (especially neonicotinoids) for native habitat restoration projects.	2 Years
	NL-S4-B: Identify nurseries in the West that can provide native plant materials for restoration projects and post on existing online lists such as Xerces Society's online Milkweed Seed Finder national directory of milkweed seed vendors (https://xerces.org/milkweed-seed-finder/), Monarch Joint Venture Monarch Watch Milkweed Market (http://support.milkweedmarket.org/kb/article/353-about-the-milkweed-market), and websites of regional and local non-profit monarch groups.	Continue
6.3. Urban and Industrial Development		
UID-S1: During project development and/or review, provide guidance for the incorporation of conservation actions that minimize impacts and provide benefits to monarch butterflies.	UID-S1-A: Identify target areas for monarch habitat restoration, enhancement, and creation at a scale appropriate for each partner.	5 Years
	UID-S1-B: Identify, and then encourage 25 key habitat-rich municipalities to take on-the-ground action.	2 Years
	UID-S1-C: Encourage (and reward through official recognition) pollinator-friendly landscapes.	5 Years
	UID-S1-D: Utilize technical service providers such as NRCS, extension agents, U.S. Army Corps of Engineers that work with private landowners.	1 Year
	UID-S1-E: Engage landscaping companies and native plant propagators to grow and plant native and locally-sourced milkweed and nectar plants.	5 Years

Strategies	Actions	Timeline (initiate within)
	UID-S1-F: Engage irrigation companies, water development agencies, the Corps, and municipalities to encourage monarch and pollinator habitat creation and enhancement in water conservation and management projects, wetland mitigation projects, and stormwater management.	5 Years
	UID-S1-G: Engage land development corporations, mining operations, and energy development projects in conserving and managing existing monarch and pollinator habitat, and creating new habitat.	5 Years
	UID-S1-H: Encourage cooperation between local, state, and federal regulatory agencies and mining and other land development operations to create, restore, and/or maintain monarch and pollinator habitat on industry lands.	5 Years
	UID-S1-I: Encourage all partners to enter actions into the USFWS Monarch Conservation Database or WAFWA Monarch CHAT database.	1 Year
UID-S2: Target outreach and education to municipalities, local land use agencies, landscape businesses, and private landowners within historic breeding range regarding the simplest and best ways to incorporate pollinator habitat in their activities.	UID-S2-A: Create a simple western monarch brochure (1 to 2-pages) for each participating state with clear messages for collective action to restore monarch populations and habitat. Distribute brochure to communities and decision makers (see EO-S2).	1 Year
	UID-S2-B: Foster networking between outreach champions (NGOs, government liaisons, academic institutions, citizens) within and among municipalities and anchor corporations by establishing and maintaining a structure that facilitates communication.	10 Years
	UID-S2-C: Engage K-12 schools, conservation corps, and faith-based groups in monarch conservation programs to encourage interest in monarch and pollinator issues in the next generation. Interested youth will become the future leaders in these and other efforts.	5 Years
	UID-S2-D: Educate and coordinate with local planning and zoning commissions, storm water managers, water conservation districts, irrigation companies, and the Corps to engage private development within their jurisdictions in monarch conservation opportunities.	5 Years
	UID-S2-E: Work with local, state, and federal regulatory agencies regulating mining, corporations, and land development operations to educate operators on monarch issues and opportunities.	1 Year
	UID-S2-F: Promote and facilitate citizen science projects to further goals and objectives of this Plan.	1 Year
UID-S3: Educate homeowners, land developers, and energy producers on issues associated with insecticides and herbicides, and provide best management practices and alternatives to their use.	UID-S3-A: Follow recommended guidelines in Xerces Society’s publication Managing for Monarchs in the West – Best Management Practices for Conserving the Monarch Butterfly and its Habitat for proper herbicide and pesticide practices in relation to land management needs.	1 Year
	UID-S3-B: Provide insecticide/herbicide BMP training to technical service providers working with private landowners, municipalities, irrigation companies, and water conservancy districts.	5 Years
	UID-S3-C: Work with big box stores (e.g., Home Depot, Walmart) to encourage consumer choice of native nectar plants and milkweed host plants that have not been treated with neonicotinoids.	10 Years

Strategies	Actions	Timeline (initiate within)
6.4. Rights-of-Way		
ROW-S1: Encourage the use of BMPs to promote monarch-friendly habitat within ROWs.	ROW-S1-A: Encourage roadside management authorities, as well as public and private utility programs and surrounding private landowners (i.e., solar, pipeline, electric) to employ monarch-friendly management practices (see Proposed Nationwide Candidate Conservation Agreement with Assurances [CCAA] for Monarch Butterfly on Energy and Transportation Lands for appropriate measures).	1 Year
	ROW-S1-B: Apprise ROW management authorities about existing and emerging legislation, policies, and commitments at the national, state, and local level that could affect their operations or underlying landowners.	1 Year
ROW-S2: Promote the use of regionally-appropriate native milkweeds, forbs, grasses, and other native plant materials for habitat restoration and other vegetation management actions within ROWs.	ROW-S2-A: See NL-S4-A.	1 Year
ROW-S3: Create and/or maintain collaborative partnerships (e.g., between DOTs and utilities) to promote monarch conservation and exchange information.	ROW-S3-A: Encourage participation of ROW management authorities in the Rights of Way as Habitat Working Group (https://monarchjointventure.org/news-events/news/rights-of-way-as-habitat-working-group-aims-to-help-create-preserve-monarch)	1 Year
	ROW-S3-B: Promote industry initiatives for pollinator habitat conservation (e.g., Electric Power Research Institute’s Power-in-Pollinators Initiative)	1 Year
6.5. Agricultural Lands		
AL-S1: Encourage landowners to voluntarily maintain diversified agricultural landscapes to benefit monarchs.	AL-S1-A: Develop and distribute brochures/educational materials highlighting the benefits (increased seed/fruit set) of increased pollinator visitation achieved by providing and maintaining pollinator habitat along field edges, riparian areas, ditches, fencerows, etc.	2 Years
	AL-S1-B: Develop and distribute flowering plant species lists formulated to optimize flowering periods with crop production schedules.	5 Years
	AL-S1-C: Develop materials and provide training on proper pesticide application to minimize drift, especially in areas providing monarch breeding habitat.	10 Years
	AL-S1-D: Create and utilize demonstration sites in agricultural areas to encourage on- or near-farm/ranch habitat installation or enhancement.	1 Year
AL-S2: Promote incentive and easement programs and grants to increase volunteer landowner efforts to add or maintain breeding and migratory habitat on private agricultural lands for the monarch butterfly and other pollinators.	AL-S2-A: Promote collaboration between public and private groups and programs to identify incentive and easement programs on agricultural lands, and collaborate with private landowners regarding these options.	1 Year
	AL-S2-B: Increase participation in existing funding programs by sharing information presented in Appendix B. Incentive-based programs offer viable opportunities for financial and technical assistance to implement successful projects.	1 Year
	AL-S2-C: Provide landowners with information regarding the various options for obtaining regulatory assurance when participating in voluntary conservation.	1 Year
	AL-S2-D: Work with NRCS in the West to identify relevant western neonic-related programs similar to “CSP Enhancement E595116Z2: Reducing routine neonicotinoid seed treatments on corn and soybean crops.”	2 Years
AL-S3: Prioritize areas to focus monarch conservation that facilitate habitat connectivity through agricultural landscapes.	AL-S3-A: Support research to identify migratory routes and habitat suitability in agricultural areas to determine priority areas to focus conservation efforts in the agricultural landscape.	Continue

Strategies	Actions	Timeline (initiate within)
<p>AL-S4: Encourage BMPs for grazing operations that maintain native milkweed, native forbs, and native grasses that serve as nectar and breeding habitat for the monarch butterfly and other pollinators.</p>	<p>AL-S3-B: Use connectivity models being developed for California's Central Valley (e.g., NRCS, Xerces/UNR/industry partners) to guide efforts for creating monarch habitat within agricultural areas, with intent to expand to other large agricultural areas in the West.</p>	2 Years
	<p>AL-S3-C: Engage private hunting ranches/clubs to incorporate monarch-friendly BMPs in their management plans for wildlife and crop production in partnership with organizations such as Pheasants Forever, Quail Forever, Ducks Unlimited, and National Wild Turkey Federation.</p>	1 Year
	<p>AL-S4-A: Identify and encourage protection of areas containing milkweed on rangelands through application of BMPs compatible with grazing operations.</p>	2 Years
	<p>AL-S4-B: Develop BMPs for grazing on public lands, and implement these through the lease/contract process, where warranted (specific BMPs bulleted under this action; see pg. 61)</p> <p>AL-S4-C: Utilize or customize already available grazing/pollinator habitat information (see pg. 61).</p>	2 Years Continue
<p>6.6. Education and Outreach</p>		
<p>EO-S1: Partner with target-audience experts to develop easy reference fact sheets or brochures specifically targeting each of the eight identified audiences.</p>	<p>EO-S1-A: Convene breakout sessions targeting the eight audiences at the 2019 Western Monarch Meeting to initiate development of content consistent with the Plan's goals for each audience, and elicit volunteers to help produce brochures.</p>	1 Year
<p>EO-S2: Develop state brochures that integrate audience-targeted information from EO-S1 with state-specific information for distribution within each of the western states.</p>	<p>EO-S2-A: Each state will work with their partners to develop their state-specific brochure consistent with the messaging as outlined in the Plan and the target-audience brochures.</p>	2 Years
<p>EO-S3: Organize, encourage, and facilitate citizen science projects to collect information on the most important regional information needs to fill information gaps.</p>	<p>EO-S3-A: Use state outreach tools (e.g., social media, press releases, etc.) to direct attention to each state's information needs and reporting to identified westwide or statewide databases (e.g., Western Monarch Milkweed Mapper, Monarch Health Project). See Research Strategies for priority information gaps.</p>	1 Year
<p>6.6.1. General Public</p>		
<p>Goal: Raise public awareness about recent declines in monarch butterfly populations and encourage citizen involvement in local efforts to survey for monarchs and milkweed and to support and create monarch habitat on their land and with local governments.</p>	<p>EO-6.6.1-A: Use WAFWA member agency outreach tools (e.g., social media, press releases, etc.) to communicate identified messages. Also See EO-S3-A.</p>	1 Year
	<p>EO-6.6.1-B: Provide state specific brochures at public use areas such as wildlife areas, parks, nature centers, etc. to inform the visiting public.</p>	2 Years
<p>6.6.2. Natural Resource Land Managers</p>		
<p>Goal: Exchange information between natural land managers regarding successful practices that benefit multiple species including monarch butterflies and other pollinators.</p>	<p>EO-6.6.2-A: Provide opportunities for exchange of information during WAFWA meetings.</p>	1 Year
	<p>EO-6.6.2-B: Request inclusion of monarch/pollinator issues as agenda items during meetings of existing land management coordination groups, forums, and meetings.</p>	1 Year
<p>6.6.3. Agricultural Land Managers</p>		
<p>Goal: Share information with agricultural land managers about the broader benefits of conservation practices that incorporate monarch habitat and share existing BMPs in useful formats.</p>	<p>EO-6.6.3-A: Provide agricultural extensions and agricultural associations (e.g., Cattlemen's Associations, Farm Bureaus, etc.) with existing guidance documents, reports, quick guides, and other information for communication with landowners.</p>	1 Year

Strategies	Actions	Timeline (initiate within)
6.6.4. Rights-of-Way Managers		
Goal: Share information with ROWs managers about the broader benefits of conservation practices that incorporate monarch habitat and share existing BMPs and outreach materials in useful formats.	EO-6.6.4-A: See ROW-S3-A and B.	1 Year
	EO-6.6.4-B: Explore and encourage providing monarch/pollinator information in DOT Adopt-a-Highway Programs and at rest areas, especially in association with demonstration habitat.	2 Years
6.6.5. Landowners Adjacent to Overwintering Sites		
Goal: Encourage landowners adjacent to overwintering sites to appreciate the unique natural phenomenon in their backyard and support existing conservation efforts.	EO-6.6.5-A: Develop a mailer or handout that grove site managers can provide to adjacent landowners that informs them of the importance of the site and voluntary actions they can take to help conserve it.	1 Year
	EO-6.6.5-B: Provide neighborhood workshops, open houses or town halls at overwinter grove sites to work one-on-one with interested landowners.	2 Years
6.6.6. State and Local Political Leadership		
Goal: Raise the awareness of state and local political leaders about recent declines in monarch butterfly populations and encourage action to mitigate threats to the species.	EO-6.6.6-A: Empower citizens with accurate and consistent messaging regarding the plight of monarchs and pollinators and provide citizens with effective strategies for communicating with their government representatives.	2 Years
6.6.7. Monarch Enthusiasts		
Goal: Encourage and inspire monarch enthusiasts (local monarch conservation groups) to take action in ways that align with this Plan.	EO-6.6.7-A: Leverage the extensive network of monarch groups and enthusiasts by communicating consistent messaging through agency media tools, especially social media.	1 Year
6.6.8. Teachers and Non-Classroom Educators		
Goal: Encourage educators to use monarch butterfly as a study organism to understand conservation and teach students about habitat. Encourage educators to focus on habitat and tagging individual wild butterflies rather than rearing.	EO-6.6.8-A: Work with western state coordinators and educators to promote use of Project WILD's Monarch Marathon curriculum (https://www.fishwildlife.org/projectwild/step-stem-and-wild-work/monarch-marathon).	2 Years
6.7. Research and Monitoring Priorities		
6.7.1. Overwintering Life Stage		
ROH-S1: Improve understanding of what microhabitat and landscape-scale requirements overwintering monarchs have and how to effectively restore monarch overwintering habitat.	ROH-S1-A: Expand the 2018 within-grove Overwintering Habitat Selection Study to include additional groves and more years of study using common protocols to inform OH-S3.	1 Year
	ROH-S1-B: Starting with the Top 25 sites (Pelton et al. 2016), map the functional extent, assess grove health, and ascertain landowners willingness to develop and implement management plans in support of OH-S3 and OH-S4.	2 Years
	ROH-S1-C: Initiate a study of importance of overwintering in low desert riparian/urban areas and the relative contribution of those areas to the overall population.	
ROH-S2: Improve understanding of overwintering mortality including normal rates and causes of mortality and how to minimize excessive mortality at the overwintering sites.	ROH-S2-A: Expand overwintering site mortality study to include multiple other grove sites using common protocols developed at Lighthouse Field State Park to inform OH-S3.	2 Years
	ROH-S2-B: Encourage participation in the Western Monarch New Year count to help inform overwinter population size changes.	Continue
	ROH-S2-C: Gather more information and analyze the relative effects of OE on western monarch fitness and mortality rates at overwintering sites in coordination with University of Georgia.	
ROH-S3: Determine which nectar species are the most important for overwintering monarchs in different areas of the coast, and for inland sites.	ROH-S3-A: Expand nectar usage study in progress at Lighthouse Field in Santa Cruz (2017-2019) to additional overwintering sites to help inform overwintering habitat restoration projects and land management plans.	2 Years

Strategies	Actions	Timeline (initiate within)
ROH-S4: Improve understanding of how climate change will affect monarchs relative to overwintering site conditions and locations.	ROH-S4-A: Building off of the recent climate niche model (Fisher et al. 2018), develop future scenarios and potential locations where monarchs may establish overwintering clusters when adapting to climate change.	5 Years
6.7.2. Breeding and Migratory Life Stage		
RBH-S1: Determine which part of the monarch's life cycle is limiting population growth.	RBH-S1-A: Send out an "all-points bulletin", especially in California, to report monarch observations between February and April, including evidence of breeding, to the Western Monarch and Milkweed Mapper to help inform where monarchs go when they leave the overwintering sites.	1 Year
	RBH-S1-B: Continue work to develop a demographic model of western monarch for the full annual life cycle and conduct sensitivity analyses, expanding upon Breeding Phenology Project with Washington State University, Xerces, Tufts, DoD, and USFWS.	Continue
RBH-S2: Determine the characteristics of "good" monarch breeding and migratory habitat (i.e., habitat that promotes reproductive performance and survivorship).	RBH-S2-A: Design and conduct study to assess productive and suitable monarch breeding and migratory habitat based on monarch vital rates in various habitats, including urban gardens. Use results to refine habitat management and restoration targets and guidelines	2 Years
RBH-S3: Determine geographic areas and habitat types most beneficial to monarchs in the West in order to prioritize conservation actions.	RBH-S3-A: Incorporate land cover data into habitat suitability models, and estimate acres and location of potential high suitability habitat occurring on public lands by jurisdiction.	1 Year
	RBH-S3-B: Ground-truth habitat suitability models using a systematic research approach, to provide information to help refine or provide regional suitability models and to determine habitat improvement potential.	5 Years
	RBH-S3-C: Update and expand habitat suitability modeling work to include new data and additional western states (i.e., Montana, Wyoming, Colorado, and New Mexico.)	5 Years
RBH-S4: Improve understanding of monarch movements throughout the life cycle, including interchange between overwintering sites within the West, major movement and migration routes, and interchange between the western and eastern populations.	RBH-S4-A: Continue and expand upon current tagging studies (Monarch Alert-Cal Poly San Luis Obispo, Washington State University, and Southwest Monarch Study, etc.) to assess movement of monarchs among overwintering sites (both coastal and inland).	Continue
	RBH-S4-B: Identify areas where movement data is lacking in key areas of the interior West and increase tagging efforts in those areas.	2 Years
	RBH-S4-C: Add ability to report and promote reporting of stopover roosting clusters to Western Monarch Milkweed Mapper (www.monarchmilkweedmapper.org) to help determine migration corridors.	1 Year
	RBH-S4-D: Synthesize and share data from tagging efforts, observation databases, and focused studies annually to identify migration and habitat connectivity patterns to help determine priority areas to focus additional research (e.g., corridor studies, mortalities at alternative energy facilities), and target habitat protection and restoration efforts (RBH-S3).	1 Year
RBH-S5: Increase understanding of effects of pesticides on monarchs and other pollinators.	RBH-S5-A: Initiate project to identify the types of data (including types of treated seed, application rates, etc.) and study designs necessary to better evaluate the effects of pesticides on monarchs and other pollinators in both agricultural and nonagricultural settings.	2 Years
	RBH-S5-B: Collect identified key data and conduct studies that assess how pesticides (particularly insecticides) are affecting monarch populations (e.g., mortality and fitness impacts, habitat values).	5 Years
RBH-S6: Increase knowledge of best practices to implement monarch/pollinator conservation on working lands.	RBH-S6-A: Work with agricultural cooperative extensions and similar organizations to identify appropriate research needed to develop effective BMPs on working lands.	1 Year

Strategies	Actions	Timeline (initiate within)
RBH-S7: Increase knowledge regarding predation, parasites, and disease affecting monarchs in the West.	RBH-S7-A: Encourage researchers involved in monarch tagging and other studies, as well as citizen scientists involved in handling live monarchs, to collect OE samples in coordination with the University of Georgia, and report the setting where monarchs were captured (e.g., native garden, non-native garden, classroom, wild, etc.).	2 Years
RBH-S8: Improve understanding of how climate change will affect monarchs relative to breeding/migratory habitat, behavior and distribution, as well as multi-trophic interactions (e.g., predators, parasites).	RBH-S8-A: Once information is acquired on what constitutes “good” monarch breeding and migratory habitat in the West (RBH-S-2), conduct potential future distribution models for each of the western states using current climate change models, similar to Idaho’s recent effort.	5 Years
6.7.3. Monitoring Strategies		
M-S1: Continue the Western Monarch Counts, both Thanksgiving and New Years counts (www.westernmonarchcount.org).	M-S1-A: Promote volunteer involvement in western monarch counts.	Continue
	M-S1-B: Provide training to agency biologists to assist in filling gaps in count coverage for key sites when necessary to count most important 75 sites.	1 Year
	M-S1-C: Analyze data using both summary and modeled statistics to provide indices for tracking population trends. (i.e., 5-year running average of Top 75 sites and MARSS [Schultz et. al. 2017] or similar model).	Continue
M-S2: Evaluate habitat restoration projects, techniques, successes, and failures to adaptively manage monarch and pollinator projects.	M-S2-A: Implementation monitoring on all habitat restoration projects should be required or conducted by all funding entities to determine if project was installed as planned.	1 Year
	M-S2-B: Conduct effectiveness monitoring for restoration projects when possible to determine if project area is being used by monarchs and thus providing habitat as planned.	1 Year
	M-S2-C: Conduct validation monitoring for projects pre- and post-restoration, when possible, to determine numbers of monarchs using sites and to indicate overall biological response of monarchs to the restoration actions.	1 Year
	M-S2-D: Monitoring plans and reports should be required by the entities funding the effort and results should be submitted to the WAFWA Critical Habitat Areas Tool (CHAT) and USFWS Monarch Conservation Database, as appropriate. See Implementation Section regarding tracking of conservation efforts.	1 Year
M-S3: Monitor changes in breeding and migratory patterns across the western landscape over time.	M-S3-A: Continue crowd-sourcing the collection of western monarch and milkweed observations over time using the Western Monarch Milkweed Mapper (www.monarchmilkweedmapper.org) and expand effort to include entire western U.S. region. Use appropriate statistical models for crowd-sourced data to extract trend information.	Continue
	M-S3-B: Encourage citizen scientist and professional biologists in western states to participate in the national Integrated Monarch Monitoring Program (IMMP) (https://monarchjointventure.org/get-involved/mcsp-monitoring)	1 Year
	M-S3-C: Seek volunteers or funding sources to establish regional or state coordinators to implement IMMP in the West.	2 Years
M-S4: Track the long-term trends of the monarch butterfly relative to multiple butterfly or other pollinator species.	M-S4-A: Continue and build upon the long-term datasets of Art Shapiro’s Butterfly Project and North American Butterfly Association annual counts to track the long-term trends of the monarch butterfly relative to multiple butterfly species in western regions.	Continue
	M-S4-B: Explore opportunities with butterfly and insect societies, museums, and others to establish or collate similar long-term studies elsewhere in the range of the western monarch.	2 Years

Strategies	Actions	Timeline (initiate within)
SECTION 7: CAPACITY, FUNDING AND IMPLEMENTATION		
7.4. Adaptive Management of the Western Monarch Conservation Effort		
I-S1: Facilitate the exchange of information among monarch conservation partners necessary for implementation of this Plan.	I-S1-A: Nevada Department of Wildlife will take the lead in organizing a Western Monarch Conservation Plan Implementation Summit in 2019.	1 Year
	I-S1-B: Promote or participate in regional coordination efforts, as appropriate, to advance Plan implementation (e.g., Environmental Defense Fund's planned California Central Valley meeting in Spring 2019).	1 Year
	I-S1-C: Establish state or regional implementation teams, as necessary.	2 Years
	I-S1-D: Prepare and post Annual Reports on the WAFWA Monarch webpage.	1 Year
I-S2: Monitor and adaptively adjust Plan goals, strategies, and actions, as warranted.	I-S2-A: Monitor conservation activities implemented under the Plan, review action items and conservation targets for additions and modifications, and produce annual reports (e.g., CHAT status reports, Plan addendums, etc.).	1 Year
I-S3: Seek funding for monitoring, Plan implementation, and conservation actions.	I-S3-A: WAFWA Monarch Working Group member states will collaborate as appropriate on grant proposals to implement actions identified in the Plan.	Continue
	I-S3-B: Explore possible establishment of additional funding mechanisms (e.g., California's Monarch Butterfly and Pollinator Rescue Program).	5 Years

APPENDIX B.

Resources for Western Monarch Conservation

Biology & Ecology

Monarch Joint Venture	https://monarchjointventure.org/monarch-biology
Western Monarch Milkweed Mapper	https://www.monarchmilkweedmapper.org/western-monarch-biology/
MonarchNet	https://www.monarchnet.org/monarch-biology

Conservation – General

Xerces Society for Invertebrate Conservation	https://xerces.org/monarchs/
Monarch Joint Venture	https://monarchjointventure.org/
Jepsen et al. 2015	http://www.xerces.org/wp-content/uploads/2015/03/NatureServe-Xerces_monarchs_USFS-final.pdf
U.S. Fish & Wildlife Service	https://www.fws.gov/savethemonarch/
Monarch Conservation Webinar Series	https://monarchjointventure.org/our-work/monarch-webinar-series
Pollinator Partnership	http://pollinator.org/

Plans & Strategies

North American Monarch Conservation Plan	https://monarchjointventure.org/images/uploads/documents/5431_Monarch_en.pdf
2018 Monarch Conservation Implementation Plan	https://monarchjointventure.org/our-work/2018-monarch-conservation-implementation-plan
Mid-America Monarch Conservation Strategy	http://www.mafwa.org/?page_id=2347
Conservation and Management of Monarch Butterflies: A Strategic Framework	https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/documents/ConservationManagementMonarchButterflies.pdf

Conservation – Western Population

Managing for Monarchs in the West (Xerces 2018)	https://xerces.org/managing-monarchs-in-the-west/
Western Monarch and Milkweed Habitat Suitability Models Project V2 (Dilts et al. 2018)	https://www.monarchmilkweedmapper.org/habitatsuitabilitymodels/
Milkweeds and Monarchs in the Western U.S.	https://xerces.org/guidelines/milkweeds-and-monarchs-in-the-western-u-s/
State of the Monarch Butterfly Overwintering Sites in California	https://xerces.org/state-of-the-monarch-butterfly-overwintering-sites-in-california/
Protecting California's Butterfly Groves	https://xerces.org/protecting-californias-butterfly-groves/
CDFW Conservation Lecture Series Archive	https://www.wildlife.ca.gov/Conservation/Lectures/Archive

Milkweed & Nectar Resources

Monarch Nectar Plant Guides (regional)	https://xerces.org/monarch-nectar-plants/
Milkweed Guides (regional/state)	https://xerces.org/milkweed/
Milkweed Seed Finder	http://xerces.org/milkweed-seed-finder/
Why Grow and Sell Native Milkweed?	https://monarchjointventure.org/images/uploads/documents/Grow_and_Sell_Milkweed_Fact_Sheet_Final.pdf
Milkweeds: A Conservation Practitioner's Guide	http://xerces.org/milkweeds-a-conservation-practitioners-guide/

Roadsides & Utility Rights-of-Way

Pollinators and Roadsides	https://xerces.org/guidelines/pollinators-and-roadsides/
Roadside Best Management Practices that Benefit Pollinators	http://www.xerces.org/wp-content/uploads/2016/08/BMPs_pollinators_landscapes.pdf
MJV Roadsides as Monarch Habitat Project	https://monarchjointventure.org/our-work/projects/roadsides-as-habitat-for-monarch-butterflies
Monarch Highway Initiative	https://monarchjointventure.org/i-am-a/departement-of-transportation/
Monarch Habitat Development on Utility Rights of Way	http://pollinator.org/assets/generalFiles/Monarch.Habitat.Manual.ROW.NWest.ver4.pdf

Pesticides

How to Help Your Community Create an Effective Mosquito Management Plan	https://xerces.org/how-to-help-your-community-create-an-effective-mosquito-management-plan-a-xerces-society-guide/
Ecologically Sound Mosquito Management in Wetlands	https://xerces.org/pesticides/mosquito-management-wetlands/
Pesticides in Your Garden	http://xerces.org/pesticides-in-your-garden/
Agricultural Pesticide Use	http://xerces.org/pesticides/agricultural-pesticide-use/

Citizen Science Opportunities

Western Monarch Milkweed Mapper (Monarch SOS)	https://www.monarchmilkweedmapper.org/
Western Monarch Thanksgiving & New Year's Counts	https://www.westernmonarchcount.org/
Monarch Larva Monitoring Project	https://monarchlab.org/mlmp
Project Monarch Health	http://www.monarchparasites.org/
Integrated Monarch Monitoring Program	https://monarchjointventure.org/get-involved/mcsp-monitoring
Journey North	https://journeynorth.org/monarchs
Monarch Alert	https://monarchalert.calpoly.edu/
Southwest Monarch Study	https://www.swmonarchs.org/
Monarch Butterflies of the Pacific Northwest	https://www.facebook.com/MonarchButterfliesInThePacificNorthwest/
USFWS Monarch Information for Friends	https://www.fws.gov/refuges/friends/monarchs.html
iNaturalist – Monarch (<i>Danaus plexippus</i>)	https://www.inaturalist.org/taxa/48662-Danaus-plexippus

Education and Outreach

Field Museum Urban Monarch Conservation Guidebook	https://lccnetwork.org/resource/urban-monarch-conservation-guidebook
Monarch Joint Venture Educator Resources	https://monarchjointventure.org/i-am-a/educator
Monarch Joint Venture Education Downloads	https://monarchjointventure.org/resources/downloads-and-links
Teaching About the Magnificent Monarch	https://www.fishwildlife.org/application/files/4715/1630/6270/MonarchResourceGuide1217.pdf
The Children's Butterfly Site	https://www.kidsbutterfly.org/
Monarch Butterfly Lesson for Kids	https://study.com/academy/lesson/monarch-butterfly-lesson-for-kids.html

Education and Outreach *continued*

APPENDIX B. Resources for Western Monarch Conservation

Books, Websites, and Videos about the Migration of Monarch Butterflies <https://kidworldcitizen.org/books-videos-migration-monarch-butterflies/>

Project WILD conservation and environmental education program <https://www.fishwildlife.org/afwa-inspires/project-wild/project-wild>

National Wildlife Federation Mayors' Monarch Pledge <https://www.nwf.org/Garden-For-Wildlife/About/National-Initiatives/Mayors-Monarch-Pledge.aspx>

Grant Opportunities				
State	Program	Program Administrator	Program Description	Website
All States	Monarch Butterfly & Pollinators Conservation Fund	National Fish & Wildlife Foundation	Grants awarded to projects that create or sustain interconnected monarch and pollinator habitats; or increase capacity and coordination among organizations, state, and regions engaged in monarch and pollinator conservation.	http://www.nfwf.org/monarch/Pages/home.aspx
California	Ecosystem Restoration on Agricultural Lands (ERAL)	Wildlife Conservation Board	Intent is to assist landowners in developing wildlife-friendly practices on their properties that can be sustained and co-exist with agricultural operations.	https://www.wcb.ca.gov/Programs/Agricultural-Lands
	Inland Wetland Conservation Program (IWCP)	Wildlife Conservation Board	IWCP assists the Central Valley Joint Venture (CVJV) in its mission to protect, restore, and enhance wetlands and associated habitats. Funding supports a wide-range of projects that achieves CVJV goals to increase populations of 6 bird groups that depend on wetlands and adjacent uplands. These mesic areas could also support vegetation associated with monarch breeding and migratory habitat.	https://wcb.ca.gov/Programs/Wetlands
	California Riparian Habitat Conservation Program (CRHCP)	Wildlife Conservation Board	Program created to develop coordinated conservation efforts aimed at protecting and restoring the state's riparian ecosystems.	https://wcb.ca.gov/Programs/Riparian
	Habitat Enhancement and Restoration Program	Wildlife Conservation Board	A general restoration program that includes projects outside the other mandated programs. Includes restoration of wetlands outside the jurisdiction of IWCP, other native habitat restoration including coastal scrub, grasslands, and threatened and endangered species habitat, and other projects that improve native habitat quality within the state.	https://wcb.ca.gov/Programs/Habitat-Enhancement
	AB 2421 would establish the Monarch & Pollinator Rescue Program (MPRP), if passed	Wildlife Conservation Board	MPRP would provide grants and technical assistance to applicants to restore California prairie in an effort to recover and sustain populations of monarchs and other pollinators. Program would also coordinate efforts to restore breeding and overwintering habitat across the monarch's range, particularly on farms and ranches in the Central Coast, Central Valley, and Sierra Nevada foothills.	

Cost-share Programs			
Agency	Program	Program Description	Website
USFWS	Partners for Fish and Wildlife	Private landowner assistance program to support habitat restoration and enhancement projects.	https://www.fws.gov/partners/
	Coastal Program	Cost-share assistance program for Coastal areas to support conservation projects, including habitat restoration, protection, research, and monitoring.	https://www.fws.gov/cno/conservation/Coastal.html
NRCS	Environmental Quality Incentives Program (EQIP)	EQIP provides financial/technical assistance to agricultural producers to plan/implement conservation practices that lead to cleaner water and air, healthier soil, and better wildlife habitat.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
	Monarch Initiative and Working Lands For Wildlife (WLFW)	Program targets conservation efforts to improve agricultural and forest productivity that enhance wildlife habitat on working landscapes. Target species, such as the monarch, are barometers for success because their habitat needs are representative of healthy, functioning ecosystems where conservation efforts benefit a much broader suite of species.	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcseprd1360874
	Conservation Stewardship Program (CSP)	CSP participants will receive an annual land use payment for operation-level environmental benefits they produce.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
FSA	Conservation Reserve Program (CRP)	Contract for 10-15 years with landowners to remove sensitive land from agricultural production and plant species that will improve environmental health and quality.	https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/
	Conservation Reserve Program (CRP) Grasslands	Part of the CRP program that helps landowners and operators protect grassland, including rangeland, pastureland, and other lands while maintaining the areas as grazing lands. The program emphasizes support for grazing operations, plant and animal diversity, and grassland containing shrubs and forbs under the greatest threat of conversion.	https://www.fsa.usda.gov/programs-and-services/conservation-programs/crp-grasslands/index
CDFW'S Comprehensive Wetland Habitat Program	California Waterfowl Habitat Program (CWHP)	The CWHP provides economic incentives to private landowners who agree to manage their properties in accordance with a wetland management plan developed cooperatively by CDFW biologists and the participating landowner. Wetlands and adjacent uplands are mesic areas that can support monarch breeding and migratory habitat.	https://www.wildlife.ca.gov/Lands/CWHP/Private-Lands-Programs/Waterfowl-Habitat

Easement Programs			
Agency	Program	Program Description	Website
NRCS	Agricultural Conservation Easement Program (ACEP)	Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/
	Agricultural Land Easements	Under ACEP, NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, ACEP helps farmers and ranchers keep their land in agriculture. ACEP also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland, and shrubland.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/
	Wetlands Reserve Easements	Under ACEP, NRCS provides technical and financial assistance to private landowners and Indian tribes to restore, protect, and enhance wetlands through purchase of a wetland reserve easement (permanent, 30-year, or term). Wetlands and adjacent uplands are mesic areas that can support monarch breeding and migratory habitat.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/
USFWS	Sacramento Valley Conservation Easement Program	USFWS will pay willing landowners a percentage of their wetland or agricultural property's fair market value to purchase the farming and development rights in perpetuity. Purchasing easements on agricultural land allows USFWS and natural resource agencies to work directly with landowners to develop, fund, and implement a wetland restoration plan.	https://www.fws.gov/refuge/sacramento/Conservation/ConservationEasements.html
CDFW'S Comprehensive Wetland Habitat Program	Permanent Wetland Easement Program	Comp Wetlands, with the Wildlife Conservation Board's Inland Wetland Conservation Program, administers this program which pays willing landowners approximately 50-70% of their property's fair market value to purchase the farming and development rights in perpetuity. The landowner retains many rights including: trespass rights, right to hunt and/or operate a hunting club, and ability to pursue other types of undeveloped recreation (i.e. fishing, hiking, etc.). Easement landowners are required to follow a cooperatively developed wetland management plan and meet bi-annually with CWHP biologists to discuss habitat conditions and management.	https://www.wildlife.ca.gov/Lands/CWHP/Private-Lands-Programs/Waterfowl-Habitat
Land Trust Alliance	Various western programs and options depending on land trust	The Land Trust Alliance (LTA) Western Region includes about 260 land trusts, with over 100 in California. Land trusts in the West have been collaborating through landscape-level initiatives, peer networks, and open communication. Federal policy, including conservation funding and tax incentives, is a high priority for land trusts in the West, particularly in rural areas without local funding. LTA can direct landowners, corporate entities, and others interested in conservation easements to active land trusts in their geographic area.	https://www.landtrustalliance.org/

APPENDIX C:

Overwintering Site Management Plan Template

Cover page with Title, Location, Authors, Date

Acknowledgements

Table of Contents

- I. Background** (monarch declines, threats, importance of overwintering sites, general site info, partners)
- II. Site Description** (location, site history, landownership, use & management, soils and dominant tree and other plant species, past or present management plans, City or County plans, site-specific threats)
- III. Survey Information for overwintering monarchs** (history of monarch counts at site and estimates by year, cluster locations, predominant winds, areas for monarch sunning, nectaring, water sources, other behaviors)
- IV. Management Plan Actions** (goals, actions, and duration of plan)
 - a. Tree Planting and Forest Management (overall approach, maps, threats addressed)**
 - i. Tree Planting** (include species, location, and purpose)
 - ii. Tree Removal** (include locations and species to be removed, including downed trees, as applicable)
 - iii. General Forestry Guidance** (work with arborist and include recommendations)
 - iv. Nursery Stock Guidance** (disease-free nursery stock and best management practices)
 - v. Hazard Tree Guidance** (public safety first, assess annually with arborist and monarch expert)
 - vi. Tree Management Timeline** (list each action: Year 1, 3-5 Years, Annually)
 - b. Reducing Monarch Mortality** (describe primary reasons for mortality, if known; monitor/adaptively manage predation or other threats; describe actions to reduce mortality, as applicable)
 - c. Timeline for Adaptive Management** (list each action: Year 1, 3-5 Years, Annually)
 - d. Increasing Nectar Sources, Monitoring & Timeline** (include species, locations & bloom period, habitat restoration monitoring)
 - e. Milkweed Guidance** (remove milkweed from in and around overwintering sites)
 - f. Public Engagement & Timeline** (e.g., fencing, interpretive signage, docents, outreach)
- V. Monarch Cluster and Habitat Monitoring & Timeline** (monitor cluster response to plan)
- VI. Timeline for Overall Plan: Management Actions & Monitoring**
- VII. Appendices** (include monarch survey info & protocols, previous management plans, nectar plant lists, other relevant information)
- VIII. References**

(Template based upon Lighthouse Field Mgmt. Plan by E. Pelton et al. 2017 / Prepared by: S. Marcum 01.25.2018)

APPENDIX D: Western States Monarch Conservation Survey Results

Background

The Western Association of Fish and Wildlife Agencies (WAFWA) developed a short survey regarding conservation efforts for monarch butterflies and other insect pollinators to help in the development of the Western Monarch Butterfly Conservation Plan. In addition, it was anticipated that the survey results would help in populating the USFWS Monarch Conservation Database, which would feed into the Species Status Assessment. This information was essential for both highlighting ongoing efforts as well as helping determine further conservation needs in the western U.S.

Methods

California Department of Fish and Wildlife developed the original survey and targeted questions in five basic areas: organization and feedback, conservation initiatives and plans, threats, conservation efforts, and funding sources. This survey was then provided to each of the 7 western states (AZ, CA, ID, NV, OR, UT, WA) to share with conservation partners identified as potentially having information about monarch conservation efforts in their respective states. Although the questions were similar, the states used slightly different survey distribution methods. Some states provided the survey in either PDF or MSWord format, while others used an online version in SurveyMonkey. All survey results were summarized by the individual states, then provided to Idaho Department of Fish and Game for a west-wide compilation.

The following summary results and graphs were taken from the west-wide compiled database. Additional information not provided here is available in the database, including individual contact information, details of plans and initiatives, additional comments, and requests for information. The entire database is available from Idaho (contact Leona Svancara at leona.svancara@idfg.idaho.gov for more information).

Results

Organization and Feedback

A total of 118 responses were received with the majority coming from California (31%, $n=36$), Oregon (24%, $n=28$), Idaho (19%, $n=23$), and Arizona (16%, $n=19$) (Figure 1).

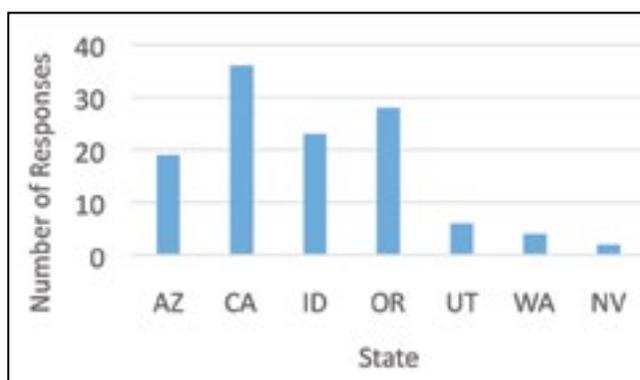


Figure 1. Number of survey responses by state.

The vast majority of respondents were from government agencies (49%, $n=58$), followed by NGOs (37%, $n=44$), and education institutions (9%, $n=10$). Commercial and private respondents totaled only 5% ($n=6$) (Figure 2). The government agencies represented, in order of prevalence with number of responses in parenthesis, included: states (15), counties or conservation districts (14), USFWS (7), NPS (7), cities (5), BLM (4), USFS (4), BOR (1), and USDA (1).

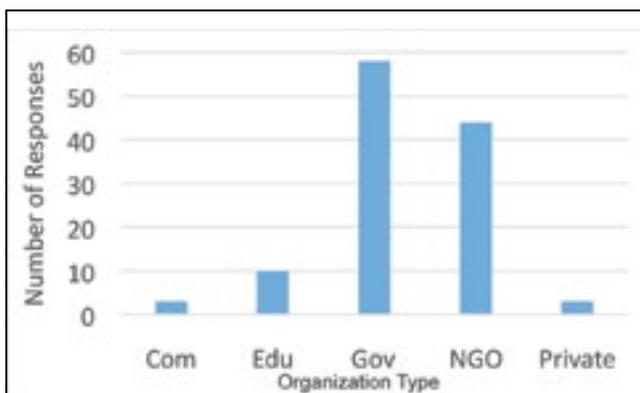


Figure 2. Number of survey responses by organization type.

Nearly 80% ($n=93$) of respondents specified they would like to receive further information regarding the western monarch conservation planning process. Only 3% ($n=4$) said no and 18% ($n=21$) of respondents did not indicate. With regard to the USFWS Monarch Conservation Database, 26% ($n=31$) indicated they would enter their own information or provide data for someone else to enter, 11% ($n=13$) would not enter their information, and 63% ($n=74$) did not respond to the question.

Conservation Initiatives and Plans

Forty percent ($n=47$) of all respondents indicated that their organization has a pollinator management or pollinator conservation initiative, the majority of which specifically addresses monarch butterflies ($n=39$). However, only 24% ($n=28$) indicated their organization has a monarch-specific conservation initiative. Of all respondents, only 6 indicated that they have a written and approved Conservation Plan addressing monarchs, including 2 NGOs, 1 state (ID), 1 zoo, and 2 private efforts. Of those 6 plans, only the 2 NGO plans and 2 private efforts specifically identified measurable goals.

Threats

Across all western states, land conversion and drought were the most commonly identified threats ($n=29$ and $n=28$, respectively), with climate change ($n=26$), disruptive vegetation management ($n=23$), and insecticide exposure ($n=22$) also selected with high frequency (Figure 3). Other threats included invasive/non-native vegetation, removal of overwintering sites, and vehicle collision.

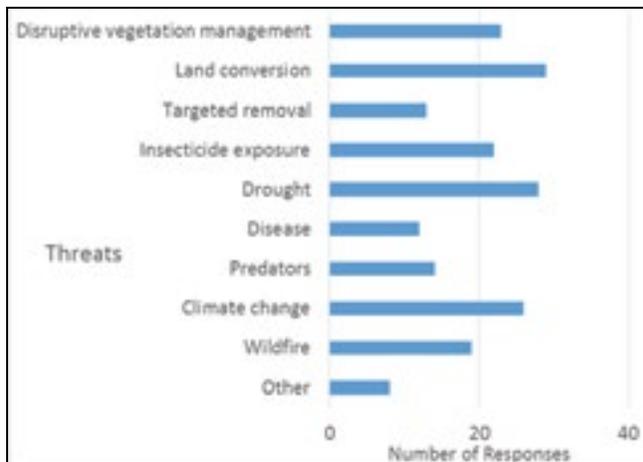


Figure 3. Threats identified by respondents across all western states.

Conservation Efforts

Nearly 60% ($n=69$) of respondents indicated they were conducting or planning to conduct various conservation efforts. Maintaining habitat (87%) was the most commonly identified, followed closely by create/establish habitat (84%) and cultivating both milkweed and nectaring plants (70% each) (Figure 4). Enhance/restore habitat, increase habitat acres, outreach/education, and form workgroups/partnerships were all identified in 58-61% of responses. Cultivating roost trees was the least selected effort (14%). Research and monitoring efforts were also less common (33-45%).

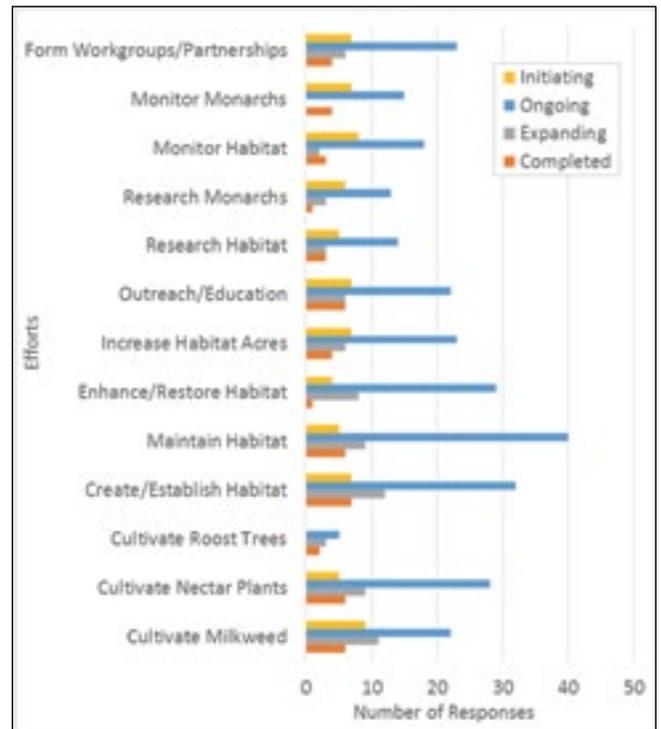


Figure 4. Conservation efforts identified by respondents.

The vast majority of conservation efforts were described as ongoing (58%), with 16% initiating new efforts, 16% expanding current efforts, and 11% completed.

Many respondents did not indicate the approximate acres being addressed by their conservation efforts. For those that did ($n=39$), 59% ($n=23$) encompass only smaller tracts of <50 acres (Figure 5). Fifteen percent ($n=6$) occur on 51-500 acres, 8% ($n=3$) occur on larger areas (501-2000), and 18% ($n=7$) are occurring at >2000 acres.

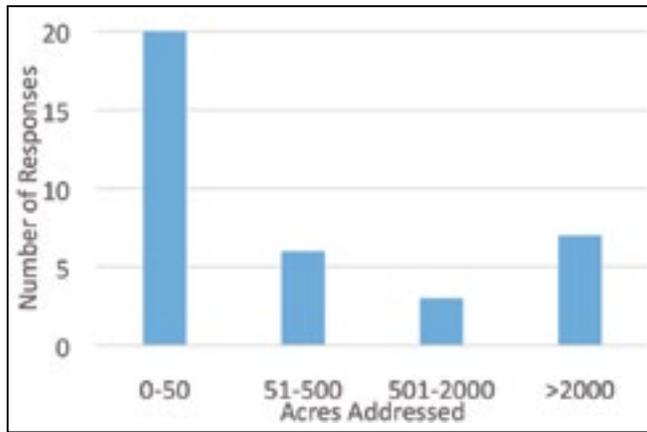


Figure 5. Areas addressed by conservation efforts.

Funding Sources

Conservation efforts tended to be funded with federal/state funding sources (39%, $n=20$) with NGO/private sources also common (35%, $n=18$) (Figure 6). Grants/contracts were identified by 9 respondents, but these may have also fit in the federal/state category. No funding, volunteer efforts, or self-funded were identified by 4 respondents. Eighteen respondents that identified conducting conservation efforts did not specify a funding source.

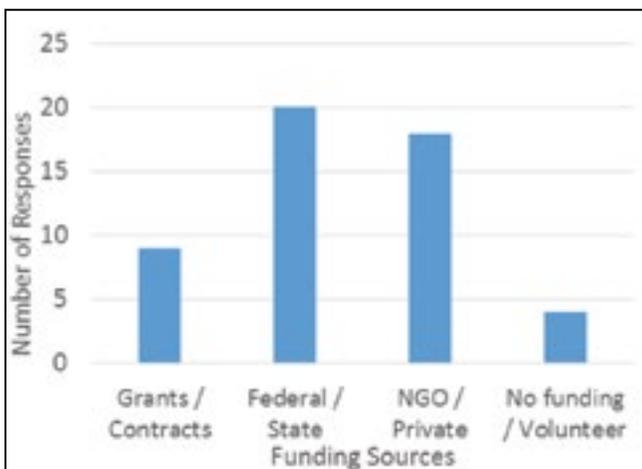


Figure 6. Funding sources of conservation efforts.

Discussion

Although responses to this survey were extremely variable in number and completeness, it did provide an initial glimpse of the breadth and depth of conservation efforts for monarch butterflies and other insect pollinators in the western U.S. The distribution of many of the responses is likely a reflection of the conservation partners originally included in the survey and additional target audiences may have been missed in some states. Originally, it was anticipated that the survey results

would help in populating the USFWS Monarch Conservation Database. While this still may be the case, it is essential that the results of both efforts be considered separately given that only 26% of our respondents indicated that they would provide their data to the USFWS.

Recognition of threats appeared to be fairly consistent across the western states, however there were some differences. For example, drought and climate change were identified as threats more often in Arizona and California, while disruptive vegetation management, land conversion, and insecticide exposure were more frequently cited in Idaho and California. It is unknown the extent to which these threats have actually been documented in each of these areas.

Overall, there does not appear to be a correlation between having a pollinator management or conservation initiative, or even a monarch-specific initiative or conservation plan, and performing conservation efforts. In fact, of the 69 respondents indicating they were, or had been, involved in conservation efforts, only 35 (50%) indicated their organization had some sort of initiative or plan in place. Conversely, having an initiative did not translate to conservation effort as at least 12 respondents indicated having an initiative but not conducting any conservation efforts.

In general, stakeholders appear to be mainly continuing ongoing efforts on habitat and cultivation needs (except roost trees), as well as outreach/education and working partnerships, all of which are vital to the long-term conservation the species. However, the lower number of research and monitoring efforts of both habitats and monarchs is concerning given how little is known of the western population.

Spatially, conservation efforts are primarily focused on small tracts of land. Larger scale efforts (>2000ac) have only be reported for California (3), Idaho (2), Arizona (1), and Oregon (1). It is unknown, based only on this survey, how many acres are being affected.



*“Delivering conservation through
information exchange and working partnerships”*

Since 1922, the Western Association of Fish and Wildlife Agencies (WAFWA) has advanced conservation in western North America. Representing 23 western states and Canadian provinces, WAFWA’s reach encompasses more than 40 percent of North America, including two-thirds of the United States. Drawing on the knowledge of scientists across the West, WAFWA is recognized as the expert source for information and analysis about western wildlife. WAFWA supports sound resource management and building partnerships at all levels to conserve wildlife for the use and benefit of all citizens, now and in the future.

Western Association of Fish and Wildlife Agencies Member Organizations

Alaska Department of Fish and Game
Alberta Environment and Parks
Arizona Game and Fish Department
British Columbia Ministry of Forest, Lands and Natural Resources
California Department of Fish and Wildlife
Colorado Parks and Wildlife
Hawaii Division of Forestry and Wildlife
Idaho Department of Fish and Game
Kansas Department of Wildlife, Parks and Tourism
Montana Fish, Wildlife and Parks
Nebraska Game and Parks Commission
Nevada Department of Wildlife
New Mexico Department of Game and Fish
North Dakota Game and Fish Department
Oklahoma Department of Wildlife Conservation
Oregon Department of Fish and Wildlife
Saskatchewan Ministry of Environment
South Dakota Department of Game, Fish and Parks
Texas Parks and Wildlife Department
Utah Division of Wildlife Resources
Washington Department of Fish and Wildlife
Wyoming Game and Fish Department
Yukon Department of Environment