



Western Monarch Butterfly Conservation Plan



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

2019-2069, Update 2025

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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.

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We also recognize and express our thanks to all the volunteers who continue to contribute thousands of hours to monitoring, observing, and collecting data in

support of western monarch research and conservation. Thank you to all the stakeholders who participated in the 2024 partners meeting, providing feedback on plan implementation, priorities, and usability to improve this update.

Finally, to all the partners actively involved in monarch conservation, we are grateful for your hard work, dedication, and passion for this butterfly. Recovery of the western monarch butterfly will not be possible without you.



Executive Summary

The monarch butterfly (*Danaus plexippus*) is one of North America's most familiar and recognizable insects, celebrated for its remarkable migration and reliance on milkweed, its larval host plant. Once abundant and widespread, monarch populations have declined significantly. Since the release of the Western Monarch Butterfly Conservation Plan (2019-2069; Plan), overwintering western monarch numbers have fluctuated dramatically. Despite the goals, actions, and increased attention generated by the Plan, monarch populations reached a record low in 2020, an overall decrease of 86% since the 1980s. In December 2024, the U.S. Fish and Wildlife Service (USFWS) proposed listing the monarch butterfly as threatened under the Endangered Species Act. Additionally, new research has advanced understanding of monarch habitat use, population dynamics, and threats across the species' range.

To address these developments and sustain a proactive, multi-state approach to western monarch conservation, the Western Association of Fish and Wildlife Agencies Western Monarch and Native Insect Pollinator Working Group (WMNIP) has completed a five-year update to this Plan. This updated Plan refines habitat and population targets, incorporates emerging science, and identifies voluntary conservation actions aimed at stabilizing and recovering the western monarch population. Ultimately, this Plan is a representation of the working group's shared vision for monarch conservation in the West and provides a coordinated framework for collaboration across partners, ecosystems, and jurisdictions.

To ensure the updated Plan represents the best available science and reflects the perspectives of conservation practitioners, the WMNIP hosted a virtual partners meeting in September 2024. The meeting included facilitated breakout sessions that yielded valuable feedback on Plan implementation, emerging challenges, and priorities for monarch conservation. Although overwintering and breeding habitats in California remain central to recovery efforts, the update process also

included specific efforts to make the Plan relevant across the western monarch range.

Implementation of the Plan since 2019 revealed structural and organizational aspects of the original Plan that needed improvement. In response, WMNIP specifically dedicated time and attention to updating Chapter 6 (formerly Section 6) to improve usability and develop priority actions across the species' range. Overlapping focal areas were consolidated for clarity and efficiency. Discussions also underscored that the absence of a shared definition of breeding habitat impeded partners' ability to measure progress toward habitat-related goals. This update, therefore, includes a working definition of western monarch breeding habitat. In addition, the Xerces Society, in collaboration with the USFWS, refined the definition of monarch overwintering habitat, which is incorporated in this revision.

The Plan now encompasses the states of Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Washington, with Colorado and New Mexico newly represented in this update. Collectively, these states include the core and important perimeter parts of the western monarch's range, spanning overwintering, breeding, and migratory habitats. The updated Plan integrates new scientific understanding of monarch ecology within each of these habitat types while identifying remaining knowledge gaps critical to future conservation.

The Plan is organized in seven chapters (formerly sections) as follows:

Chapter 1: Introduction and Plan Overview – Describes the need, purpose, planning approach, and state authorities guiding the development of the Plan.

Chapter 2: Western Monarch Butterfly Ecology – Provides an overview of monarch life history, current population status, and habitat requirements, including new breeding habitat principles and an overwintering habitat conceptual framework.

Chapter 3: Summary of Potential Threat Factors – Provides an overview of a suite of potential threats affecting the western monarch population and its habitats.

Chapter 4: Current Conservation Efforts – Summarizes recent and ongoing activities by federal and state agencies, NGOs, academic institutions, industry partners, and community scientists.

Chapter 5: Monarch Population and Habitat Goals and Objectives – Presents working definitions of habitat and establishes near-term, measurable objectives for population and habitat targets aimed at reversing population decline and supporting recovery.

Chapter 6: Conservation Strategies and Actions – Outlines strategic approaches for overwintering habitat; breeding and migratory habitat; plant materials; research

and monitoring; and interagency collaboration and partnerships.

Chapter 7: Capacity, Funding, and Implementation – Provides guidance on implementation and Plan progress tracking, summarizes lessons learned, and describes the adaptive management process for evaluating and adjusting conservation actions.

Growing public and institutional attention to monarch conservation underscores the need for coordinated landscape-scale action. This Plan provides a unified framework for western monarch conservation intended for collaborative implementation among federal, state, Tribal, NGO, academic, private-sector, and community partners. While leadership and coordination will be provided by WMNIP, achieving the Plan’s goals will depend on broad engagement and sustained action across all partners.



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



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Edward K. Boggess.



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



CHAPTER 1: Introduction and Plan Overview



Beth Waterbury/IDFG.

The monarch butterfly (*Danaus plexippus* Linnaeus, 1758) 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; Xerces 2018). As early as 2008, stakeholders

from Canada, Mexico, and the U.S. developed the North American Conservation Plan to maintain 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. In 2020, USFWS found the species was warranted but precluded from listing. In December 2024, the USFWS proposed listing monarchs as threatened with protections under the 4(d) rule (USFW 2024a).

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 USFW 2015). The memorandum also encouraged states to consider adding the monarch butterfly and other pollinator taxa to their State Wildlife Action Plans as Species of Greatest Conservation Need. Building on 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 eleven westernmost states in the conterminous United States (U.S.), comprising the majority of the 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 by 86% since the late 1990s, from >1.2 million in 1997 to an average of <167,000 individuals over the last decade (Xerces 2025). A 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 estimated 84% decline in the eastern monarch population overwintering in central Mexico (Semmens et al. 2016). The concurrence of monarch population declines with a similar global decline in abundance, diversity, and health of pollinator taxa (IPBES 2016; Edwards et al. 2025) 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 of 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, pesticide use, climate change, parasites, disease, and predators (Jepsen et al. 2015; Shirey and Reis 2023;

Xerces 2018). The primary factors driving western monarch population declines are gradually coming into focus. Parallel threats of habitat loss, insecticides, climate change, parasites, disease, and predators are implicated in western monarch declines (Xerces 2018; Crone et al. 2019; USFW 2024b), but the relative contributions of these factors require 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 eastern monarchs 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. Though eastern and western monarchs are not genetically distinguishable, they are treated as distinct populations. They do, however, vary demographically, especially with respect to migratory behaviors and traits (Freedman et al. 2021; USFW 2024b). The two populations occupy disparate ecosystems and thermal regimes while breeding and overwintering (Freedman et al. 2021), and as a result, western monarchs face a unique combination of threats. Therefore, a separate conservation strategy specific to the western population is needed to effectively reverse their decline.

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 in 2017 to develop a west-wide, multi-state cooperative approach to improving grassland, wet meadow, riparian, and shrubland ecosystems that support the monarch butterfly during its breeding and

migratory life stages. In 2022, this group changed its name from the Western Monarch Working Group to the Western Monarch & Native Insect Pollinator Working Group (WMNIP) to include other native pollinators. 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 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-governmental 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 is adaptive by necessity, and the need for regular review and updates is recognized. See Chapter 7.2 Implementation for a schedule of review and updates to the Plan.

States currently involved in the WMNIP and development of this Plan include Arizona, California, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, and Colorado. This Plan is inclusive and applicable to other western states, such as Wyoming and Montana. Given our current state of knowledge, these states comprise the majority of western monarch range. However, western monarchs are known to overwinter in Baja, Mexico, and breed in Canada; thus, the conservation strategies in this Plan are also applicable to these areas.

The success of the Plan will depend on many partners and interested individuals throughout western North America. Current partners include, but are not limited to, federal, state, and local agencies, Tribal wildlife organizations, NGOs, and academic institutions.

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 for which 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. For wildlife species not currently listed under the ESA, management authority 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 nectariferous habitats) into their broader wildlife habitat management activities. Some states have the authority to designate species as endangered, threatened, or fully protected, and to 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 (SWAPs) 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 Huggins/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
Colorado	CPW	Yes	No	Yes
Idaho ²	IDFG	Yes	Yes	Yes
Nevada	None	Yes	No	Yes
New Mexico ³	NMDOW	Yes	Yes	Yes
Montana	MFWP	Yes	Yes	Yes
Oregon	None	Yes	No	Yes
Utah	None	Yes	No	Yes
Washington	WDFW	Yes	Yes	Yes
Wyoming	None	No	No	No

¹ CDFW = California Department of Fish and Wildlife; IDFG = Idaho Department of Fish and Game; MFWP = Montana Fish, Wildlife & Parks; WDFW = Washington Department of Fish and Wildlife; CPW = Colorado Parks and Wildlife; NMDOW = New Mexico Department of Wildlife

² The monarch butterfly is the official state insect of Idaho.

³ The information provided for New Mexico is reflective of legislative changes that will take place as of July 2026



CHAPTER 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 in multiple books, articles, and websites (e.g., Monarch Joint Venture, Monarch Watch, and the 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 large (~10 cm wingspan) and easily recognized by their bold wing patterns (Figure 1) (Altizer and Oberhauser 1999). The upper surfaces of the forewings and hindwings display black to dark-brown veins on an orange background, bordered by two rows of white spots. The 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 typically have slightly larger wings, while females exhibit darker and thicker wing venation.

Monarch eggs are about the size of a pinhead and are off-white or yellow, characterized by longitudinal ridges that run from the tip to the base (Monarch Joint Venture 2025). Monarch caterpillars (larvae) are likewise strikingly patterned, displaying vivid black, white, and yellow transverse bands along the body. Monarch larvae go through five size stages, or instars, growing larger after each molt (Figure 2).

The chrysalis is green and spindle-shaped. Just before the monarchs emerge, their black, orange, and white wing patterns are visible through the pupa covering (Monarch Joint Venture 2025).

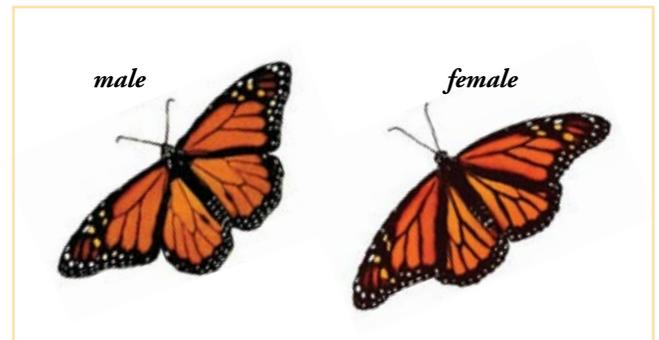


Figure 1. Adult male (left) and female monarch butterflies showing wing pattern differences. Photo: Norchester Garden Club.

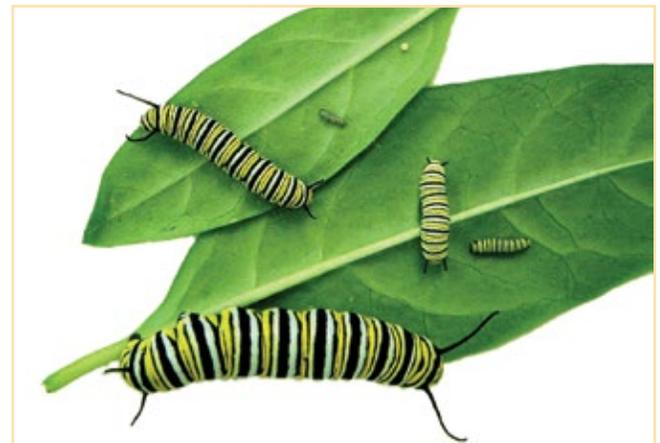


Figure 2. The five instar stages of the monarch caterpillar. Photo: Monarch Joint Venture.

2.2. Taxonomy

The monarch (*Danaus plexippus* Linnaeus, 1758) belongs to the order Lepidoptera (moths and butterflies) and the family Nymphalidae, characterized by small forelegs covered with specialized hairs—hence the common name “brushfoot butterflies.” Monarchs are further classified in the subfamily Danaiinae, the “milkweed butterflies.” Both larval and adult monarchs are specialized in accumulating 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. Six subspecies of *Danaus plexippus* are currently recognized. Genetic analyses of eastern and western North America populations show no clear differentiation, though research continues (Lyons et al. 2012; Freedman et al. 2021; Talla et al. 2020). Morphological differences, however, have been documented—eastern monarchs tend to have larger, more angular forewings, reflecting adaptation for long-distance migration (Altizer and Davis 2010; Yang et al. 2016).

2.3. Life History

Like all moths and butterflies, monarchs undergo complete metamorphosis consisting of four stages: egg, larva (caterpillar), pupa (chrysalis), and adult. The cycle takes about one month but is highly temperature-dependent, with cooler conditions slowing development.

Female monarch butterflies lay their eggs singly on the underside of young milkweed (*Asclepias* spp.) leaves or flower buds, and occasionally on related genera such as *Gomphocarpus*. The tiny cream-colored eggs hatch in 3–5 days. After first consuming their eggshell casing for extra nutrients, the larvae immediately begin feeding on milkweed. Milkweed provides both nutrition and cardenolides, protective toxins that make the larvae unpalatable to many predators. The larvae’s striking coloration serves as a warning to would-be predators. Caterpillars progress through five instars over 9–14 days (Oberhauser and Solensky 2004). The fifth instar forms a green chrysalis with gold trim and attaches to milkweed, nearby vegetation, or other structures. The pupal stage lasts about 10 days. Upon emerging, the adult expands and dries its wings and begins searching for nectar and mates.

Monarch eggs, caterpillars, and pupae are vulnerable to extreme weather, predation, parasites, and disease, with fewer than 10% surviving to adulthood in the eastern population (Nail et al. 2015). Vital rate data (e.g., survival, growth, reproduction, and recruitment) are largely unavailable for western monarchs. Breeding adults emerging in spring and summer mate within a few days and live 2–5 weeks, producing several generations as they migrate northward across the western U.S. and southern Canada.

As day length shortens, temperatures drop, and milkweed quality declines, the fall generation enters reproductive diapause (Goehring and Oberhauser 2002), accumulates lipids, and begins a south-southwest migration to overwintering sites. Migrants may live 6–9 months (Cockrell et al. 1993; Herman and Tatar 2001); based on their longevity, this overwintering generation is also referred to as the “super-generation.”

2.4. Migration and Distribution

Monarch butterflies occur throughout North America to about 50°N latitude in southern Canada (Figure 3), but are uncommon in western Washington, northwest Oregon, and western British Columbia, where native milkweeds are largely absent (Pyle 2015). Western monarchs typically arrive at overwintering sites in coastal California and Baja California in September and October. Tagging studies show that some western monarchs, primarily from the Southwest, migrate to overwintering grounds in Mexico, where they mix with eastern monarchs (Billings 2019; Morris et al. 2015; Pyle 2015). A small portion of the western monarch population “winter” in Arizona, including both breeding and non-breeding individuals. The wintering Arizona monarch butterflies may be active for months after arrival (Morris et al. 2015). For the purposes of this document, we will refer to monarch butterflies that arrive and stay in California for the winter as overwintering and associated with overwintering habitat, and monarch butterflies that arrive in Arizona and lose the urge to migrate as wintering in Arizona.

Smaller overwintering groups occur in California’s Saline Valley (Xerces 2025; Giuliani 2010) and Rancho Mirage, California (Gail Morris, pers. comm.). Occasional late-season monarchs are observed in southern Nevada, though the Nevada Division of

Natural Heritage considers these to be non-representative of true overwintering populations due to their lack of overwintering behavior.

Overwintering monarchs remain in reproductive diapause, limiting activity to sunning, nectaring, and rehydrating. This dormancy conserves lipid reserves essential for winter survival and spring dispersal (Brower et al. 2011). However, in southern coastal California and the Phoenix area, mild winters and the widespread planting of non-native tropical milkweed (*Asclepias curassavica*) enable year-round breeding, potentially disrupting normal overwintering behavior (Xerces 2018; Fisher et al. 2018; GBIF.org 2025; Wenner and Harris 1993). Active winter breeding has also been recorded further north in the San Francisco Bay Area (James et al. 2021) (Figure 4).

By late November–December, changing environmental conditions trigger monarchs to break diapause (Green and Kronforst 2019; Herman et al. 1981). Mating likely occurs at overwintering sites before spring dispersal (Herman et al. 1989), after which the population expands northward and eastward, tracking milkweed emergence. Successive monarch generations continue to colonize northern and eastern regions, following the availability of milkweed and suitable temperatures.

Significant progress has been made in mapping milkweed and monarch natal habitats in the West. Because monarchs are strongly associated with milkweed distribution, filling these data gaps is essential for conserving both seasonal habitats and the migratory phenomenon. In 2017, the Xerces Society launched the [Western Monarch Milkweed Mapper](#), a public reporting portal for monarch and milkweed observations in 11 western states. Combined with field surveys in Idaho, Nevada, Oregon, and Washington (2016–2017), the data enabled the development of habitat suitability models for monarch breeding and for multiple native milkweed species in the seven westernmost states (Dilts et al. 2018).

The models show that suitable breeding and migratory habitat is widespread, with highly suitable areas in California’s Central Valley, southern Idaho, eastern Washington, northern Nevada, southern Arizona, and portions of Oregon and Utah (Figure 5). The models provide valuable tools for prioritizing conservation, restoration, and monitoring efforts in the West.

In contrast to the eastern population, migration routes for western monarchs remain poorly defined. Historical collection records suggest that fall migrants often follow riparian corridors, which likely provide reliable nectar,

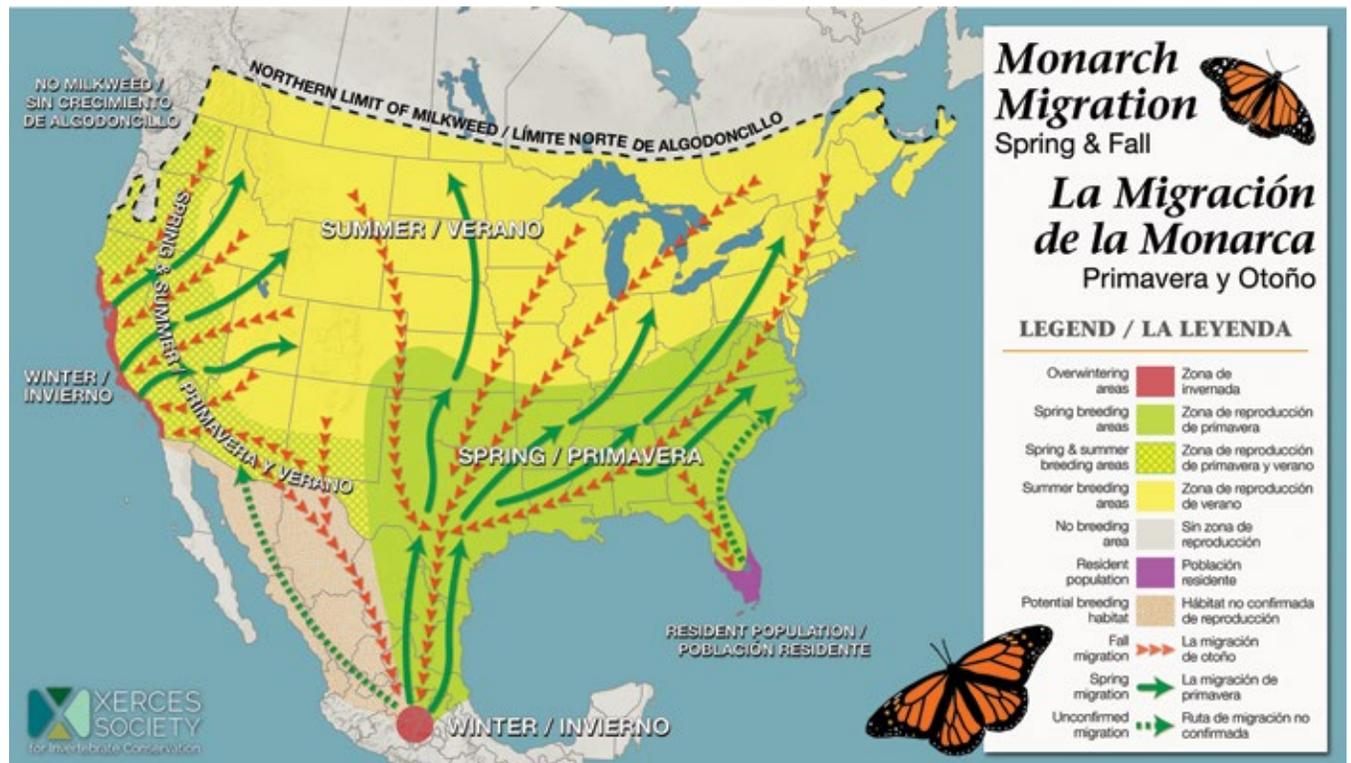


Figure 3. Monarch migration and distribution in North America. Map courtesy of Xerces Society.

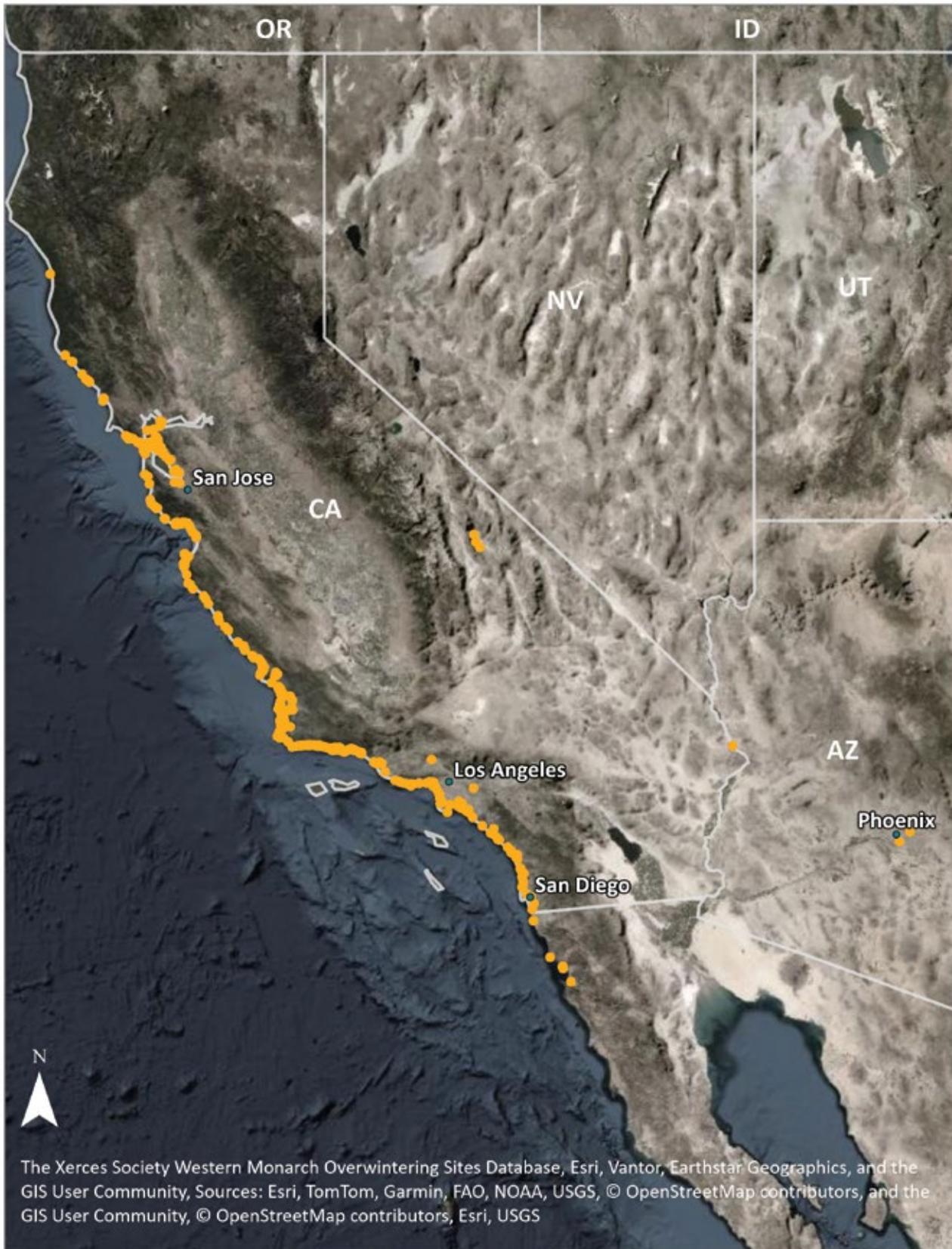


Figure 4. Historic and active overwintering sites (red). Map courtesy of the Xerces Society.

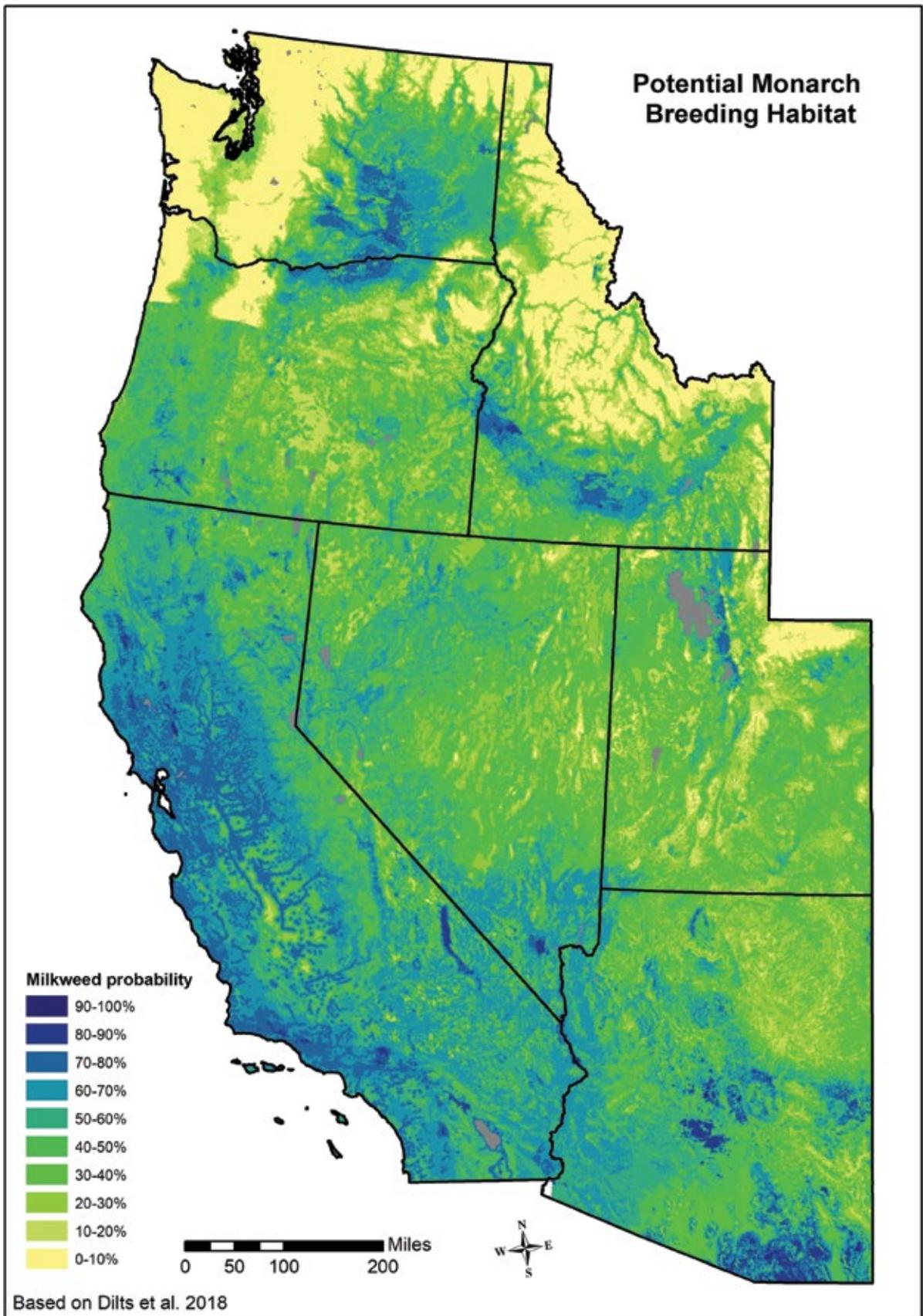


Figure 5. Predicted “all milkweed species” habitat suitability model of the seven western states (Dilts et al. 2018). Given that monarch breeding habitat is delimited by distributions of its obligate milkweed host plants, this map provides a relative measure of potential monarch breeding areas in the West.

water, and roosting sites (Brower and Pyle 2004; Dingle et al. 2005). A recent model confirmed associations between migrants and riparian areas (McIntyre et al. 2024). The Southwest Monarch Study, a community science group, has documented use of several river corridors as primary monarch migration routes (Morris et al. 2015).

Tagging by the Monarchs of the Pacific Northwest project (2012–2016) tracked captive-reared monarchs from Washington and Oregon to California overwintering sites (James et al. 2018), with additional evidence of south and southeast movement from eastern Washington and Idaho toward Arizona or Mexico. Further work by James and Kappen (2021) confirmed migration between California overwintering sites and movements among these sites through winter. Isotopic analysis of monarchs in California overwintering sites showed natal origins throughout the West, with about 40% originating 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 remain largely undefined (Pelton et al. 2019).

2.5. Habitat

Monarch habitat is generally categorized as breeding, migratory, or overwintering. Breeding habitat includes native milkweeds for larvae, nectar plants for adults, and often trees or shrubs for shading and roosting. In some western areas, monarchs rely on non-native nectar plants where native blooms are scarce in summer and fall (James 2016; Waterbury and Potter 2018). Migratory habitat provides nectar sources and roost trees during spring and fall movements. Because breeding and migratory habitat types share key components—milkweed, nectar sources, and roosting structure—they often overlap. Monarchs are described as being “wedded, not welded” to rivers during migration (Pyle 1999); watercourses offer suitable habitat features (Dingle et al. 2005) but may not always align with migration direction (Pyle 1999).

Milkweed presence alone does not guarantee monarch use. Females select oviposition sites based on characteristics that support reproduction: taller stems with moderate cardenolide levels (the compounds in milkweed that make them toxic and are sequestered by monarchs that in turn make them toxic) and younger

growth are most attractive, and species of milkweed with lower latex and cardenolide content yield higher larval survival (Pocius et al. 2021). Weather suitable for larval development is also critical for breeding success (see Chapter 3.5; Yang et al. 2022).



Monarch breeding habitat, Montour Wildlife Management Area, Gem County, Idaho. Steve Dempsey/IDFG.

Monarch breeding habitat in the West differs from that in the eastern portion of the North American migratory monarch’s range: milkweed stands in western North America are generally less dense and more widely dispersed. Consequently, the stems-per-acre standards used in the East are not applicable in the more arid western landscapes. The absence of a formalized breeding habitat definition has hindered efforts to track progress toward habitat-based goals and to compare conservation, enhancement, and restoration strategies.

To address this, researchers, agency biologists, and practitioners collaboratively developed a working definition of western monarch breeding habitat in 2025 (see box “Western Monarch Breeding Habitat Principles”). This definition was created specifically for this Plan to enable consistent tracking, though other definitions may be appropriate for different contexts. For the purposes of this Plan, references to monarch breeding habitat are based on this working definition, which remains subject to refinement as new research clarifies factors influencing monarch habitat use and movement.

Western Monarch Breeding Habitat Principles

Milkweed Distribution and Connectivity

The definition of western monarch breeding habitat centers on the distribution and connectivity of *milkweed stems* and their groupings. Milkweed habitat functions as a network of stems and patches connected at local and landscape scales, reflecting how caterpillars and adult monarchs experience habitat. While milkweed is the basic necessity for breeding, additional habitat features—such as nectar plants, shrubs, and trees for perching and shelter, and pesticide-free conditions—also support monarch reproduction and survival. These characteristics influence habitat quality, which is not addressed in the current definition but remains critical for breeding success and should be incorporated into future, more comprehensive habitat definitions.

Multi-Scale Framework for Habitat Connectivity

The multiscale habitat definition was designed to characterize a connected network of habitats capable of sustaining populations across the western monarch's breeding range.

- **Scale 1: Node or Minimum Habitat Unit (MHU)**

The smallest functional unit of habitat (“minimum habitat unit” or MHU) capable of supporting one caterpillar's development consists of approximately five mature stems of a regionally native milkweed (≥ 20 cm in length) within 10 m^2 . MHUs occur in groups or patches and combine to form larger assemblages on the landscape.

Habitat quantity is measured by the number of stems capable of supporting monarchs, rather than physical area, with established plants (typically 5–10 years old) representing long-term habitat. This distinction is necessary to account for the diversity of *Asclepias* species on the landscape.

The ratio of stems to MHUs—or “patch power”—is calculated as the number of milkweed stems divided by five. That is, an MHU with 10 stems has twice the “patch power” of an MHU with five stems. Monarch survival from egg to adult is very low, so, on average, approximately 100 MHUs (20 caterpillars) are needed to lead to one surviving adult. It is important to note that milkweed species vary in growth form: in some species, a single stem represents an entire plant, while in others, a single plant may produce many stems.

- **Scale 2: Complex (Local Subpopulation Scale)**

A complex consists of groups of milkweed or MHUs. Complexes represent the spatial scale at which adult monarchs mate, nectar, and oviposit.

A functional complex includes at least 20 MHUs connected within a typical daily flight distance (≤ 100 m). This is a working minimum, though larger complexes (200–500 MHUs) are preferable for restoration targets.

Habitat area should be calculated using a fixed value of 10 m^2 per MHU, independent of spatial arrangement, provided the MHUs form part of a qualifying complex.

- **Scale 3: Regional Management Zone** (*Ecoregional*)

Regional habitat zones correspond to the ten breeding and migratory regions identified in the *Western Monarch Butterfly Conservation Actions* (U.S. Fish and Wildlife Service 2023). Boundaries are based on EPA Ecoregion Level III classifications and the phenology of western monarch breeding and migration.

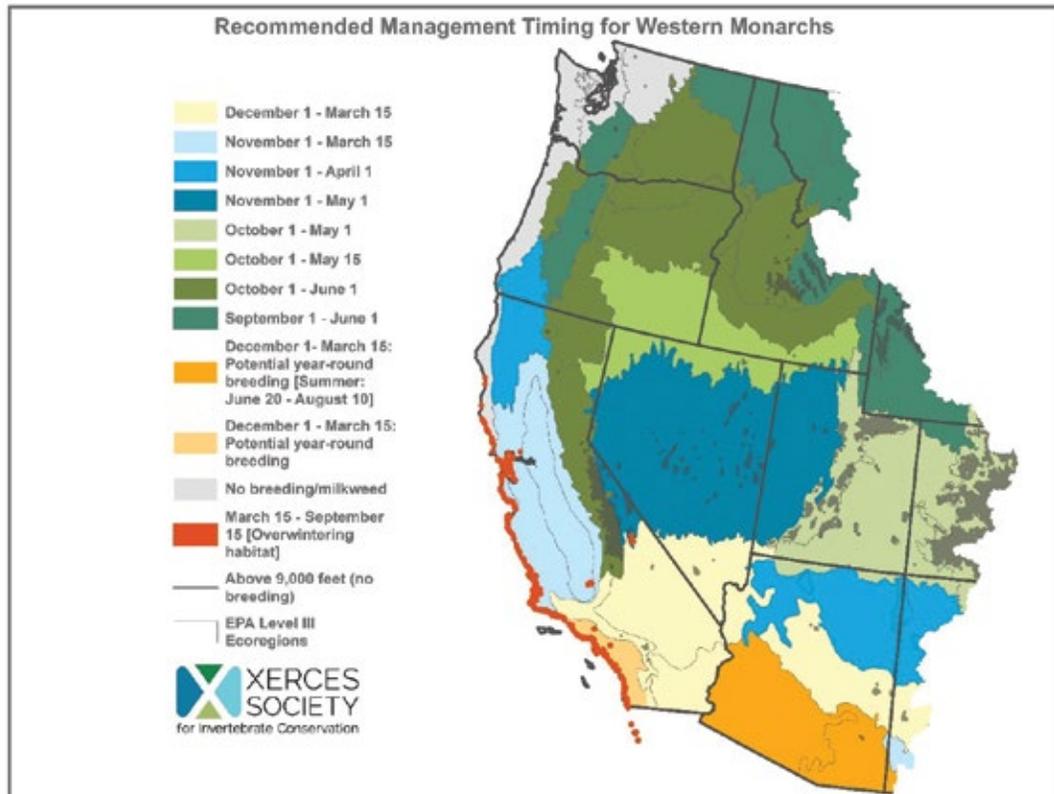


Figure 6. Recommended management windows in the western U.S. by zone.

These zones (Figure 6) guide the timing of management activities and promote landscape-level habitat connectivity. This scale also accounts for regional variation and supports the development of region-specific habitat targets. While the use of this scale is not required from a biological perspective, its strength lies in facilitating coordinated planning and implementation. Boundaries and targets may be refined as new information becomes available on habitat connectivity and western monarch population dynamics.

- **Scale 4: Network** (*Landscape Connectivity*)

The network scale incorporates the entirety of the breeding range for western monarchs. Specifically, it links breeding complexes across the landscape to overwintering grounds on the California coast. Complexes within 60 km of one another are considered connected at this scale.

Network connectivity depends on the temporal availability of milkweed species that support early-, mid-, and late-season breeding. Connectivity among these seasonal complexes ensures continuous habitat availability throughout the monarch's breeding cycle.

Isolated complexes should be prioritized for restoration to improve connectivity and enhance range-wide population resilience so that targets can be developed at the regional scale.

Connectivity as a Central Criterion

At every spatial scale—from individual milkweed stems to the broader western network—the ecological function of monarch habitat depends on connectivity.

- **Within MHUs:** connectivity among stems supports individual caterpillar development as they move between plants.
- **Within complexes:** connectivity among MHUs supports local population processes such as mating and dispersal as adult monarchs search for locations to oviposit.
- **Among complexes:** connectivity across the breeding range supports the annual colonization of spring and summer breeding habitat.
- **Across management zones and the network:** connectivity links overwintering sites to breeding areas, ensuring monarch population persistence throughout the annual cycle.

Next Steps

Current breeding habitat metrics were developed using *Asclepias fascicularis* as the reference species; however, creating a “milkweed conversion table” will be necessary to account for variation among *Asclepias* species that are regionally appropriate. It will be necessary in the near term to include a more comprehensive definition of “habitat quality” that references the spatial distribution of key habitat features within complexes. Beyond milkweed, essential resources such as nectar sources, shade, and water should ideally occur within 50–100 meters of all Monarch Habitat Units (MHUs). Management considerations, including pesticide restrictions and related criteria, are best applied at the complex scale. Additional priorities include developing regional connectivity targets and establishing principles for defining migratory habitat.

Overwintering habitat consists of groves providing microclimates and structure for monarch clustering and survival. Most sites occur at low elevations (<300 feet) (Lane 1993) within 1.5 miles of the Pacific Ocean or San Francisco Bay (Leong et al. 2004), where maritime influence moderates temperature (Chaplin and Wells 1982). Many sites occur in shallow canyons (Lane 1993) or along riparian corridors, though other locations include treed hilltops or coastal plains (Xerces 2023). Trees provide a clustering substrate and shelter from wind and storms (Leong et al. 2004). Optimal conditions include moderate, non-freezing temperatures and variable, dappled light (Leong et al. 1991; Saniee and Villablanca 2022; Rich and Weiss 1991). Monarchs also use nearby water and nectar sources throughout

winter (Tuskes and Brower 1978; Chaplin and Wells 1982).

While most overwintering sites share these characteristics, exceptions exist. For example, Saline Valley sites occur inland at higher elevations of ~1,400 ft, illustrating site variability. Though non-native *Eucalyptus* spp. dominate coastal overwintering sites, monarchs also cluster on native Monterey pine (*Pinus radiata*), Monterey cypress (*Cupressus macrocarpa*), western sycamore (*Platanus racemosa*), and other available native trees (Griffiths and Villablanca 2015; Xerces 2025). Additional cluster substrates include other pines, willows, coast live oak (*Quercus agrifolia*), coastal redwood (*Sequoia sempervirens*), mulefat (*Baccharis salicifolia*), and

Acacia spp. Over half of clusters observed since 2023 have occurred on eucalyptus, and a 1991 survey found them as the sole roost trees at 56.4% of sites (Xerces 2025; Sakai and Calvert 1991). In the desert southwest, aggregations occur near rivers or ephemeral creeks, using Goodding’s willow (*Salix gooddingii*) and Fremont’s cottonwood (*Populus fremontii*) as roost trees.

To better describe and delineate overwintering habitat, partner organizations developed a [conceptual model](#) dividing sites into three components: core, shelter, and support zones (Figure 7) (Xerces and USFWS 2023). This framework aids restoration and fuels management planning.

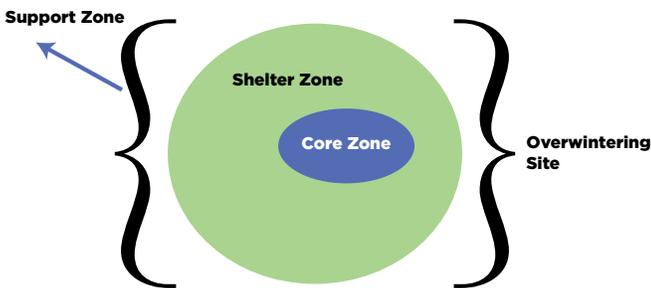


Figure 7. The overwintering habitat mapping conceptual model.

Core zone: Area containing trees where monarchs cluster, defined by the location of clustering from available data observations.

Shelter zone: Vegetation and topography providing wind protection and suitable microclimates, encompassing the core zone.

Support zone: A 500-foot surrounding area that offers nectar, hydration, and landscape features that buffer groves from prevailing winds (Xerces and USFW 2023).

2.6. Population Status

Historical estimates place the California overwintering population between 1 and 10 million butterflies (Nagano and Lane 1985; Nagano and Freese 1987). Since the 1980s, community science monitoring has documented marked declines. Standardized surveys beginning in 1997 through the Western Monarch Thanksgiving Count (now the Western Monarch Count, WMC) estimated 1.2 million western monarchs in 1997 (Pelton et al. 2016). Despite expanded monitoring, overwintering numbers have since dropped sharply, averaging 86% below 1997 levels (Figure 8). The four lowest counts—all recorded since 2018, including two below 10,000—highlight alarming trends.

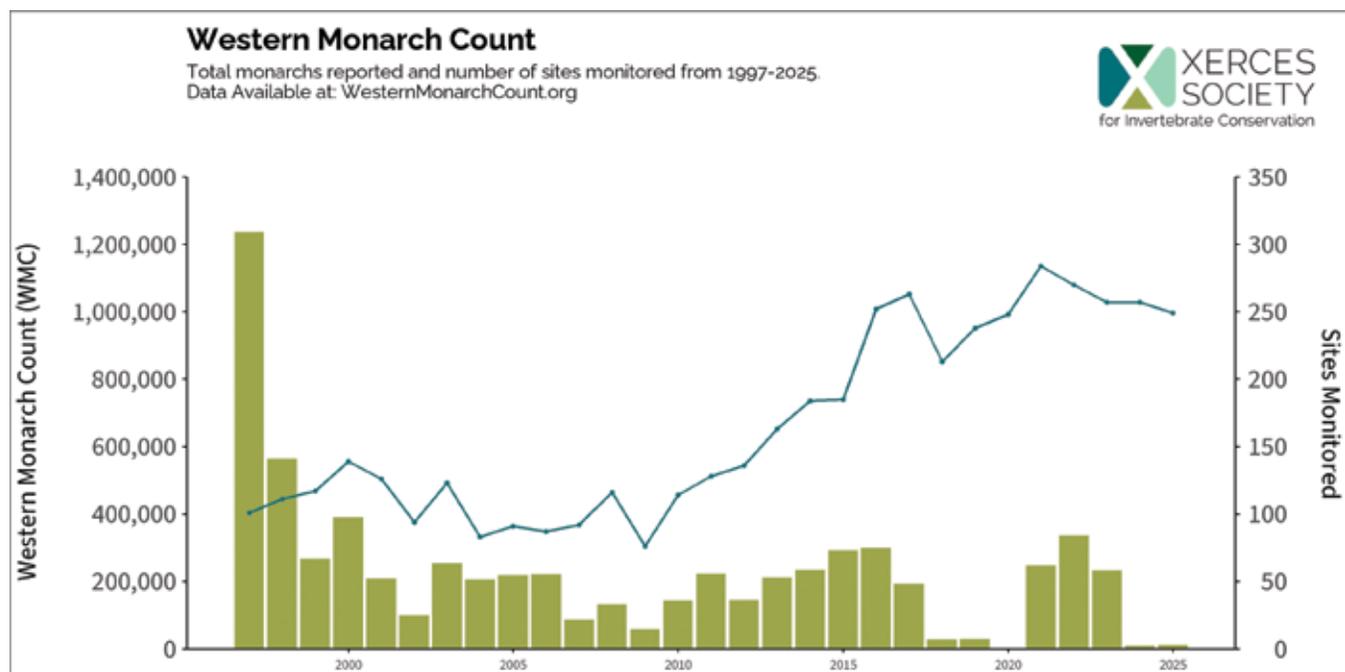


Figure 8. The Xerces Society Western Monarch Count, 1997–2025. Despite large increases in monitoring effort since 2010, counts reflect only small fluctuations in abundance estimates.

A population viability analysis found that western monarch numbers have declined by over 95% since the 1980s, with quasi-extinction risks of 72% within 20 years and 86% within 50 years (Schultz et al. 2017). Long-term monitoring across a west-east transect in northern California also showed declines in monarch observations during spring and summer breeding and migration (Espeset et al. 2016).

The updated USFWS species status assessment for North American monarchs (USFW 2024) projected extinction probabilities for the western population exceeding 80% in 20 years and 99% in 60 years. Even under “best-case” scenarios, the population is expected to continue declining. A threats analysis (Crone et al. 2019) identified land use change—more than climate variables—as the strongest driver of western population declines (see Chapter 3 for full discussion).



Tara Johnson



Tara Johnson



CHAPTER 3:

Summary of Potential Threat Factors



Edward K. Boggess.

This chapter 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 same extent as the eastern population (Jepsen et al. 2015); however, for both populations, exposure to insecticides, degradation and loss of habitat, and effects of a shifting climate have been cited as key drivers (USFW 2024; Crone et al. 2019; Thogmartin et al. 2017). Other threats include disease, predation, and captive rearing. Identifying the threats affecting the western monarch population is an essential step toward understanding and effectively conserving this imperiled species.

3.1 Loss and Degradation of Overwintering Habitat

Overwintering has been suggested as the most vulnerable element of the monarch's annual cycle (Pyle and Monroe 2004) (Figure 9). Although this has not been confirmed, as a full life cycle analysis is needed, the loss and degradation of California overwintering habitat is likely an important, if not the leading driver of western monarch declines (Voorhies et al. 2019; 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 by natural factors (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 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 2025, unpublished data). At least 63 sites in total have been destroyed or severely damaged since the 1980s (USFW 2024a). An analysis based on data from the Farmland Mapping and Monitoring Program indicated that ~50% of the area within 500 m of overwintering sites was developed by 1982 and is now ~56% developed (Crone et al. 2019). As recently as 2025, trees in monarch overwintering sites on publicly owned land were cut down (Hillary Sardiñas, pers. comm. 2025). Local stakeholders or land managers may be unaware of overwintering habitat, given that many sites lack signage, monarchs are only present seasonally, and clusters can be difficult to spot without training.

Overwintering sites in California have mixed ownerships and therefore have variable levels of protection that collectively do not provide consistent or comprehensive protections from development, habitat modification, or monarch collection (Pelton et al. 2016; IELP 2012). Under the proposed ESA listing (see Chapter 4), only 61 of the ~430 active or historically occupied sites are designated as critical habitat (USFW 2024a; Xerces 2025). Though the California Coastal Commission designates monarch overwintering sites that occur within the Coastal Zone (more than half of all known sites) as Environmentally Sensitive Habitat Areas (ESHA)—thus requiring that impacts be avoided or mitigated—there are few other protections in place for these important habitat areas, especially those that exist outside of the Coastal Zone. Even sites within the coastal zone may be vulnerable to tree removal and other fuels reduction activities. For example, the 2025 proclamation of a state of emergency from the California Governor’s office allows for suspension of the state Endangered Species Act, Environmental Quality Act, and Coastal Act for fuel-related activities that could damage or destroy overwintering sites (Executive Department State of CA 2025). Additionally, a site’s designation as ESHA is often not known, as Local Coastal Programs designate ESHA sites and are responsible for issuing permits. Despite their special status, many sites are altered due to a lack of knowledge that native and non-native trees comprising overwintering habitat in the coastal zone are protected. Given the inconsistent and varying local, state, and federal laws, it is difficult to determine which legal protections, if any, may apply. A 2012 [report](#) by the International Environmental Law Project is one of the few tools available to determine which protections may apply to an individual site (IELP 2012).

Non-native *Eucalyptus* species such as blue gum (*E. globulus*) make up a significant proportion, if not the majority, of overwintering habitat for western monarchs (Xerces 2025; Longcore et al. 2020; Sakai and Calvert 1991; see Chapter 2.5). While intentionally planted in the early 1900s, they are now commonly seen as hazardous and a non-native or an invasive nuisance by many (Ritter and Yost 2009). *Eucalyptus* may drop limbs, which can damage property or pose a hazard; they can also be a wildfire risk, as they contain flammable, oily resin and build up fuels through leaf litter, dropped limbs, and shed bark, more than other native trees (Wolf and DiTomaso 2016). Hazard risks with eucalyptus are

commonly cited reasons for the destruction of monarch groves (Sakai and Calvert 1991); while these hazard risks are important considerations, steps can be taken to mitigate the risks while still maintaining the groves. Land managers and agencies are often focused on protecting and restoring native habitat; thus, they may face policies that compel them to remove eucalyptus trees despite their importance to monarchs.

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 (Pleasants and Oberhauser 2012; Flockhart et al. 2015; Thogmartin et al. 2017), though 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 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.

3.2.1 Urban and Agricultural Development

Urban development is another important factor contributing to the loss of monarch breeding habitat in the West. The 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’ populations grew by 9.2% between 2010 and 2020 and represent the second-fastest-growing region in the nation (U.S. Census Bureau 2021). Population growth drives the need for more land to support urban infrastructure, such as homes, schools, shopping areas, office buildings, and roads, converting natural habitat and open space into highly modified landscapes. For example, in California between 1992–2008, about 640,000 net acres of agricultural land

were converted to urban or built-up uses (University of California Agricultural Issues Center 2012). Of this, 28% 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). Grassland and shrubland habitat in California's Central Valley has continued to decline in the 21st

century, with an estimated drop of 22%, or 1,930 km², between 1973 and 2010 (Soulard and Wilson 2013). 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 the first spring generation of monarchs.



Figure 9. Map of priority zones for conserving western monarchs developed by partners. The recommended actions vary by zone, which include the early breeding zone and central coast as first priority areas, followed by the summer breeding zone and north and south coasts as second priority zones.

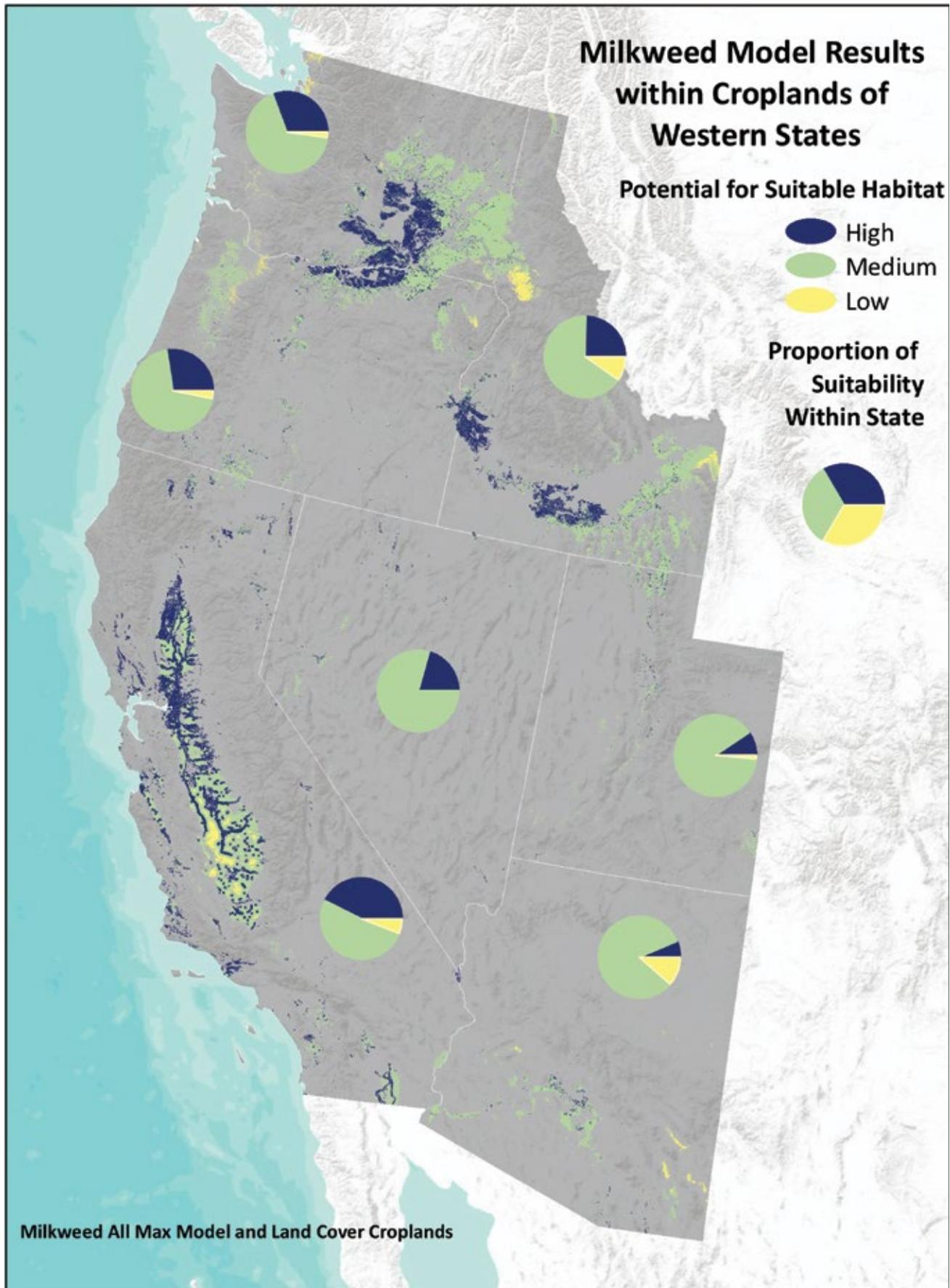


Figure 10. Milkweed model potential for suitable habitat within croplands of the western states and proportion of high, medium, and low milkweed suitability in seven western states. Map produced by CDFW from Dilts et al. (2018).

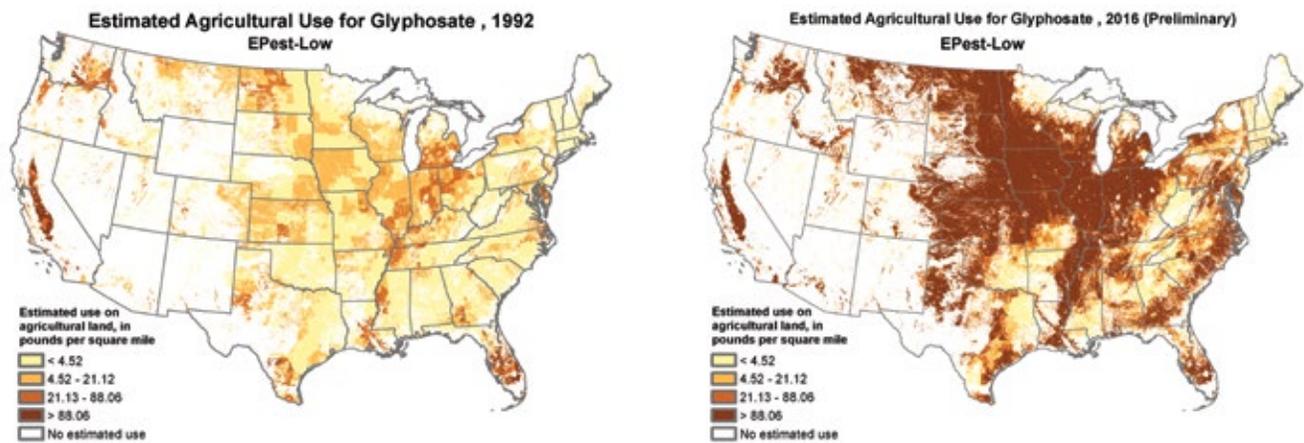


Figure 11. Increasing glyphosate use on U.S. agricultural land, 1992 versus 2019. Data from the USGS Pesticide National Synthesis Project, available from: https://water.usgs.gov/nawqal/pnsp/usage/maps/show_map.php?year=1995&map=GLYPHOSATE&hilo=H

In many areas of the West, agricultural production centers often intersect with suitable monarch breeding habitats (Figure 10; Dilts et al. 2018). Depending on the crop or commodity, agricultural practices can impact the quality and quantity of monarch breeding habitat. Data from the USGS Pesticide National Synthesis Project (USGS 2018) show increasing use of herbicides on agricultural lands in the West, particularly broad-spectrum, systemic herbicide glyphosate (Figure 10). Glyphosate use generally corresponds to predicted high-suitability monarch breeding habitat in the West. In California alone, millions of acres are treated with glyphosate each year. Although its usage has declined in recent years—from 5.6 million acres in 2016 to 4.5 million acres in 2022—it remains the top herbicide applied in the state (California Department of Pesticide Regulation 2024a). In 2022, approximately 21% of glyphosate use in California was for non-agricultural purposes, with around 14% applied to rights-of-way (California Department of Pesticide Regulation 2024b). 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).

3.2.2 Invasive Plants

Invasive plants often pose a threat to the health of native ecosystems, and land managers in the West are tasked

with fighting their spread. However, management practices to remove invasives from the landscape can potentially be harmful to monarchs and their habitat. For instance, roadside and aerial broadcast spraying are among the recommended techniques to control large patches of star thistle (*Centaurea solstitialis* L.) (USFS 2014), and nearby milkweed and other native nectar sources may unintentionally be killed or contaminated as a result. Black mustard (*Brassica nigra*), ice plant (*Carpobrotus edulis*), and cape ivy (*Delairea odorata*) are all problematic invasives in coastal California and beyond that are simultaneously used as fall and spring nectar sources for migratory monarchs (CAL-IPC 2006; Xerces 2025b). Spraying herbicides to control their spread can remove nectar sources from the landscape and expose adult monarchs and other pollinators to these chemicals, as herbicide drift and deposition onto both target and non-target plants can contaminate nectar and pollen (Zioga et al. 2022; Zioga et al. 2023). For additional details on herbicide impacts on monarchs, see Chapter 3.3.2.

Russian olive trees (*Elaeagnus angustifolia*) and tamarisk (*Tamarix spp.*) are woody invasives that spread along riparian corridors all over the West and often require mechanical or chemical treatments. Though they may provide benefits, such as shade along these corridors for monarchs, they have, overall, been linked to decreased native plant diversity (Sing and Delaney 2016; Brock 1994) that could ostensibly provide the same services. Other common riparian invasives that managers are tasked with controlling include arundo, reed canarygrass (*Phalaris arundinacea*), and common reed (*Phragmites australis*). Whitetop (*Lepidium draba*) readily

outcompetes native species in a wide array of habitats throughout the U.S. (Weyl 2018; Zouhar 2004), and stinknet (*Oncosiphon piluliferum*) is similarly advancing in more arid regions such as southern Arizona. To protect overall habitat integrity, land managers often need to use a multifaceted approach to contain or remove invasive species that threaten natural resources and ecosystem function. Targeted herbicide use can be an effective tool for removing invasive plants and supporting the recovery of native plant communities. However, because these compounds can pose direct and indirect risks to monarchs and other pollinators, it is important to evaluate these risks carefully and implement measures to minimize potential harm.

3.3. Pesticides

Pesticide exposure poses an ongoing and future risk to monarchs throughout their range. As a highly vagile species, monarchs may be lethally or sub-lethally exposed to pesticides 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 pesticide use or exposure. Because of this, monarchs may encounter pesticides at any life stage through direct contact exposure to pesticide applications, residues on vegetation, or systemic uptake by host and nectar plants.

Monarchs face the risk of multiple exposures from egg to adult throughout the migratory and breeding range, which may be sublethal but impair development, flight capacity, reproduction, or other important functions. At overwintering sites, monarchs cluster in high densities, making them especially vulnerable to acute pesticide incidents affecting large numbers simultaneously. In January 2024, a mass mortality incident occurred when approximately 200 monarchs, roughly 10% of the 2,000 individuals estimated to be clustering at the site during this time, were found dead and dying at an overwintering site in Pacific Grove, California. Samples tested revealed lethal concentrations of multiple pyrethroid insecticides, along with detectable levels of neonicotinoids, other insecticides, and a variety of fungicides and herbicides present at sublethal or unknown toxicity levels for monarchs (Hladik 2024). This incident underscores both the demonstrated and potential risks pesticides pose to the species. The following subsections provide a brief overview of each

major pesticide group and its documented and potential impacts on monarchs.

3.3.1 Insecticides

Insecticides are a category of pesticides formulated to control insect pests. Many commonly used insecticides are broad-spectrum and therefore effective in killing a wide range of insects, including beneficial pollinators. Insecticides are used across a wide range of sectors. Homeowners use insecticides to control pests in yards and gardens and may purchase plants from garden centers that sell ornamentals treated with insecticides that are long-lived and highly toxic to insects. 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 native grasshoppers and crickets over large areas. Vector control districts use insecticides in areas where mosquitoes may spread infectious diseases (e.g., 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 insecticide classes include neonicotinoids (Figures 11 and 12), organophosphates, and pyrethroids (EPA 2017). Neonicotinoids have become the most applied 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 relatively long environmental persistence. Their low toxicity to vertebrates and their systemic plant protection make neonicotinoids appealing for pest control, but they also cause unintended harm to pollinators. Neonicotinoids and other systemic pesticides may pose heightened risks to monarchs, as they can be absorbed by milkweed plants, leading to chronic exposure for larvae feeding on contaminated foliage. Monarch caterpillars may be particularly vulnerable to chronic oral exposure, as they are less mobile than adults and tend to feed on a small number of milkweed plants in close proximity (Fisher et al. 2020). Studies examining pesticide residues in milkweed plants across various landscapes—including agricultural fields, urban areas, open spaces, and nursery plants—have consistently detected systemic pesticides that are highly toxic to lepidopterans (butterflies and moths), such as

methoxyfenozide and chlorantraniliprole (Botias et al. 2016; Long and Krupke 2016; Olaya-Arenas and Kaplan 2019; Halsch et al. 2020; Halsch et al. 2022).

New pesticides, including biopesticides—such as fungal pathogens, Gram-negative bacteria, and neem oil—may present risks to monarchs but remain largely unstudied (Cappa et al. 2022; Chavana and Joshi 2024). 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* sprays on monarchs are lacking (Malcolm 2018). However, field and laboratory studies have shown that spraying *Bacillus thuringiensis* var. *kurstaki* (*Btk*) for forest management can reduce the survival and abundance of other non-target lepidopteran larvae, raising concerns about potential impacts on monarchs (Johnson et al. 1995; Herms et al. 1997; Peacock et al. 1998; Boulton et al. 2002; Boulton and Otvos 2004).

In California's Central Valley, pesticide contamination in milkweed plants was found to be widespread in early summer, when monarchs are likely to occupy that region (Halsch et al. 2020). The highly monarch-toxic chlorantraniliprole was detected in 91% of milkweed samples, while the environmentally persistent methoxyfenozide was detected in 96% of samples (Halsch et al. 2020). However, the potential impacts of many other detected pesticides remain uncertain due to significant gaps in toxicity data for monarchs and other butterfly species (Braak et al. 2018). These knowledge gaps limit the ability to fully assess the ecological significance of pesticide residues in both milkweed and monarchs (Belsky and Joshi 2018). Pesticide use in residential areas, including home gardens, parks, and other spaces where monarch host plants or roosting sites may be present, also poses potential risks. An estimated 25% of all insecticide use occurs in residential settings (Atwood and Paisley-Jones 2017), and surveys indicate widespread pesticide application to homes, lawns, and gardens in metropolitan areas across the U.S. (Locke et al. 2019). In addition, in many urban and suburban areas across the West, mosquito and tick populations are rigorously controlled with a combination of individual yard treatments and area vector control programs.

Because western monarch breeding and migratory habitat often correspond to wet areas where mosquitoes

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 and tick 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, Tribal, and private rangelands utilize liquid (spray) and solid (bait) applications depending on timing, location, species targeted, and scale of eruptions. These programs, administered by the USDA Animal and Plant Health Inspection Service (APHIS), may involve aerial insecticide applications across hundreds of thousands—sometimes millions—of acres of western rangeland each year between April and September (Davis et al. 1992; USDA 2019). Broad-spectrum insecticides are typically used in these programs (e.g., diflubenzuron, chlorantraniliprole, malathion, carbaryl), and these compounds are known to cause a range of lethal and sublethal effects in monarchs, other Lepidoptera, and other non-target terrestrial insect species (Abivardi et al. 1999; Lahm et al. 2007; Graham et al. 2008; Krishnan et al. 2020; Krishnan et al. 2021a).

Other state, federal, and county agencies also implement pest management and eradication programs throughout the western U.S. Large-scale, coordinated efforts—such as area-wide quarantine and eradication programs—may pose additional threats to monarchs and other pollinators, and can impact a wide range of landscapes, including forests, working lands, and urban and suburban areas. For example, during spongy moth eradication efforts in Santa Barbara County in the 1980s, researchers found that approximately half of the native Lepidoptera larvae collected from areas aerially treated with *Bacillus thuringiensis* (*Bt*) died from *Bt* infection (Brown et al. 1984). Large-scale programs pose concerns for monarchs overwintering, breeding, or migrating through treated areas.

Insecticides are just one facet of crop protection tools available to growers. Today's farmers use a range of Integrated Pest Management (IPM) strategies—a

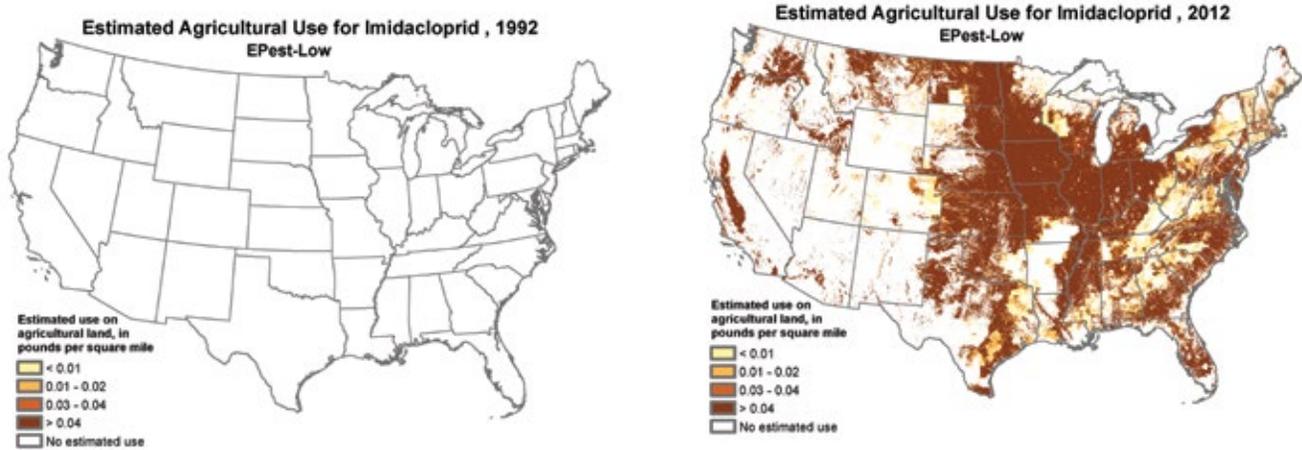


Figure 12. Estimated agricultural use of imidacloprid, a widely-used neonicotinoid insecticide, in 1992 (left) and 2014 (right). As of 2025, 2014 is the most recent year that includes neonicotinoid seed treatments. Starting in 2015, the data provider responsible for generating the county-level pesticide use estimates stopped reporting seed treatment applications. Consequently, maps from 2015 onward do not accurately capture the full extent of neonicotinoid use on U.S. agricultural lands.

science-based approach that emphasizes prevention, scouting and monitoring, and targeted pesticide use only when necessary. IPM practices may incorporate tools such as crop rotation, resistant crop varieties, habitat management to support beneficial insects, digital tools, precision application technologies, and more selective pesticide products. When used effectively, IPM can minimize reliance on chemical inputs, reduce costs, improve sustainability, and decrease risks to pollinators and other non-target species, while helping to slow the development of pesticide resistance.

As noted in Chapter 3.2, to the extent that 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 that growers have adequate crop protection tools available. Furthermore, managing monarch exposure to insecticides involves thoughtful risk management, including placing monarch conservation activities in landscapes where they are most compatible with surrounding land use and likely to be most effective.

3.3.2 Herbicides

Herbicides are a category of pesticides designed to control weeds. Research in the Midwestern U.S. has widely documented herbicide-driven milkweed loss as a key factor contributing to monarch population declines (Hartzler 2010; Pleasants and Oberhauser 2012; Saunders et al. 2018). While this body of work has

focused on the breeding grounds of eastern monarchs, herbicide use may be contributing to milkweed loss in the western U.S., including in agricultural, rangeland, and developed landscapes where broadleaf herbicides are used to manage vegetation. However, the direct toxicological impacts of herbicides on monarchs remain poorly understood. These pesticides have often been considered to pose little to no direct risk to pollinators; however, emerging evidence suggests that they can have lethal and sublethal impacts.

Herbicides such as glyphosate and paraquat have been documented to cause a range of harmful impacts on bees (Cousin et al. 2013; Battisti et al. 2021; Tahir et al. 2023; Phokasem et al. 2025). Additionally, exposure to various herbicides has been shown to negatively affect larval survival and development in other lepidopteran species (Gupta and Bhattacharya 2008; Bohnenblust et al. 2013; Riihimäki et al. 2025).

While limited, existing studies on the effects of herbicides on monarchs also suggest potential risks. For instance, exposure to the herbicide atrazine has been shown to reduce leaf consumption by monarch larvae, and larvae exposed to both atrazine and S-metolachlor exhibited smaller wing sizes in adulthood compared to control groups (Olaya-Arenas et al. 2020). These herbicides, along with a variety of others such as diuron, have been detected in milkweed plants across the monarch breeding range (Halsch et al. 2020; Olaya-Arenas et al. 2020; Halsch et al. 2022). Additionally, some herbicides have also been detected in monarchs

overwintering in coastal California (Hladik 2024), suggesting either carryover from larval exposure or contact during the adult stage.

3.3.3 Fungicides

Fungicides are a category of pesticides formulated to control fungal pests and diseases. Studies analyzing pesticide residues in field-collected milkweed and monarchs frequently detect fungicides, particularly from the strobilurin and triazole classes (Olaya-Arenas and Kaplan 2019; Halsch et al. 2020; Main et al. 2020; Halsch et al. 2022; Hladik 2024). Despite this, research on the impacts of fungicide exposure on monarchs remains limited. However, existing studies link fungicides to sublethal effects in monarchs (Olaya-Arenas et al. 2020b) and other butterflies (Peterson et al. 2019; Riihimäki et al. 2025), suggesting the potential for harm. Notably, all three studies found evidence of either carryover of chemical residues or impacts of larval exposure into adulthood. While acute toxicity from fungicide exposure appears to be less common than with insecticides, sublethal effects may persist, potentially impairing key adult fitness traits such as flight capacity and reproductive potential (Olaya-Arenas et al. 2020b; Riihimäki et al. 2025). However, research has primarily focused on strobilurin fungicides (e.g., azoxystrobin, trifloxystrobin, pyraclostrobin), highlighting the need for data on other fungicide classes. Some fungicides are also likely to interact with other pesticide classes, potentially amplifying their harmful effects on monarchs (for more on pesticide interactions, see Chapter 3.3.5).

3.3.4 Adjuvants

Adjuvants and co-formulants are added to pesticide formulations to improve their efficacy, stability, and/or application. Unlike pesticide active ingredients, the EPA does not assess the ecological risks of adjuvants and co-formulants. However, emerging research suggests that many of these compounds classified by the EPA as ‘inert ingredients’ are, in fact, toxic to insects (Mesnage and Antoniou 2018); they are reviewed in CA and considered to be pesticides. For example, widely used surfactants such as organosilicones, alkylphenol ethoxylates, and certain alcohol ethoxylates have been shown to be directly toxic to pollinators (Mullin et al. 2015; Mullin et al. 2016; Mesnage and Antoniou 2018; Straw and Brown 2021; Straw et al. 2022; Gelles et al. 2025). Despite these findings, data on their effects on monarchs

and other butterflies remain limited, making it difficult to fully assess their impact on the species.

Adjuvants, which are specifically designed to enhance insecticide toxicity in insects, may also increase the risks certain pesticides pose to monarchs. For example, the widely used synergist piperonyl butoxide can increase the toxicity of common insecticides, such as neonicotinoids and pyrethroids, in other pollinators by 1.7- to 154-fold, depending on the pesticide active ingredient (Iwasa et al. 2004). One study detected piperonyl butoxide in nearly 43% of milkweed samples purchased from commercial nurseries (Halsch et al. 2022), and the compound was also detected in milkweed growing in California’s Central Valley (Halsch et al. 2020), suggesting that monarch exposure may be common in certain contexts. However, its direct effects on the species remain unknown, as they have not been directly tested.

3.3.5 Pesticide Interactions

To fully understand how pesticides affect monarchs, it is important to evaluate how pesticide exposure interacts with other environmental stressors (see Chapter 3.8) and how multiple pesticides may act in combination. When different pesticides are encountered simultaneously, their effects can be additive (the total impact equals the sum of individual effects), antagonistic (effects are reduced compared to individual exposures), or synergistic (combined effects exceed the sum of individual effects). Research on other pollinators indicates that additive and synergistic effects are the most common outcomes of combined pesticide exposure (Siviter et al. 2021; Tosi et al. 2022). Synergistic effects are more likely when pesticides with different modes of action are involved, which can amplify the risks posed by pesticides, including those typically perceived as lower risk to pollinators, such as fungicides and herbicides (Iwasa et al. 2004; Tosi et al. 2022; Riihimäki et al. 2025).

Although few studies have measured pesticide residues in milkweed plants or in monarchs themselves, those that have consistently detected a wide range of pesticides within samples (Olaya-Arenas and Kaplan 2019; Halsch et al. 2020; Main et al. 2020; Halsch et al. 2022; Hladik 2024). These findings suggest that monarchs are often exposed to more than one pesticide at a time, yet little is known about the effects of these combinations on monarch health (Olaya-Arenas et al. 2020).

3.4. Shifting Weather and Climatic Conditions

Monarchs are subject to the shifting climate patterns in the West, which likely affect all life stages and migration. Increasing temperatures, drought, heat waves, and storm regimes are challenges for monarch conservation and recovery (USFW 2024b). 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). However, modeling efforts and expert opinions vary on the degree and mechanisms by which changes in climate patterns pose a threat (Crone et al. 2019; Espeset et al. 2016; Thogmartin et al. 2017; USFW 2024b; Shirey and Reis 2023; Zylstra et al. 2021).

Models of future climate predict an increase in summer maximum temperatures (Alder and Hostetler 2013). The duration of heat waves is also projected to increase (Keellings and Moradkhani 2020; USFW, 2024b). Generally, warmer summer temperatures have been correlated with higher abundance of various butterfly species, while fall warming has generally associated with a decline in abundance (Forister et al. 2021). However, the increase in frequency and duration of heat waves at local scales can directly impact the survivorship of larvae (Yang et al. 2022) and adults. Larvae experience thermal stress between 30–36°C (86–96.8°F), with high mortality rates at 42°C, and 100% mortality when exposed to 44°C (111°F) after a single 12-hr pulse. Elevated nighttime temperatures also exacerbate thermal stress (USFW 2024b; Nail et al. 2015). Adult females similarly produce fewer eggs when exposed to constant high temperatures (Barker and Herman 1976). As a result, the timing and availability of suitable breeding conditions may shift temporally or geographically in response. This increase in temperature may cause a northward shift or expansion in some milkweed species, changes in nutritional value, or dieback in the summer. Either scenario may result in loss of currently occupied breeding habitat and/or longer migration distances in the fall (Batalden et al. 2007; Lemoine 2015). Predicted longer migration distances would likely have a limited impact, as migration distances of the western population are considerably shorter than those of the eastern population. It is also plausible that longer migration distances may result in lower parasite risk (see Chapter

3.5.1), given the positive association between longer migration distance and lower disease load (Altizer and de Roode 2015).

Droughts are already considered a contributing factor in the decline of the western monarch population (Stevens and Frey 2004; Stevens and Frey 2010) and have become longer and more variable across much of the western U.S. (Zhang et al. 2021). Conditions by mid- and end of century are projected to become more variable seasonally across the region, depending on the type of ecological drought (Bradford et al. 2020). 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 (Stevens and Frey 2010). 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; Phillips et al. 2018). Migrants would be particularly vulnerable, as they rely on nectar sources to build up lipid reserves and fuel their fall migration (Chaplin and Wells 1982; Spaeth et al. 2025).

Climate change may also directly affect the migratory and overwintering phenology of monarchs (Malcolm et al. 2018). Diapause induction, part of the migratory syndrome, is influenced by declining temperatures in the fall, in addition to influences from milkweed quality and photoperiod (Goehring and Oberhauser 2002). Similarly, western migrants can return to reproductive activity when exposed to higher temperatures, especially after diapause termination in November–December (Green and Kronforst 2019; Herman 1981). Therefore, increasing fall and winter temperatures may influence the length of time monarchs overwinter and the proportion that become reproductively active throughout winter (Green and Kronforst 2019; James 2024).

While there have long been accounts of year-round breeding on the coast of central and southern California (Wenner and Harris 1993), a spike in winter breeding activity was documented in 2020 in the San Francisco Bay area, primarily on non-native tropical milkweed

(James 2024; James and Kappen 2021). One model suggests a future expansion of areas climatically suitable for winter breeding (Momeni-Dehaghi et al. 2024). A primary concern of an early return to breeding is the potential for phenological mismatch between monarchs and native milkweed species, which are typically dormant until early spring (Yang et al. 2022; Fallon et al. 2015). Early-emergent milkweed species are therefore a critical resource for the first generation (Schultz et al. 2017). Alternatively, a model predicting future climate scenarios for Santa Barbara County, California overwintering sites suggested that climatic shifts may result in an inland and upslope displacement of suitable overwintering conditions (Fisher et al. 2018). Several correlative modeling efforts have suggested various climate variables as important drivers of current and potential future breeding and overwintering distributions (e.g., Fisher et al. 2018; Dilts et al. 2019; Svancara et al. 2019; Fisher et al. 2024). However, efforts such as these are challenged by a mismatch in scale between the broad macroclimate data typically available for modeling and more local microclimates experienced by organisms, and therefore should be interpreted with caution (Lenoir et al. 2017; Kemppinen et al. 2024).

An increased frequency of severe weather events is expected with shifting climate conditions and could threaten monarchs concentrated at small overwintering sites (Brower et al. 2012; Pelton et al. 2016). Added and exacerbating stressors, including 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). The increase in wildfire frequency and intensity has also contributed to changes in overwintering and breeding habitat (see 3.6).

The ability of monarch butterflies to cope with or adapt to ongoing and future climate changes is uncertain. Monarchs exhibit several attributes indicative of a higher adaptive capacity (Thurman et al. 2020), including a broad distribution encompassing a wide range of climate conditions, highly connected populations, the ability to disperse long distances, low site fidelity, and high genetic diversity (Thurman et al. in prep). However, monarchs also exhibit important characteristics suggestive of a lower ability to adapt to climate change, including an annual long-distance migration that is dependent on

environmental cues, as well as dependence on seasonal phenology (temperature) and a single host-plant (milkweed) for larval development (Thurman et al. in prep).

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 threats may be amplified by other primary drivers of decline.

Many disease-causing pathogens are known to attack monarch butterflies, including fungi, bacteria, viruses, and protozoan parasites. Fungi identified include microsporidian *Vairimorpha* (formerly *Nosema*) spp., and *Beauveria bassiana* (Pocius et al. 2021; McLaughlin and Myers 1970). The Nuclear polyhedrosis virus is often the hypothesized cause of ‘Black Death’ where larvae or pupa darken in color shortly before death (Pocius et al. 2021). The most well-studied pathogen, however, is the protozoan parasite *Ophryocystis elektroscirrha* (OE). These microbes can have debilitating effects on monarch survival, mass, fecundity, mobility, and lifespan.



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.

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 then move into the caterpillar's gut and 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 concern where non-native tropical milkweed (*Asclepias curassavica*) is cultivated. Tropical milkweed is widespread and abundant in Florida and 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). Resident monarchs that feed on non-native, tropical milkweed in the winter have been found to have nine times the OE pathogen load of wild, migratory monarchs (Satterfield et al. 2016; Satterfield et al. 2018) and may also spread this deadly pathogen to the migratory monarchs, further contributing to their decline. There is concern that tropical milkweed may also interrupt or affect the migratory cycle. Larvae reared under fall conditions were more likely to emerge reproductive when fed tropical milkweed as opposed to native milkweed (Majewska and Altizer 2019; Pocius et al. 2021). Alternatively, tropical milkweed sites can disproportionately attract OE-infected and reproductively active migrants, thereby reinfesting their offspring (Satterfield et al. 2018). However, the degree to which urban gardens with tropical milkweed attract migrants or overwintering monarchs is still unclear (Erikson et al. 2025). Either interaction increases the likelihood of debilitating infection of OE in monarchs, leading to a higher risk of mortality and reduced reproductive and migratory success.

3.5.2. Predation

Monarchs incur mortality from a wide variety of predators and parasitoids throughout their life cycle. Invertebrates in more than 30 genera have been identified as predators (Pocius et al. 2021). Monarchs are particularly vulnerable in the egg and larval stages, and relatively few monarchs reach the adult stage. Nail et al. (2015b) found that less than 10% of eggs laid result in adults. 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.

Monarch eggs and larvae are preyed upon by ants, spiders, true bugs, beetles, wasps, mantids, and lacewing larvae. 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 specific to the western monarch population are largely understudied (Freedman et al. 2021). The invasive and widespread paper wasp also readily eats larvae, with high incidence in urban gardens (Baker and Potter 2020; Erikson et al. 2025). Another 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).



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.

Adult monarchs are also preyed upon by both vertebrates and invertebrates. Invertebrate predators include 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, kingbirds, and European starling. Accounts from specific overwintering sites have documented other non-avian predators, such as the eastern fox tail squirrel and yellowjacket wasps attacking clusters (Peter Ibsen, Connie Massiotti, Nick Stong pers. comm.).

3.6 Wildfires and Fuels Management

Wildfires have been an integral and often healthy form of disturbance in many western ecosystems (McLaughlan et al. 2020). They pose several risks and benefits to the western population, which vary greatly by habitat type and are influenced by climate change and land management activities. Changes in weather patterns and fire suppression practices in recent history have increased wildfire size and severity (Dole et al. 2023; Abatzoglou and Williams 2016), which may increase habitat damage and the incidence of monarch mortality.

While adults may escape, wildfires can directly kill immature stages during the breeding season. Fire also immediately reduces the amount of milkweed and nectar available on the landscape. However, there is evidence that fire can stimulate the growth of nectar plants and increase 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). For instance, plots that were burned had far higher densities of milkweed (*Asclepias viridis*) and stimulated re-growth and breeding activity within the same season (Baum and Sharber 2012). Similarly, nearly three times as many adult monarchs were sighted in prairies that were control-burned relative to sites that were managed through grazing in one study (Leone et al. 2019). There is a paucity of research on the potential positive or negative effects of prescribed fire specific to western 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).

Smoke may be an additive stressor to western monarchs and their migration as well (Pelton et al. 2018). Air pollution from wildfire in the late summer (August–September) is estimated to at least double in the Pacific Northwest under some climate models (Xie et al. 2022). Migrating monarch behavioral responses to smoke are poorly studied. However, overwintering monarchs exposed to smoke will abandon their overwintering clusters, via “frenzied flight” when temperatures are warm enough for them to do so or drop to the ground when it is too cold for flight (Brower and Malcom 1991). James and Kappen (2021) anecdotally note that

several tagged Oregon monarchs released in smoky conditions were successfully resighted at California overwintering sites. Further study is needed on the effects of smoke and air quality on monarch migration patterns and behavior.

Wildfire is a pervasive threat to overwintering sites as well. Many are in high fire risk areas, where fire starts could easily ignite decadent trees, leaf litter, and ladder fuels that accumulate without active fuels management. Even with appropriate fuels management, massive fires such as those driven by Santa Ana winds can destroy overwintering habitat (Westerling et al. 2004; Safford et al. 2022). 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). In winter 2024–25, at least two overwintering sites were partially burned in fires in the Los Angeles area, including the highly destructive Palisades Fire; one additional site was spared because of an on-site water tank, which managers were able to use to drench the vegetation in time (Sara Cuadra-Vargas, pers. comm. 2025). Warmer temperatures and longer dry seasons are expected to increase wildfire frequency and size in western habitats. As a result, public policy and state agencies encourage vegetation removal within “[defensible space](#)” to reduce the threat of wildfire to homes and communities (CALFIRE; see Chapter 3.1). Similarly, the California Vegetation Treatment Program ([CalVTP](#)) fuels reduction projects are larger in scale and, on occasion, encompass overwintering habitat. Applied research investigating the compatibility of common treatments with overwintering site habitat requirements would provide timely and proactive recommendations for vegetation management practitioners. Proper guidance would ensure fuels reduction efforts further protect overwintering habitat rather than degrade it.

3.7 Overutilization and Captive Rearing 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 the negative effects of captive rearing and release of monarchs on wild monarch populations, given their already declining numbers. Captive rearing poses the risk of transmitting disease

between caterpillars raised in higher densities than they would occur in the wild, using materials that may have accumulated parasites and pathogens (Altizer and De Roode 2010). While disease and predation are natural parts of the monarch life cycle, it is possible to unintentionally infect multiple generations of caterpillars through the repeated use of rearing containers and materials. Infected individuals released into the wild may increase the incidence of disease in the wild population and cause lower survival and migration success (Bradley and Altizer 2005). The loss of genetic diversity is a concerning impact of releasing captive-bred individuals into the wild, and even slight adaptations to captivity can be inherited by later generations (Willoughby and Christie 2018). Non-natural rearing conditions can influence monarchs' wing color and shape, which may have consequences for breeding and migration success (Davis et al. 2020). In some states (e.g., California and Washington), a scientific collecting permit is required for rearing and other scientific and educational activities associated with monarch butterflies. Additional permits from states may be required to release the butterflies. Limited captive rearing and release of monarchs can be a tool to support educational and scientific study; however, rearing and releasing monarchs 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.

3.8 Other Potential Threats

Aside from the threats outlined above, there are other understudied hazards to western monarchs that could play a role in their decline. Vehicle strikes are also a known source of mortality, though the overall impact on the population remains unclear (USFW 2024; Kantola et al. 2019; Mora Alvarez et al. 2019). Pollution from light, noise, and chemicals may also threaten monarchs. Light pollution can affect larval feeding behavior and migratory flight behavior (Parlin et al. 2022; Haynes 2023). Early research suggests that noise pollution may also affect larvae behavior (Taylor and Yack 2019; Davis et al. 2018). Concerns have also been raised over renewable energy facilities, where adults may collide with turbines at wind farms and high-temperature air pockets at “Solar Electric Generating Systems” (Weschler and Tronstad 2024; Kagan et al. 2014). These threats should be reevaluated as more research becomes available.

3.9 Interaction Between Threats

Many of the threats facing monarchs interact in various ways. For example, pathogens, the shifting climate, and non-native tropical milkweed are interconnected. As described in Chapter 3.5, OE infection and transmission are higher in year-round breeding populations, which commonly utilize tropical milkweed that can accumulate OE spores because it does not die back in the fall (Satterfield et al. 2016). Warmer winters may also encourage breeding on the evergreen plant if it is the most readily available species in winter (James and Kappen 2021; Satterfield et al. 2016). Therefore, non-native tropical milkweed and climate change likely feed into OE prevalence, but it has not yet been determined whether these year-round breeding populations are definitively a source or sink for migrants (Freedman et al. 2021; but see Erickson et al. 2025).

Effects of the shifting climate interact with other threats to habitat, including wildfire, invasive species, and development. Changes in temperature and weather patterns will likely change the overall distributions of invasive species that alter habitat quality (Poland et al. 2021). Wildfire, which is increasing in frequency and severity due to changes in temperature and precipitation patterns, may also promote invasives, particularly in heathlands, arid shrublands, and temperate forests (Alba et al. 2015; Poland et al. 2021). Tree failure at overwintering sites resulting from more severe storms and droughts increases fuel loads. As development continues into the wildland-urban interface (WUI), pressures to remove fuels will likely also rise, as will habitat degradation or fragmentation (USFS Northern Research Station 2024).

Additional stressors monarchs may experience, such as poor nutritional status (Tosi et al. 2017; Linguadoca et al. 2021; Castle et al. 2023), warming temperatures (Albacete et al. 2023), and pathogen infection (Doublet et al. 2015; Poquet et al. 2016; Grassl et al. 2018) have been shown to influence pesticide response in bees and could similarly affect monarchs, though this has not been directly tested. There is also some evidence that the natal plant species can affect pesticide susceptibility in monarchs (Prouty et al. 2021; Krueger et al. 2021), possibly due to changes in detoxification enzyme activity and/or gene expression in larvae feeding on milkweed plants with different phytochemistry (e.g., cardenolide profiles and concentrations) (Krueger et al. 2022).



CHAPTER 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 directs federal entities to increase and improve pollinator habitat and directs 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 and have begun

incorporating that information into planning and management guidance.

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 \$4 million per year, \$1.2 million 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 of the initiative.

Over the last four years in the western U.S., USFWS has 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

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West in targeting conservation efforts in a strategic way. 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 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 <i>State of the Overwintering Sites in California</i> 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 <i>Managing for Monarchs</i> in the West (Xerces 2018)	Xerces Society
Protecting California's Butterfly Groves (Xerces 2017)	Xerces Society
Western Monarch Butterfly Threats Analysis	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
NFWF Monarch Butterfly & Pollinator Conservation Fund	Partial funding provided by USFWS
Central Valley Farmer Habitat Restoration Guide	USFWS and Xerces Society
California Seed Strategy Project	BLM, NPS, USFWS
Trinational Conservation Science Partnership	USFWS, Commission for Environmental Cooperation, Environmental and Climate Change Canada, National Commission of Protected Natural Areas
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)

USFWS Project	Project Partners
Early Season Milkweed Project (2022)	U.S. Forest Service, University of California, Davis, Santa Barbara Botanic Garden, California Central Coast Joint Venture
Monarch Conservation Opportunities Tool v.1 (2024)	USFWS Center for Pollinator Conservation
San Joaquin Valley Monarch Collaborative (2024)	Monarch Joint Venture, Pollinator Partnership, Xerces Society, California DoT, CDFW, CADRP, BLM, USGS, Valley Eco, and others
California Agriculture Conservation Benefit Agreement	The Almond Alliance, The Wine Institute, The Strawberry Commission
Indigenous Co-Stewardship of Pollinators in the Western U.S. Workshop (2024)	Institute of American Indian Arts, USFWS, BLM, Tribal Alliance for Pollinators, Native American Fish and Wildlife Society, National Wildlife Federation's Free, Prior, Informed Consent with Indigenous Partners Initiative, USGS, USDA, Wildlife Conservation Society, National Native Bee Monitoring Network
Pesticide Research on Central Valley Refuges	USFWS, University of Nevada, Reno, USGS
USFWS National Pollinator Plan (2023)	USFWS Center for Pollinator Conservation with many additional federal and non-federal partners
Western Monarch Breeding Habitat Science Meeting (2025)	WAFWA WMNIP, University of California, Davis, Washington State University, Xerces Society, USFWS, BLM, USGS, NRCS, DoD, and others

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 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 was completed in 2020: a Candidate Conservation Agreement with Assurances (CCAA) for energy and transportation rights-of-way (ROW). The CCAA is a multi-sector effort to foster voluntary conservation for the monarch butterfly across land uses to support energy and transportation infrastructure. More than 40 organizations worked together to develop the CCAA, and in its first five years, commitments by partners encompassed more than 1.2 million acres across the country.

The CCAA is one tool that helps entities conducting beneficial actions on their lands for monarchs have regulatory predictability in the event that the species is listed. Other tools under the ESA that give regulatory flexibility and predictability to landowners willing to implement voluntary conservation actions on their land

include Safe Harbor Agreements, Conservation Benefit Agreements (CBAs), 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 native milkweed species.

USFWS launched the Center for Pollinator Conservation (CPC) in 2023. The CPC promotes working together to address declining pollinator populations in America. This national center is a place for land managers, decision and policy makers, scientists, program leaders, and others to explore, coordinate, and share best practices and approaches to address declining pollinator populations in North America. Staff includes a director, a western monarch coordinator, a national

communications coordinator, and a biologist. The CPC operates across agency programs and regions and with other federal agencies and interested parties to connect, coordinate, and communicate on pollinator conservation efforts. The CPC works to improve the state of pollinator science and assist partners in implementing conservation actions that benefit pollinator 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 did 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 midstories 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) — The Bureau of Land Management (BLM) manages the largest amount of wildlife habitat in the U.S. and is a leader in pollinator habitat management and monitoring in the Western U.S. BLM’s 2022 Strategic Plan for Pollinator Conservation identifies five goals that apply to all pollinators, but also specifically to the monarch butterfly:

1. Inventory BLM-managed lands and identify management needs for pollinators.
2. Implement proactive efforts to conserve and restore pollinator habitats.
3. Improve BLM business practices, policies, and planning for pollinator conservation.
4. Increase science support tools and information for pollinator species and habitat management.
5. Increase communication and collaboration internally and with BLM partners.

BLM manages significant portions of the breeding range and migratory pathways of the western monarch butterfly. BLM’s Special Status Species Management Policy includes guidance to recover ESA listed species and prevent the need to list sensitive species. BLM nationally considers the western monarch a BLM special status species, with six BLM states (AZ, CO, NV, NM, OR/WA, and UT) also identifying it as a sensitive species. Western monarchs are identified as a Tier 1 (highest priority) BLM special status species, which means they are more likely to receive targeted attention for recovery.

BLM is an active participant in many international, national, and regional monarch coordination groups, including Monarch Joint Venture, Collaborative Wildlife Protection and Recovery Initiative – Monarch Working Group, WAFWA WMNIP, and many other general pollinator collaborative groups. BLM strives for active collaboration with state, industry, and Tribal partners.

Recent BLM-led or -supported western monarch efforts include:

- CA: BLM manages an entire overwintering site and shares management of another site and is collaborating with partners to manage and monitor these sites.
- CA: BLM is actively participating in the California Multi-Agency Monarch and Pollinator Conservation Collaborative.
- CA: BLM partnered with Monarch Joint Venture to establish 400 permanent plots on BLM lands as part

of a national monitoring effort, finding over 9,000 milkweed plants and more monarchs on BLM lands than expected. Over 100 plots have been visited three years in a row to gather more detailed data.

- CA: BLM is using Seeds of Success to increase seeds of early emerging milkweed plants and important nectar plants for monarchs.
- OR: BLM created a three-acre pollinator garden at Wood River Wetland and planted showy milkweed and other nectar plants for monarchs and other pollinators, which have been used annually by monarchs.
- AZ: BLM has protected bract milkweed habitat at the San Pedro House that was originally planned to be mowed and has collected and planted seeds to expand the habitat.
- Multi-State: BLM's extensive efforts to conserve the sage steppe biome for sage grouse and other species benefit the monarch through the restoration and management of wet meadows (milkweed habitat), increased forb production through adjustments to grazing management and habitat restoration seeding treatments, and many other management actions.
- National: BLM supported NatureServe to model western monarch habitat by season of use and relative importance to inform habitat management, particularly habitat connectivity.
- National: Using BLM's national monitoring program, Assessment, Inventory, and Monitoring (AIM), BLM identifies milkweed and other pollinator plants, with some plots also assessing plant phenology and pollinator visitation.

Natural Resources Conservation Service (NRCS) — NRCS, through the U.S. Department of Agriculture, provides farmers, ranchers, and other landowners with 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 potential for modification, depending on the results of continuing research and monitoring.

National Park Service (NPS) — NPS manages overwintering, nectaring, and breeding habitat for the western population and continues to be committed to implementing the Plan. NPS has been active in promoting milkweed cultivation in Arizona, and many western park units operate native plant nurseries to propagate a wide variety of pollinator 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 the Xerces Society to conduct overwintering population counts of 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 also resilient to impacts from DoD activities and other stresses, such as drought and invasive species. DoD has been involved in promoting pollinator and pollinator habitat conservation efforts 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 its effort to minimize future military operational impacts in the event the monarch becomes an ESA-

listed species. The 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. DoD has also supported Monarch Joint Venture and Environment for the Americas, via the U.S. Forest Service, to collect data on monarch habitat across many installations nationwide using the Integrated Monarch Monitoring Program. Monarch Joint Venture will help DoD interpret the data and identify priority areas for monarch conservation, including best management practices. This collaboration with USFS and DoD has also funded additional partners to engage with DoD conservation and monitoring work, including the Xerces Society, Washington State University, Rights-of-Way as Habitat Working Group, and California Association of Resource Conservation Districts.

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 to 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, rehabilitation, and revegetation sites.

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 the Association of Fish and Wildlife Agencies 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 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 benefited 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, the Arizona Game and Fish Department (AZGFD), Arizona State Parks (State Parks), Arizona Department of Transportation (ADOT), and the Arizona Department of Agriculture (AZDA). AZGFD and State Parks are planning monarch and pollinator habitat inventory, development, and/or enhancement projects in many State Wildlife Areas and State Parks throughout the state. ADOT has used diverse native-only seed mixes for revegetation for over 20 years, providing nectar sources along the highway system throughout the state. In collaboration with the Arizona Bird Conservation Initiative (ABCI), AZGFD is expanding the [Motus](#)

[Wildlife Tracking System](#) (Motus) network in Arizona to better understand the population dynamics of many species, including the monarch butterfly. By utilizing this technology and collaborating with partners, knowledge gaps about birds, butterflies, and other wildlife can begin to be filled and guide conservation efforts that benefit species, their habitats, and people. Additionally, as a key stakeholder during NEPA and other environmental compliance processes, AZGFD regularly provides recommendations to development project proponents to increase awareness of monarch butterfly habitat, to seek to minimize impacts to habitat, and enhance habitat for pollinator species.

ADOT recently updated its roadside vegetation management guidelines to include recommendations on reduced mowing and seasonal mowing strategies to promote flowering species on the roadside, and ADOT is a member of the core team that developed the Nationwide Candidate Conservation Agreement with Assurances (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 2024, AZDA updated 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 food production. Annually, AZDA provides outreach to certified pesticide applicators and others about protecting pollinators and other beneficial organisms through proper pesticide usage. Though AZDA does not work with butterflies per se, its Office of Plant Services provides a state-approved list to the USDA Animal and 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.

The [Arizona Monarch Collaborative](#) (AMC) was established in 2019 to bring together various stakeholders, including state and federal agencies, local municipalities, conservation non-profits, private landowners, and Tribal partners to implement monarch conservation strategies throughout the state. The AMC aims to host annual partner meetings and trainings that provide an opportunity to share information and updates

on current conservation efforts. Additionally, the AMC is currently developing a statewide monarch conservation plan that includes WAFWA Plan strategies and actions that are modified to meet Arizona's unique conservation needs.

Research by the Desert Botanical Garden, Southwest Monarch Study, and many other AMC partners is underway to further understanding of monarch breeding and migratory habits, milkweed propagation studies, milkweed palatability to monarchs and other pollinators, and more. Examples of this research include efforts to tag monarchs with BlüMorpho Motus tags to better understand migration and the [Desert Refuge](#) community science project.

Conservation is happening within Arizona municipalities as well. The cities of Phoenix, Mesa, Scottsdale, Tempe, Flagstaff, and Tucson are all regular signatories of the [Mayors' Monarch Pledge](#) and are working to update their policies and develop monarch and pollinator habitat where possible.

California — Interagency partnerships — First convened in 2022, the California Multi-agency Monarch and Pollinator Collaborative (Collaborative) is a working group of 13 state and federal partner agencies. The Collaborative was created to inform and promote integrated science, natural resource management, and policy that can increase the pace and scale of monarch and pollinator conservation throughout California. The Collaborative assessed the strategies in the 2019 Conservation Plan and adopted priorities for partners. The Collaborative website also compiles information for use by practitioners and agency biologists for monarch conservation: (<https://wildlife.ca.gov/Conservation/Invertebrates/Monarch-Butterfly/MultiAgency-Collaborative>).

California Department of Fish and Wildlife — California Fish and Game Code (§ 1021) authorizes 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.

CDFW owns six properties that support aggregations of overwintering monarchs and has conservation easements on an additional two sites. In 2023, CDFW contracted with the Xerces Society to assess the status of monarch habitat and fire risk on these properties. The Xerces Society developed management recommendations and avoidance and mitigation measures (AMMs) to reduce impacts to monarchs during fuel reduction activities. Starting in 2025, CDFW began fuel reduction activities on these properties; they plan to track monarch response to these actions.

CDFW co-facilitates the California Monarch Plant Materials Working Group with the Xerces Society. The working group is composed of over 70 participants from agencies, native plant nurseries, non-profits, and members of the public. The group has focused on increasing the supply of early-season milkweed species, including California milkweed and heartleaf milkweed, for restoration projects. With plant materials from this effort, CDFW planted early-season milkweed onto one of its properties; the agency also worked with the conservation organization River Partners to add late-season and nectar resources to over 500 acres throughout the Central Valley and San Diego area.

Monarchs are included on CDFW's [Terrestrial and Vernal Pool Invertebrates of Conservation Priority List](#), and a Scientific Collecting Permit is required for research, education, and propagation-related activities involving monarchs. Project planners and reviewers can view monarch overwintering habitat in the [California Natural Diversity Database](#). When projects undergoing environmental review could impact monarch overwintering or breeding habitat, CDFW typically includes information on AMMs in its comments to lead agencies during the California Environmental Quality Act review process.

CDFW is a partner on the Motus cSWG with Washington, Oregon, and Idaho (see the Washington section for more information). CDFW trialed the technology at overwintering sites at Montana de Oro State Park in 2023 and will initiate a tagging project in 2026 during cluster breakup to evaluate migratory pathways for the first breeding generation.

California Department of Parks and Recreation — California State Parks protects and manages biological resources in over 280 parks statewide. Many parks host breeding and overwintering western monarch butterflies across their range, including more overwintering sites than any other landowner in California, over 25% of which are priority monarch overwintering sites. To direct management actions, site-specific grove management plans are being prepared or updated for many priority sites, incorporating the latest information regarding microclimate characteristics, threats to the grove, and conservation opportunities, such as appropriate native planting practices.

California Department of Pesticide Regulation — The California Department of Pesticide Regulation's (DPR) mission is to protect human health and the environment by fostering sustainable pest management and regulating pesticides. In 2018, DPR published a California Management Plan for the Protection of Pollinators (DPR 2018). The plan focuses on strategies to mitigate the risk of pesticides to managed pollinators. These strategies also benefit native bees and other pollinators. In 2021, DPR funded its first Ecosystems Monitoring projects and has since secured funding for additional contracts. The funded projects monitor for pesticides in the environment and will provide information on the fate of pesticides after application. In January 2024, DPR adopted regulations to limit neonicotinoid pesticide product use on certain agricultural commodities. These regulations were developed to protect pollinators and reduce the overall amount of neonicotinoid pesticides applied in the state. DPR also sponsors symposia and establishes 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 — The California Department of Transportation (Caltrans) operates and manages the State Highway System, and biologists recommend avoidance and minimization measures for monarchs 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 a nationwide CCAA (described below). Through enrollment in the Monarch CCAA, Caltrans will integrate Caltrans Pollinator

Standard Practices to further enhance monarch habitat by adopting appropriate conservation measures that promote monarch and pollinator habitats.

Wildlife Conservation Board — 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 2018. MPRP provides 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. To date, the MPRP has supported 11 grants, totaling approximately \$10.5 million.

California Coastal Commission — Within the California Coastal Zone, monarch overwintering groves are designated as Environmentally Sensitive Habitat Areas (ESHA). Under the Coastal Act, ESHA are protected against significant disruption of habitat values. The California Coastal Commission also collaborates with local jurisdictions to ensure projects permitted through Local Coastal Programs require monarch habitat protection, consistent with the Coastal Act. Development in or near groves is limited to work that cannot be avoided and must follow best management practices, such as avoiding work during the overwintering season.

California Department of Food and Agriculture — The California Department of Food and Agriculture’s (CDFA) mission is to serve the citizens of California by promoting and protecting a safe, healthy food supply, and enhancing local and global agricultural trade through efficient management, innovation, and sound science, with a commitment to environmental stewardship. In 2018, Governor Brown issued [Executive Order B-54-18](#), which directed California’s Secretaries of Food and Agriculture and Natural Resources to implement the California Biodiversity Initiative to secure the abundance and richness of native plants and animals in California under current and changing climate conditions. The goal is to preserve California’s biodiversity by integrating biodiversity protection into the state’s environmental and economic goals and efforts. California’s agriculture is critical for food security, and the economic security of agriculture is dependent on co-existing with biodiversity.

CDFA’s Office of Agricultural Resilience and Sustainability has several climate-smart agricultural incentive programs, which help farmers to be more sustainable and climate-resilient. One of these programs is the Pollinator Habitat Program (PHP). The PHP provides funding to established and experienced organizations to work directly with farmers and ranchers to implement habitat and management practices that support pollinators, including monarchs. The program’s primary objective is to support pollinators through the provision of floral resources, host plants, and other elements of suitable habitat. PHP has funded the California Native Plant Society for projects on native plant propagation protocols and detailed pollinator and plant and interaction information. These developed resources will benefit monarchs and be integrated into [Calscape.org](#), enabling gardeners, farmers, and landscape professionals to design resilient habitats that enhance ecosystem stability and function.

Colorado — In 2022, the Colorado Department of Natural Resources commissioned a study of Colorado’s native insect pollinators in response to Senate Bill 22-199. The results of this study led to the passage of HB24-1117, which gave Colorado Parks and Wildlife (CPW) authority to monitor and conserve invertebrates. This resulted in six total permanent positions at CPW that coordinate invertebrate and rare plant work across the state. In 2015, the monarch was included in an appendix of the SWAP, as Colorado didn’t have any management authority. However, given this recent legislation, invertebrates will now be included in the main SWAP document, with monarchs listed as a Tier 1 Species of Greatest Conservation Need.

In the last five years since the inception of this plan, CPW has been establishing monarch-friendly habitat through a diversity of programs, including the Conservation Reserve Program (CRP) and Corners for Conservation. Since its inception, Corners for Conservation has established over 10,000 acres of habitat across eastern Colorado in landscapes largely dominated by agriculture. In 2017, the House Joint Resolution 17-1029 designated I-76 as the “Colorado Pollinator Highway.” CDOT’s Procedural Directive #503.1 established landscaping and maintenance requirements for the pollinator highway, and the CDOT Pollinator Habitat Enhancement Plan provides guidelines for roadside management to support pollinating insects. CPW has also developed the Colorado Seed Tool app,

which provides site-specific seed mix recommendations to practitioners and landowners/managers. Users can specify pollinator habitat as a key outcome of their seeding project.

Idaho — Beginning in 2015, the Idaho Department of Fish and Game (IDFG) engaged in multiple efforts to address information gaps regarding the distribution and status of the monarch butterfly and its key breeding habitats in Idaho. From 2015–2018, IDFG collaborated with the Washington Department of Fish and Wildlife and the Xerces Society on a USFWS-funded State Wildlife Grant. Deliverables of the grant included assessing the monarch for inclusion as a SGCN in respective SWAPs, presenting monarch workshops to key constituencies, developing and launching the Western Monarch Milkweed Mapper, and conducting 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. Idaho recently completed a comprehensive review and revision of its 2015 SWAP (IDFG 2024) and retained the monarch as an SGCN, along with numerous conservation actions intended to benefit the species.

Survey data from 2016 contributed to refined habitat suitability models for breeding monarchs and milkweed species in the West (Dilts et al. 2018) and to the development of current and future potential distribution models for monarchs and milkweed in Idaho (Svancara et al. 2019). Workshops developed and promoted relevant monarch and pollinator conservation tools used as key resources by Wildlife Management Area (WMA) staff and other land managers. These workshops also created a platform for expanded communication, networking, and information-sharing among technical services professionals.

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). Several efforts are also underway to enhance habitat plantings on IDFG WMAs by upgrading seed mixes to increase benefits to pollinators, including the monarch butterfly. IDFG's Botany Program developed a guide to the native milkweeds of Idaho in collaboration with

USFWS and the Xerces Society (Kinter 2019). The guide highlights 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 public.

Multiple efforts by Idaho state agencies continue 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 also to achieve conservation benefits for monarchs and other pollinators.

More recently, IDFG biologists and volunteers have been assessing milkweed (*Asclepias* spp.) patches for patch health, persistence, and disturbance since 2022 using a non-invasive protocol. Beginning in 2025, this effort will expand to cover the entire state of Idaho. Surveyors also search patches for monarch activity, including adult monarch sightings and observations of eggs and/or larvae. When new patches are encountered, they are mapped, assessed, and added to an internal database to serve as a baseline against which future surveys can be compared. The overall goal of this work is to document the status of Idaho's milkweed patches—whether they are expanding, contracting, or remaining unchanged, as well as the use of milkweed by monarchs in Idaho. Preliminary data suggest that, at least in some regions of the state, although milkweed appears to be expanding, there is currently little to no sign of monarch use at most patches.

Finally, IDFG is initiating work in 2025 as part of a collaboration with Washington, Oregon, and California to expand the network of Motus stations

in the Pacific and Intermountain western U.S. to facilitate management of several SGCN, including the monarch butterfly. With funding from a Competitive State Wildlife Grant, 80 monarchs will be captured throughout the four-state project area and tagged with Motus-compatible transmitters. Understanding migratory patterns and habitat use will substantially improve our ability to implement conservation and management actions for monarchs in Idaho, such as habitat restoration or protection that reduces threats and enhances climate resiliency, or to provide better movement data to inform energy development infrastructure siting across the Snake River Plain.

New Mexico — In New Mexico, the New Mexico Department of Wildlife (NMDOW) has added the monarch to its [2025 State Wildlife Action Plan](#) as a Species of Greatest Conservation Need (SGCN). Additionally, during the 2025 legislative session under [Senate Bill 5](#), insects were added to the definition of wildlife, and NMDOW was given the authority to protect any species of wildlife based on set criteria, including whether it is a SGCN and science-based reasons for protection. NMDOW also started receiving upwards of \$2.7 million in Land of Enchantment Legacy Funds annually (in perpetuity) in state fiscal year 2025 and \$3.5 million in Government Results and Opportunity funds annually (for three years) in state fiscal year 2026. All these funds are earmarked for work on SGCN; with the inclusion of the monarch on the SGCN list in 2025, this opens the door to much more work being done in the future on this and other pollinating insect SGCNs. In terms of efforts involving lands managed by NMDOW, the Institute for Applied Ecology (IAE) is implementing a River for Monarchs project along the Rio Grande in New Mexico. The focus of this project is to restore native milkweed and nectar plants at 16 sites along 200 miles of the Rio Grande. As part of this effort, IAE staff planted pollinator-friendly plants on the NMDOW-managed Bernardo Wildlife Management Area (WMA) in October 2024. The majority of these plants were previously seed-sourced onsite, grown in a greenhouse, then planted in the area where the seeds were initially harvested. A total of 1,300 individuals of the following species (number of individuals of each in parentheses) were planted: showy milkweed (*Asclepias speciosa*; 163), whorled milkweed (*Asclepias subverticillata*; 418), Hopi tea greenthread (*Thelesperma megapotamicum*; 98), upright

prairie coneflower (*Ratibida columnifera*; 357), Rocky Mountain zinnia (*Zinnia grandiflora*; 70), and Hooker's evening primrose (*Oenothera elata*; 194). Additionally, IAE installed bee houses to attract native bees to the area where the native flowers were planted. IAE is in the process of evaluating the success of these activities.

Nevada — In Nevada, although no state agency has regulatory authority over Lepidoptera and there are limited protections for plants, there is a growing collective of federal and state agencies, Tribal nations, educational institutions, NGOs, citizen scientists, and other entities working together for milkweed and monarch conservation. These include, but are not limited to, U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), Department of Defense (DoD), U.S. Forest Service (USFS), Natural Resources Conservation Service (NRCS), Nevada Department of Wildlife (NDOW), Nevada Division of Forestry, Nevada Division of Natural Heritage (NDNH), Nevada Department of Transportation (NDOT), University of Nevada, Reno (Extension Program and faculty research), the Xerces Society, Nevada Monarch Society, the Walker Basin Conservancy, The Nature Conservancy (TNC), Sierra Club, Eastern Sierra Land Trust, and Nevada Bugs and Butterflies. Nevada also has a growing number of plant nurseries supplying native milkweeds and supporting monarch conservation.

Some monarch conservation efforts in Nevada include: USFWS supports monarch conservation by working with partners to facilitate projects, such as tagging monarchs, testing for parasites, surveying for breeding monarchs and milkweed locations, monitoring for larvae, and contributing to the western habitat suitability modeling and assessment study. Public outreach and engagement, including past involvement with the School Yard Habitat program as part of the Partners for Fish and Wildlife program, participation in the University of Nevada, Reno (UNR) Pollinator Day, participation in the international Monarch Blitz, and submission of records to iNaturalist. Some of these activities have resulted in the installation of pollinator gardens. Biologists have also hosted workshops and native plant walks to educate the public about pollinator plants and phenology. USFWS also supports pollinators in general via implementation of the National and Native Seed Strategies.

The Bureau of Land Management in Nevada (BLM-NV) includes the western monarch on its [Nevada Special Status Species List](#) (dated September 2023). BLM-NV supports various agencies and NGOs in a variety of projects promoting a better understanding of milkweed and monarch conservation. BLM-NV personnel provide data via online portals for hostplants and monarch observations.

The Department of Defense (DoD) Legacy Resource Management Program and the U.S. Forest Service International Programs (USFS IP) have supported research on monarch ecology, management, and conservation in Nevada, including at Stillwater National Wildlife Refuge, Fallon Naval Air Station, and the Fallon Range Training Complex at Dixie Valley. Researchers include those from Washington State University and the University of California, Davis.

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) is a partner of the Monarch Joint Venture. NRCS, via a Conservation Innovation Grant, worked with the Xerces Society and native seed suppliers to provide for restoration in multiple states, including Nevada.

The Nevada Department of Wildlife (NDOW) has actively participated in the development of conservation strategies for WAFWA's Western Monarch Butterfly Conservation Plan. The species is included in the [2022 State Wildlife Action Plan](#) (SWAP). Within the Biodiversity 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 (WMAs), working with partners to conduct surveys, tagging of monarchs, and including monarch considerations in habitat restoration projects.

Multiple agencies of Nevada's Department of Conservation and Natural Resources (DCNR) engage in pollinator conservation in general and monarchs specifically. These agencies include the Division of Forestry, whose plant nursery promotes planting of

natives, including native milkweeds. Nevada State Parks participates in monarch monitoring. It has also installed pollinator gardens, including the one at Walker River State Park.

DCNR's Nevada Division of Natural Heritage (NDNH), as part of its mission to track data on rare and at-risk species across the state, collects and curates historical and contemporary data on the western monarch as well as reports of suitable habitat. NDNH participates in collaborative conservation efforts with various agencies and organizations, including the Nevada Monarch and Pollinator Collaborative, which NDNH established to bring various stakeholders together to communicate their efforts in monarch conservation. NDNH also partners with the Monarch Joint Venture and educates communities about the importance of Nevada's pollinators, including monarchs, and the vital role these species play in supporting ecosystems.

NDNH hired its first rare invertebrate specialist in spring 2024; as such, NDNH will become more active in overall pollinator conservation. Currently, limited resources allow only limited monitoring of known breeding populations of monarchs in the state, with a focus on tagging fall breeding and migrating monarchs in western Nevada in collaboration with the [Southwest Monarch Study](#). The western monarch has a state rank of S3, meaning that it is considered vulnerable or at moderate risk of extirpation across the state.

In 2023, NDNH began collaborating with the Nevada Department of Transportation (NDOT) for its application to the Nationwide Candidate Conservation Agreement for Monarch Butterfly on Energy and Transportation Lands (CCAA). The two agencies also cooperated to produce an NDNH survey for milkweeds growing in NDOT rights-of-way statewide. The crew documented all monarchs encountered during that survey.

This interagency cooperation continues today for the benefit of monarchs and other species, including other pollinators. In 2024, NDNH botanists completed a survey of U.S. 95 right-of-way in the Oasis Valley region of Nevada for the federally threatened Spring-loving Centaury plant (*Centaureum namophilum*) in support of NDOT's Section 7 consultation for the Monarch CCAA. NDOT continues to conduct outreach and education regarding western monarchs and milkweeds

with its employees and the public. In late September 2024, NDOT became an enrolled partner in the CCAA and is preparing best management practices as part of its commitment to pollinator conservation in general and monarch conservation specifically.

The University of Nevada, Reno (UNR) supports research, conservation, outreach, and practical application via its Extension Program as well as by a group of students, research scientists, and faculty. The Extension Program, through Master Gardeners and outreach with children and adults, promotes establishing and maintaining gardens and waystations for pollinators in general and monarchs specifically. Researchers at UNR include Matt Forister, Elizabeth G. Pringle, and Thomas E. Dilts. Investigations include determining threats and trends and developing efficient ways of mapping suitable habitat.

Other Nevada-specific research has come from faculty at the University of California, Davis and Washington State University-Vancouver (WSU-V). Much of that research is from Cheryl B. Schultz's lab at WSU-V from studies done within Nevada, including at Stillwater National Wildlife Refuge, Fallon Naval Air Station, and the Fallon Range Training Complex at Dixie Valley. Investigations include phenology, studying larval performance in different habitats, increasing the efficiency and effectiveness of managing habitat for monarchs, determining if monarch habitat can serve as an umbrella for native pollinator communities, and evaluating the use of Motus technology for tracking monarch movements.

The Xerces Society is a great promoter of citizen science activities, outreach, and research in Nevada. There are multiple Xerces Ambassadors as well as an Endangered Species Conservation Biologist based in the state. The Xerces Society has been supportive of and/or participated in research out of UNR and WSU-V, as well as other projects, including general mapping via the collaborative [Western Monarch Milkweed Mapper](#) and habitat suitability modeling.

The [Walker Basin Conservancy](#) has been monitoring monarch activity and adjusting its land management practices to aid monarch conservation. It contributes to monarch citizen science efforts by submitting milkweed and monarch data to the Western Monarch Milkweed Mapper. It also submits tagging data to the Southwest Monarch Study. It received a National Fish and

Wildlife Foundation Monarch Butterfly and Pollinators Conservation Fund grant that provided for habitat restoration and improvement on private and public lands within the Walker Basin.

The [Nevada Monarch Society](#) (NMS) is a non-profit organization founded in 2016 that teaches high school students about monarch conservation. This included installing and maintaining a 5,000 ft² native garden. NMS holds at least three native plant sales a year. It also helps community members create monarch waystations and register with Monarch Watch (<https://www.monarchwatch.org/>). NMS has been trying to expand its efforts into southern Nevada, but the limited availability of desert native milkweed species has been a barrier.

Oregon — In Oregon, dedicated agencies, non-profits, and volunteer groups have been leading monarch butterfly habitat restoration, conservation, and public outreach across the state. The 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 goals to improve pollinator habitat and cultivate 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 receive 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. The Oregon Department of Parks and Recreation (OPRD) has a high level of interest in restoring monarch habitat on park lands, but has not developed comprehensive monarch recommendations due to a 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 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 creating native milkweed and pollinator waystations, providing educational materials, tagging adult butterflies, and cultivating milkweed. Additionally, USFWS, through its Partners for Fish and Wildlife and Coastal programs, and NRCS, through many of its 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, and federal agencies, and private citizens, developed a locally led monarch habitat restoration strategy in 2016. In 2017, the collaborative received a ~\$200,000 grant from NFWF and secured an additional \$260,000 in matching funds 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 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 in 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 principal leader in monarch conservation in Oregon is the Xerces Society, which is based in Portland. Xerces Society is leading key analyses that provide information on the status of monarchs in the West, including Oregon. Much of its 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 its 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 — Utah's diverse and unique landscape plays a critical role in the conservation of western monarch butterflies, providing essential breeding habitat despite the state's predominantly arid environment. A vast network of rivers, wetlands, and springs spans Utah's mountains and valleys, offering essential milkweed and nectar resources for summer breeding monarchs. These corridors also facilitate the migration of monarchs in the fall as they journey toward overwintering grounds.

As of 2025, Utah lacks a state agency with explicit authority to manage butterflies or other native insects. However, this absence has not deterred conservation efforts; rather, it has galvanized community-driven initiatives and broad-based participation in pollinator conservation. Recognizing the importance of preserving native insect species, especially pollinators, the Utah Legislature took a significant step in 2019 by allocating funds for Utah State University to establish the Rare

Insect Conservation Program (RICP) within its Quinney College of Natural Resources. In partnership with the Division of Wildlife Resources, the RICP has spearheaded research on Utah's native insects, identified conservation priorities, and provided guidance to land managers and stakeholders to mitigate the need for Endangered Species Act listings. Monarch butterflies were among the initial focal species that shaped the state's insect conservation strategies and partnerships.

One of the first challenges in Utah's monarch conservation efforts was identifying key breeding habitats across the state's diverse landscapes. Early habitat models indicated that monarchs and milkweed are most abundant in wetland and riparian regions. In 2018, community science volunteers were mobilized to document milkweed diversity, distribution, and monarch activity. The following year, the RICP expanded these efforts by launching the Utah Pollinator Pursuit (UPP), a community science initiative dedicated to gathering crucial data on sensitive insect pollinator species across the state. Since its inception, the UPP has grown significantly, with hundreds of volunteers contributing annually to habitat monitoring and conservation initiatives benefiting monarchs and other at-risk and data-deficient pollinators.

Through collaborative efforts with large-scale conservation projects, including the Southwest Monarch Study and the Monarch Migration & Milkweed Phenology Project (through Journey North), Utah's volunteers have conducted habitat surveys, tagged monarchs, and contributed valuable data on breeding and migration patterns. Since 2019, an interagency team of natural resource managers in the Uinta Basin has tracked and tagged hundreds of breeding monarchs across a range of public and private lands, including State Wildlife Management Areas, Dinosaur National Monument, and lands managed by the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM). Several of these tagged monarchs have been recovered at overwintering sites along the Pacific Coast, highlighting the importance of monitoring western monarch distribution and habitat use on public lands.

In 2021, Utah's state legislature established the Utah Pollinator Habitat Program, administered by the Utah Department of Agriculture and Food (UDAF) in coordination with Utah State University's Native Plant Conservation Program. This initiative aims to

increase awareness of pollinator conservation issues and expand the availability of native pollinator habitat for landscaping and restoration efforts. During its first four years, the program successfully distributed over 130,000 native plants to nearly 700 project recipients, supporting habitat enhancements in rural and residential gardens, local parks, and large-scale restoration sites. The program has also strengthened partnerships with local nurseries and educational institutions, including Utah State University's Dale and Adele Young Teaching Greenhouse and the Utah Department of Corrections' Green Thumb Nursery Program, fostering horticultural education and increasing the commercial availability of pollinator-friendly native plants. Due to widespread public and legislative support, efforts are underway to secure permanent funding for the program's expansion.

Community groups have played a vital role in raising public awareness and advocating for monarch conservation in Utah. Utah Friends of Monarchs (FoM) has been a leading force in public engagement, organizing annual milkweed and native plant giveaways, springtime monarch sighting contests, and educational outreach events. Western Monarch Pathways (WMPP) has supported the planting of monarch-friendly habitats in northern Utah by providing milkweed seeds and planting guidance and raising awareness about the status of western monarchs and the impacts of habitat loss and pesticides. These organizations have also contributed to the establishment of 180 registered Monarch Waystations across the state, located at sites including residential properties, public school grounds, the Hogle Zoo, Tracy Aviary, Fairmont Park, Nibley Firefly Park, Young Living Farms, and Intermountain Healthcare hospitals and clinics.

The non-profit organization Sageland Collaborative has been instrumental in connecting community science volunteers with conservation initiatives, habitat restoration projects, and educational outreach opportunities. As a project partner for the Utah Pollinator Pursuit, Sageland has utilized monarch habitat use data to inform its wetland restoration initiatives and best practices. Tracy Aviary has supported monarch and pollinator conservation efforts through demonstration gardens, native seed swap events, and public outreach.

Local municipalities and public institutions have embraced monarch conservation through innovative programs and habitat restoration projects. The Salt

Lake County public library system has established Seed Libraries at each of its branches, allowing residents to access native seeds and educational resources on supporting monarchs and other pollinators. Salt Lake City Public Lands' Native Plant Program, launched in 2019, has focused on propagating and planting native ecotype plants in public lands and parks, particularly in wetland areas along the Jordan River. As part of these efforts, nine Utah-native milkweed species have been incorporated into project sites, including Fairmont Park's Monarch Waystation and Butterfly Habitat.

Nibley City has demonstrated a strong commitment to monarch conservation through its Firefly Nature Park, which supports wild monarch populations, features a community-tended pollinator garden, and now includes an outdoor classroom with interactive learning stations. The mayor of Nibley City has reinforced this dedication by re-signing the Mayors' Monarch Pledge through the National Wildlife Federation and engaging residents in habitat-building and pollinator education initiatives.

The City of American Fork has undertaken significant conservation efforts to preserve and restore vital monarch habitats, renaming a key area Monarch Park in recognition of these efforts. The city has also received strong support from local leadership to take the Mayors' Monarch Pledge. Additionally, the mayors of Millcreek, Eagle Mountain, and Cedar Hills have successfully pursued Monarch City USA designations, further demonstrating Utah's commitment to grassroots-driven pollinator conservation.

Utah's universities are also involved in meaningful actions to create diverse pollinator habitat and provide students and communities with educational opportunities to learn about pollinator declines and ways to help. The Utah State University Extension System has partnered with federal, state, and non-profit organizations to establish pollinator habitat, promote integrated pest and pollinator management (IPPM) techniques, and assist working lands with increasing the diversity of native plants for pollinator and beneficial insect habitat. Utah Valley University's GRIT Garden program involves students in successful food gardening methods, has incorporated pollinator strips and reduced pesticide loads into growing spaces, and promotes resources about supporting native pollinators, including monarch butterflies. Southern Utah University community

education opportunities include classes on gardening to support native pollinator health and diversity.

Washington — The monarch butterfly was recognized in early Washington butterfly guides (Pyle 1974; Christensen 1981) as a migratory butterfly that is “rare in Washington...but may be encountered anywhere”. Monarchs' range mainly includes eastern Washington, east of the Cascade Mountain Range, where hostplants (milkweeds) occur (Waterbury and Potter 2018; Waterbury et al. 2019), but they have been occasionally observed in western Washington, where some observations are linked directly to illegal commercially-reared releases. In the 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.

The Washington Department of Fish and Wildlife (WDFW) manages over 1 million acres in Washington, and following Pyle's analysis, the Wildlife Diversity Program directed eastern Washington land 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 and other butterflies. Working with the Washington Department of Agriculture, the state recognizes the activity as potentially harmful. In Washington, the release of commercially-reared butterflies is illegal without a permit ([WAC 220-450-010](#)). Despite state law, the illegal release of butterflies continues to be a challenge.

The decline of western monarchs brought new attention to the butterfly and its habitat. In 2015, WDFW identified the monarch butterfly 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 the 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 (CSWG) 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 et al. 2019). The project also contributed to monarch and milkweed information gains in additional states, through launching the Western Monarch Milkweed Mapper. WDFW and the Xerces Society held monarch training workshops for agency scientists and butterfly naturalists to assist with continued data collection in Washington. WDFW conducted milkweed and monarch surveys throughout eastern Washington, collecting data on a total of 741 milkweed patches and surveying approximately half of those for monarchs, detecting monarchs in 104 milkweed patches and documenting 227 new breeding records of monarch eggs and larvae. Results of this study were used to identify threats, develop management recommendations, and outline research needs (Waterbury et al. 2019). For example, primary threats identified were invasive plant species, herbicide application, and mowing, followed by secondary threats of recreational disturbance, livestock grazing, insecticide application, loss of floodplain function, and wildfire. Land management practices to protect monarchs and milkweeds are being incorporated into long-term management plans for WDFW Wildlife Areas (WLA). For instance, in 2025, WDFW developed Best Management Practices for Pollinators, including monarchs, to be included in all future WLA plans.

In 2017, WDFW collaborated with the Washington Butterfly Association Spokane Chapter to initiate surveys for five eastern Washington butterfly SGCNs, including the monarch. The Washington Butterfly Association members continue to report occurrences of SGCN butterflies, including monarchs. Several new studies have been initiated to investigate monarch habitat needs and migration behavior. For example, Boone et al. (2025) initiated research in Washington, Oregon, Idaho, Nevada, and California to show that larva to adult survival is higher on showy milkweed in shade versus sunny conditions, indicating that monarch conservation plans would benefit from restoration actions that provide shaded microrefugia, among other findings. Additionally, in 2025, WDFW, along with the California Department of Fish and Wildlife, the Idaho Department of Fish and Game, the Oregon Department of Fish and Wildlife, and the American Bird Conservancy, was

awarded a CSWG through 2027 to substantially expand the Motus Wildlife Tracking System (Motus) in the Pacific and Intermountain U.S. The Motus network CSWG project will enable researchers and conservation managers to identify migratory pathways and movement of monarchs, birds, and bats, and fill data gaps such as understanding status, distribution, threats, migratory behavior, and identifying key habitat areas to help prioritize restoration and conservation actions. Understanding important migratory corridors is a data gap identified in this Plan, and this lack of knowledge hinders prioritization of on-the-ground habitat preservation or restoration.

Since 2023, monarchs have been recognized as a state candidate species (WDFW 2023) and a priority species in the Priority Habitat and Species Program (PHS). These designations acknowledge a need to address knowledge gaps to determine if the species warrants state listing as Endangered, Threatened, or Sensitive and to provide additional conservation attention related to the development of habitat. In recent years, Washington has enacted legislation to advance conservation, research, and policy for pollinators:

- [SB 5552](#) (2019): Established a Pollinator Task Force, which provided policy recommendations to prioritize and advance pollinator health and recovery
- [SB 5253](#) (2021): Implemented key recommendations from the Pollinator Health Task Force established under SB 5552
- [SB 5972](#) (2024): Limits the use of neonicotinoid insecticides by unlicensed applicators in non-agricultural or production settings.

4.3 Native American Fish and Wildlife Society

In February 2024, the Native American Fish and Wildlife Society (NAFWS) launched a Tribal-only working group to enhance intertribal communication and promote integration of traditional management practices, specifically focused on Tribal pollinator concerns. This group meets every other month to discuss key issues related to pollinators and share knowledge and solutions.

During the development of the working group in 2024, pollinator-focused NGOs were invited to participate in the discussions, sharing opportunities for collaboration and available funding. In 2025, the focus will shift to elevating Tribal presenters, allowing them to share their unique projects and programs related to pollinator conservation.

Currently, the working group includes participation from 38 federally recognized tribes and two state-recognized tribes, collectively working towards the sustainable management of pollinator populations.

4.4. Community 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 the Xerces Society, National Wildlife Federation (NWF), Monarch Joint Venture, Monarch Watch, and Pollinator Partnership has led the way nationally, with local NGOs and grassroots 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 in 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:

- Certifying or registering pollinator habitats in developed areas (e.g., Monarch Waystations)
- Advocating with civic officials to endorse NWF’s Mayors’ Monarch Pledge
- Holding hometown monarch festivals, land manager workshops, and professional development opportunities for educators
- Assisting golf course managers with habitat through Audubon International’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
- Monitoring monarchs and their habitat through community science programs such as the Monarch Larva Monitoring Project, Western Monarch Milkweed Mapper, Western Monarch Count, Southwest Monarch Study, Project Monarch Health, and the Integrated Monarch Monitoring Program
- Providing free or reduced-cost plant materials for pollinator plantings

Early in the Plan’s development, the Western Monarch Working Group developed a short survey regarding conservation efforts for monarch butterflies and other insect pollinators to help in the development of this Plan. Respondents included government agencies, non-profit organizations, educational institutions, commercial enterprises, and other private entities. Forty percent of all respondents indicated that 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.



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



CHAPTER 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, the sustained low population size, combined with environmental variability and natural fluctuations typical of insect populations, poses a continued risk of extirpation. A 2017 population viability analysis predicted a 72% probability that the western population could be lost within 20 years without intervention (Schultz et al. 2017).

This Plan identifies near-term (10-year) measurable objectives for both population size and habitat targets. These objectives are intended to halt population decline and promote recovery. The near-term goals established at the Plan's adoption are retained in this 2025 update. The authors of the 2017 population viability analysis recommended pursuing a population target of 4.5 million overwintering monarchs to ensure persistence; however, short- and long-term goals will be developed as new information becomes available on western monarch vital rates and the conservation potential for breeding habitats.

5.1 Monarch Population Goals and Objectives

The Western Monarch Mid-season Count (formerly the Thanksgiving Count), initiated in 1997 and conducted

annually in November using standard protocols, represents the most consistent and robust measure of the overwintering population available (see Figure 8 for annual abundance estimates relative to the number of sites surveyed). While the number and location of sites monitored each year have varied, the consistency of this monitoring effort allows for statistically robust comparisons of population size across years and locations.

The fewest sites visited in any year was 76 in 2009, when several traditionally large sites were not visited. Since 2020, the number of sites monitored annually has increased to 249 or more, consistently including the major overwintering sites. In 2016, a late-season count (conducted after the peak season, around late December) was added, followed by an early-season count in October 2024 (Xerces 2025a). These additional surveys provide valuable insights into population trends throughout the overwintering period and may help refine conservation timing and management actions.

Although more than 400 overwintering sites are known, monarchs are not evenly distributed among them; a relatively small subset of sites consistently hosts the majority of the population. The 127 overwintering sites with the highest average counts over the last decade (2015–2024) accounted for more than 98%

of the total overwintering population during that decade (see Supplemental Materials). The 10-year (2015–2024) average for the 127 sites representing 98% of the population over the period was 167,433.8 butterflies (SD= 135,952.7). Given the large interannual fluctuations in population size and variability in survey coverage, a five-year running average will serve as the primary population size metric. Committing to annual counts at the top 127 sites would provide a reliable and consistent measure of population status over time.

A five-year average of 500,000 overwintering monarchs is 10 times greater than the highest quasi-extinction threshold (50,000 individuals) modeled by Schultz et al. (2017). Achieving and maintaining this level would indicate that the population is stabilizing or potentially increasing. This ambitious target was established in 2019, however, and is unlikely to be achieved by 2029 based on overwintering counts through winter 2024–2025 (see Chapter 2.6, Population Status).

To complement the five-year running average target and account for realistic near-term population challenges, this Plan includes an additional priority objective: the overwintering population should not fall below 250,000 individuals. Both objectives, the five-year running average and the minimum threshold, will be reevaluated with the subsequent Plan update to reflect new monitoring data, research findings, and population trends.

Short-term Population Objective:	By 2029, the preceding 5-year average of monarch butterflies counted will be a minimum of 500,000, as estimated from the 127 overwintering sites representing 98% of the population during the Western Monarch Count. At no point should the counts drop below an estimated 250,000 individuals.
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5.2 Habitat Goals and Objectives

Habitat goals and objectives will be updated as additional foundational data from the West are identified and collected. Objectives have been developed for each strategy (see Chapter 6) that provide measurable conservation gains; however, the amount of additional

habitat required to support the western monarch population remains unknown.

For the Mid-American Monarch Conservation Strategy, planners used a hypothesized numerical relationship between the number of milkweed stems in the Midwest and the number of monarchs overwintering in Mexico to estimate the number of additional milkweed stems needed to achieve population targets (Nail et al. 2015; Pleasants 2017). In contrast, western monarch breeding habitat differs markedly from that of the eastern population: milkweed stands in the West are typically less dense and more widely dispersed. As a result, the stems-per-acre standards used in the East are not applicable in the more arid western landscapes. The absence of a formalized breeding habitat definition has limited the ability to track progress toward habitat-based goals and to compare conservation, enhancement, and restoration outcomes.

To address this, researchers, agency biologists, and practitioners collaboratively developed a working definition of western monarch breeding habitat in 2025 (see Chapter 2.5, Habitat). For the purposes of this Plan, all references to monarch breeding habitat are based on this definition, which will be refined as new research improves understanding of monarch habitat use and movement.

As additional observations are reported and habitat suitability modeling efforts identify key environmental predictors (Dilts et al. 2018; McIntyre et al. 2024), a better understanding will emerge regarding milkweed densities in various habitat types, spatial distribution of milkweed patches on the landscape, limiting factors unique to the western landscape, and priority areas for conservation efforts. As these knowledge gaps are addressed, additional or improved habitat targets can be developed.

As described in Chapter 3, monarch overwintering habitat continues to be lost or degraded due to land-use change, drought, and vegetation senescence, which reduce habitat suitability. Therefore, it is a high priority to reduce impacts through conservation of unprotected overwintering sites and by improving management at sites that have protections.

Monarch researchers and the USFWS identify the coast range and Sierra Nevada foothills surrounding

California’s Central Valley as priority areas for immediate habitat improvement, particularly to enhance early spring milkweed and nectar resources supporting the first breeding generation. Historically, the Central Valley likely played a more significant role in supporting monarchs; however, losses of milkweed and nectar plants have been extensive. Between 1980 and 2000, the U.S. Geological Survey estimated that 1,054 km² (~260,450 acres) of grassland and shrubland habitat in the Central Valley and adjacent foothills were lost to urbanization and agricultural conversion (Sleeter et al. 2010). These losses coincided with the most substantial declines in the western monarch population.

To mitigate these habitat losses, an initial target for habitat improvements in California’s Central Valley and adjacent foothills has been established. It is anticipated that conservation actions will be required across multiple land use types, including natural areas, developed lands, rights-of-way (ROWs), and agricultural landscapes.

The San Joaquin Valley accounts for more than 60% of California’s total pesticide use by weight, reflecting the region’s intensive agricultural production (California Department of Pesticide Regulation 2024a). Although data on pesticide contamination in monarch habitats in the region are limited, studies from the broader Central Valley indicate widespread contamination in milkweed during early summer, when monarchs are likely present (Halsch et al. 2020). Incorporating best management practices to reduce pesticide contamination into monarch habitat creation and management plans will improve habitat quality in the San Joaquin Valley and other conservation priority regions.

An additional objective for Breeding Habitat and Migratory Habitat emphasizes the need for additional habitat conservation progress outside of California. While California remains a central focus, most of the western monarch’s range lies beyond the state’s borders, and sufficient abundance of and connectivity between breeding and migratory habitats throughout the range are essential for recovery. A ten-year target for habitat improvement outside of California’s Central Valley is provided in this Plan.

Strategy-specific, measurable objectives have been developed to ensure accountability for Plan implementation (see Chapter 6, Monarch Conservation Strategies). Chapter 7.1 (Capacity, Funding, and

Implementation) identifies potential funding sources. The Working Group will evaluate objectives and habitat targets annually to adapt goals and strategies based on implementation progress, monitoring results, population response, and emerging science. This Plan will be updated every five years, at which time additional habitat objectives may be amended or replaced. Habitat improvement efforts are encouraged to continue or be initiated in all regions in the interim to sustain momentum and expand the western monarch’s recovery footprint.

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.
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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. By 2034, a minimum of 50,000 acres of monarch-friendly breeding habitat and migratory pathways will be provided outside of California across a variety of land use types.
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Edward K. Boggess.



CHAPTER 6: Conservation Strategies and Actions



Lisa Damerel.

This chapter describes strategies and associated actions to guide conservation and management of the western population of the monarch butterfly in the states of Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Washington over the planning period (2026–2069). The strategies and actions herein provide voluntary guidance to support western monarch conservation for all interested partners at multiple scales, from urban gardens to tri-national migration pathways.

The conservation strategies in the 2019 Conservation Plan were reorganized to account for overlap between categories. For example, many habitat-related actions in the natural lands section were also applicable in rights-of-ways and agricultural landscapes. The applicability of each action to the former categories is included in the tables in Appendix A. The revised sections are as follows: 6.1 Overwintering Habitat (OWH), 6.2 Breeding and Migratory Habitat (BMH), 6.3 Plant Materials (PM), 6.4 Research and Monitoring (RM), and Collaboration and Partnerships (CP).

Each section begins with an overview of its strategies. Numbered strategies (e.g., PM-S1, PM-S2) are followed by recommended actions labeled with lettered sub-codes (e.g., PM-S1-A, PM-S1-B). For example, the Plant Materials section (6.3) presents six strategies, and within PM-S1, five specific actions are outlined. Each action is accompanied by discussion and examples. The last section, Collaboration and Partnerships, highlights collaborative actions from the other sections.

6.1 Overwintering Habitat

The overwintering stage is one of the most vulnerable periods of the monarch's life cycle (Pyle and Monroe 2004) for two main reasons: (1) the “super-generation” must rely on stored fat reserves and limited nectar resources to survive from October through February–April (depending on the year) before reproducing; and (2) most of the population aggregates within a small stretch of suitable habitat along the California coast, where extreme winter weather events can occur. Between 28–58% of overwintering monarchs die between the mid- and late-season Western Monarch Counts ([Xerces](#)

2025), underscoring the harshness of this period. A small portion of the western monarch population “winters” in Arizona, including both breeding and non-breeding individuals. The wintering Arizona monarch butterflies may be active for months after arrival (Morris et al. 2015). For the purposes of this document, we will refer to monarch butterflies that arrive and stay in California for the winter as overwintering and associated with overwintering habitat, and monarch butterflies that arrive in Arizona and lose the urge to migrate as wintering in Arizona.

The dominance of non-native eucalyptus in monarch overwintering sites has caused many property owners and land managers to overlook these groves as important monarch habitat, which has contributed to the loss and degradation of overwintering sites. Since the 1980s, at least 63 sites have been destroyed (Sakai and Calvert 1991; Meade 1999; Xerces 2025), and damage to others—including top priority sites—has become increasingly common (Xerces Society 2020). Causes of destruction or damage include development, tree trimming for utilities or fire prevention, and wildfire. For example, the 2018 Woolsey Fire destroyed the Leo Carrillo State Park site (a Xerces Top 50 Priority Site), and the 2025 Palisades Fire burned another important site in Topanga State Park. Many municipalities, counties, and landowners are unaware that coastal monarch sites are classified as Ecologically Sensitive Habitat Areas (ESHA; Section 30240, California Public Resources Code) by the California Coastal Commission, requiring Local Coastal Plan (LCP) permits for projects that would significantly alter or destroy overwintering sites. This lack of awareness contributes to ongoing impacts.

Other ecological factors also degrade overwintering habitat, including grove senescence, pests, disease, extreme precipitation, and drought. Many eucalyptus groves, planted widely in California in the late 1800s and early 1990s, are now over 100 years old and nearing the end of their natural lifespan. If these older trees die without being replaced by younger ones, groves senesce. Drought—especially in the Central Coast—has caused canopy dieback and increased tree damage and mortality during high winds or rainfall. Drought severity is projected to intensify in California (California Fourth Climate Change Assessment 2018), further weakening trees and increasing pest and disease susceptibility. Extreme rainfall can undermine riparian trees and blue

gum eucalyptus (*Eucalyptus globulus*), with its shallow roots and heights often exceeding 100 ft, is prone to falling when soils are oversaturated or eroded.

Protecting overwintering sites is critical to sustain the migratory phenomenon and long-term survival of the western monarch population. Although no single management approach fits all sites, targeted action can improve habitat quality. For example, removal of trees may have left some sites too exposed to sun and wind, requiring planting of replacement trees or shrubs. In contrast, overly dense canopies may benefit from selective thinning to restore optimal light and wind conditions. Many sites also require careful reduction of downed material and ladder fuels (such as shed bark), which accumulate heavily in eucalyptus-dominated groves. Because nectar is a limiting resource in winter, planting native nectar plants can further support monarchs. The strategies below outline recommended approaches to manage, restore, and protect overwintering (OWH) groves.

OWH-S1: Increase the frequency of habitat assessments and the number of management plans for overwintering sites.

OWH-S1-A: Conduct regular (at least every 10 years) habitat assessments at overwintering sites, focused on the sites that support 98% of the monarch population (see calculations in Chapter 3).

OWH-S1-B: Provide habitat assessment training to increase the number of biologists who can conduct assessments.

OWH-S1-C: Create new and update existing management plans to guide management actions at overwintering sites, focused on, but not limited to, sites that support 98% of the monarch population.

OWH-S1-D: Provide existing grove management planning guidance and develop new resources for managers of overwintering sites.

OWH-S1-E: Use adaptive management techniques such as validation monitoring to continue to develop and improve best practice guidance for grove management.

OWH-S1-F: Develop and apply habitat modeling tools to predict long-term outcomes of tree planting and other vegetation management, using results to guide strategic planning and inform site-specific management decisions.

Given the dynamic nature of monarch overwintering habitat, active management is essential to maintain its suitability for monarchs. To ensure management decisions reflect current conditions, routine habitat assessments should be conducted at least every 10 years, and more frequently when resources allow (OWH-S1-A). These assessments should document canopy cover, tree health and age, species composition, monarch cluster locations (if known), and any past or ongoing management actions or constraints.

Currently, only a limited number of biologists have the expertise to assess overwintering habitat, creating a bottleneck given the number of sites needing attention. Training additional biologists to conduct these assessments (OWH-S1-B) would expand capacity, enabling more sites to be evaluated and informing timely management actions.

Habitat assessments provide the foundation for management but do not themselves establish priorities. The next step is to develop a comprehensive management plan for each site, informed by assessment data, analysis, and input from key community partners. This plan should outline prioritized management actions with timelines (OWH-S1-C). A [template overwintering management plan](#) developed by USFWS—based on the management plan developed by the Xerces Society, Groundswell Coastal Ecology, California Department of Parks and Recreation, and the USFWS for Lighthouse Field in Santa Cruz—includes recommended sections on site description; monarch resources such as cluster trees and water; tree and forestry management; nectar sources and milkweed; public engagement; success criteria and monitoring; and adaptive management. For completeness, plans should also address relevant

environmental permitting requirements, such as those under the California Coastal Act and the California Environmental Quality Act, which may affect the types of management actions allowed.

Existing overwintering habitat guidance, such as [Protecting California’s Butterfly Groves: Management Guidelines for Overwintering Habitat](#) (Xerces 2017), provides a valuable foundation. However, management recommendations should be updated regularly (OWH-S1-D) to incorporate findings from new research and novel management techniques. Ongoing monitoring is also necessary to evaluate whether management actions are achieving intended outcomes or require adjustment (OWH-S1-E). Given the long timeframe for tree maturation, modeling tools can help predict the outcomes of tree planting and guide long-term decision-making (OWH-S1-F).

It is also critical to understand how the overwintering site is supporting monarchs using Western Monarch Count methods (RM-S9). While the protocol was developed to be easily applied by community science volunteers, there are still training, funding, and volunteer support components that are critical to ensuring that counts are as accurate as possible. To cover as many sites as possible, it is imperative to continue training interested members of the general public, land managers who manage overwintering sites, and agency biologists who support monarch conservation within their respective agencies (OWH-S1-B).

OWH-S2: Prevent future loss and degradation of overwintering habitat.

OWH-S2-A: Increase stand age diversity by planting additional trees to improve grove longevity, guard against simultaneous senescence, and expand suitable overwintering habitat.

OWH-S2-B: Explore alternate tree species that can replace blue gum (eucalyptus) and pilot them in a suite of overwintering sites.

OWH-S2-C: Increase nectar availability by planting additional nectar resources during the overwintering period in sites where they are lacking

- OWH-S2-D:** Improve wind breaks in the understory through additional planting as needed.
- OWH-S2-E:** Actively manage canopy and stand density for appropriate microclimatic conditions and to reduce potential safety hazards in sites open to the public.
- OWH-S2-F:** Increase conservation easements in overwintering habitat.

Monarch habitat is deteriorating from both natural and human causes (described above). Replanting has only occurred at a few actively managed sites, and natural regeneration is often limited in small groves where existing trees restrict the resources needed for seedling survival. Adding trees to increase stand age diversity (OWH-S2-A) can support succession and accelerate habitat quality improvements, given the long time required for trees to mature and create conditions favored by monarchs.

Although various tree species occur in monarch overwintering sites, few are native. The principal native species—Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa*)—have a narrow distribution in California (Longcore et al. 2020). Blue gum dominates many overwintering sites and offers benefits such as rapid growth and nectar during the overwintering period. However, it is non-native, allelopathic, fire-prone, shallow-rooted, and drought-intolerant, making it unstable at large heights and vulnerable to changing climate and weather conditions. Replacing blue gum with a mix of native and non-native species will improve stand diversity and resilience. Alternative eucalyptus species (e.g., *E. sideroxylon*) require trials in varied conditions before broader use (OWH-S2-B). Once appropriate species are identified, collaboration with local nurseries, NGOs, agencies, and Tribal entities will be important for seed collection, propagation, and planting.

Adult monarchs consume only nectar, which supplies sugars and other nutrients for winter survival as they deplete fat reserves (Chaplin and Wells 1982). Warmer winters can accelerate fat loss and end diapause prematurely (Anparasan et al. 2025). Some native plants bloom during fall migration or early spring, providing resources at the edges of the overwintering period

(Henry et al. 2022; Lighthouse Field Overwintering Management Plan), but most senesce in winter. Non-native species common in overwintering sites—such as *Eucalyptus* spp., English ivy (*Hedera helix*), and cape ivy (*Delairea odorata*)—flower in winter and are frequently used by monarchs, as are ornamental plants in nearby gardens. More trials are needed to identify additional native or non-invasive species that bloom during winter (see OWH-S4). Adding native nectar sources and structural windbreaks through strategic planting can also reduce erosion as well as increase resilience to drought and fire.

Evidence is mixed on whether microclimatic variation within groves influences monarch clustering behavior. While a multivariate analysis identified some important factors (Leong et al. 1991), newer models (Saniee and Villablanca 2022) suggest a broader climatic niche. As research advances (see Research and Monitoring), groves should be managed to provide suitable microclimatic conditions where applicable. Managing senescing groves for safety (OWH-S2-E) for both adjacent properties and visitors is of paramount importance, as recent tree and limb failures have caused property damage and human fatalities. Management plans must balance safety with conditions that support monarchs.

While many monarch overwintering sites are located on public lands and benefit from a degree of protection, a significant number of high-priority sites lie partially or entirely on private property. Conservation easements can play a critical role in safeguarding these private lands by minimizing the risk of intentional or accidental destruction (OWH-S2-F). Ongoing management of these easements is essential to prevent continued site degradation.

- OWH-S3:** **Increase fire resilience in overwintering sites.**
- OWH-S3-A:** Research the impacts of fuel reduction strategies on monarch overwintering habitat.
- OWH-S3-B:** Generate and disseminate best practices for tree management and fuels reduction projects that occur within and/or near overwintering habitat.
- OWH-S3-C:** Remove fuels from overwintering sites following best management practices.

OWH-S3-D: Use adaptive management techniques, such as validation monitoring, to continue to develop and improve best practice guidance for fuel reduction strategies.

Fire is an increasing threat to overwintering sites (see description above). Fuel reduction could also be a threat if activities are conducted during the overwintering period or done in a manner that negatively affects microclimatic conditions. Given the growing threat associated with this issue, it is imperative to better understand how different fuel reduction strategies impact monarch habitat (OWH-S3-A). In some cases, best practices may already be known, such as avoiding work during the overwintering period. Identified BMPs should be widely disseminated to improve outcomes for monarchs (OWH-S3-B). Removal of dead and downed trees, ladder fuels, and other hazards should be conducted carefully in overwintering sites while research is being conducted (OWH-S3-C). To adjust practices over time, sites where fuels were reduced should be monitored and results shared (OWH-S3-D).

OWH-S4: Reduce pesticide exposure in overwintering sites.

OWH-S4-A: Collaborate with the California Department of Pesticide Regulation, which oversees pesticide applicator licensing and certification, and other instructors to raise awareness about practices that reduce monarch exposure to pesticides near overwintering sites.

OWH-S4-B: Educate landowners adjacent to overwintering sites about the hazards of pesticides to monarchs during the overwintering period.

OWH-S4-C: Publish and disseminate BMPs on pesticide application avoidance within overwintering sites.

OWH-S4-D: Develop a protocol for how to test dead monarchs for pesticides.

In 2024, approximately 200 adult monarchs were found adjacent to the Pacific Grove Monarch Sanctuary exhibiting signs of pesticide poisoning (Cibotti et al. 2025). This represented 10% of the total butterflies at the grove that winter. In coordination with the

California Department of Fish and Wildlife, specimens were collected for testing by the U.S. Geological Survey. The analysis documented exposures to a suite of pesticides, including insecticides, fungicides, and herbicides. On average, each specimen contained residues of seven different pesticides, with three pyrethroids (bifenthrin, cypermethrin, and permethrin) reaching or exceeding lethal dose levels (Cibotti et al. 2025). Despite an investigation by the Monterey County Agricultural Commissioner's office, the source of the exposure has not been identified, likely because of how commonly these chemicals are applied. Monarchs often forage on floral resources adjacent to overwintering sites to consume nectar, which helps them survive this life stage. The wider landscape, therefore, contributes to the species' chance of survival.

This incident highlights the risks monarchs face from pesticide applications near overwintering sites. It is therefore important to work with partners, including agencies and neighbors, to raise awareness of the potential impacts to reduce future incidents (OWH-S4-A and OWH-S4-B). USFWS published voluntary recovery actions for monarchs in 2023 (Darst and Marcum 2023). Its recommendations include, but are not limited to, avoiding pesticide applications during the overwintering period. However, if that is not possible, applications should be limited to areas more than 500 ft from sites when monarchs are present and conducted on low wind days to prevent drift, according to label instructions for use. Recommendations also include avoiding certain classes of pesticides known to target lepidopterans, including biological pesticides (IRAC Lepidoptera Insecticide Mode of Action Classification) and using the most targeted application method possible. Such BMPs should be broadly disseminated (OWH-S4-C) to avoid accidental exposures.

It is important to have a thorough and documented procedure available for individuals who encounter butterflies with apparent pesticide exposures, which could be adapted from [recommendations](#) developed by the Xerces Society in May 2025. Agencies authorizing and investigating incidents need to coordinate on the investigation and response. Finally, testing should be conducted in the same manner, so results are comparable across screenings (OWH-S4-D).

Groups to communicate to and collaborate with include County Agricultural Commissioners (CDEA), California

Department of Pesticide Regulation, Structural Pest Control Board, California Department of Public Health, local and regional land managers and landowners, and non-profits.

- OWH-S5:** **Formalize and expand a network of land managers for the exchange of information regarding overwintering grove management.**
- OWH-S5-A:** Develop an online information sharing and dissemination portal for overwintering grove land managers.
- OWH-S5-B:** Hold periodic workshops and/or in-person meetings/site visits to foster coordination of land managers and share biological outcomes from BMPs and habitat restoration implementation.
- OWH-S5-C:** Maintain the overwintering managers working group to continue to facilitate information exchange between managers.

As described in the introduction to this chapter, partnerships are essential catalysts of monarch conservation. The sharing of new information, as well as lessons learned, can aid partners in carrying out management actions more effectively and efficiently. There are a variety of formats that can facilitate the dissemination of key information, including online portals, virtual and in-person meetings, workshops, and field trips (OWH-S5-A and OWH-S5-B). In particular, the monarch overwintering managers working group (OWH-S5-C), started in 2019 and co-facilitated by the Xerces Society and USFWS, provides a quarterly format for interested parties to receive updates on overwintering numbers and science, hear about specific projects, and pose questions.

- OWH-S6:** **Educate key groups on the importance of overwintering habitat to stem habitat loss and degradation.**
- OWH-S6-A:** Raise awareness about the importance, location, and management of monarch overwintering sites across a variety of partners to stimulate conservation and advocacy.

- OWH-S6-B:** Identify and engage regional and local government departments, biologists, tribes, and land managers that oversee, write, or approve development or vegetation management project proposals. Communicate the importance of overwintering habitat, and provide tools to view vital overwintering habitat locations, and provide access to other associated data.
- OWH-S6-C:** Educate public and private land managers about overwintering sites that are designated as Environmentally Sensitive Habitat Areas (ESHA).
- OWH-S6-D:** Increase signage at overwintering sites to reduce impacts while highlighting their importance and the monarch's plight to stimulate public involvement.
- OWH-S6-E:** Publicize the High Priority Overwintering Sites list and make the list accessible in a variety of formats.

Education and outreach empower diverse groups to take ownership of monarch conservation and become effective advocates (OWH-S6-A). Outreach facilitates the dissemination of scientific findings, BMPs, and core conservation messages to partners such as land managers. A primary objective of ensuring the public and key interest groups are well informed is to safeguard monarch overwintering sites. A lack of awareness about existing protections and regulations can result in actions that inadvertently destroy or degrade these habitats. Outreach is particularly important for regional and local government departments, biologists, Tribes, and land managers who oversee, write, or approve development or vegetation management proposals, enabling them to avoid impacts to overwintering sites and improve on-site management techniques (OWH-S6-B).

Overwintering groves are considered Environmentally Sensitive Habitat Areas (ESHA) pursuant to the California Coastal Act of 1976 (Act). According to the Act, ESHA 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 (§ 30240 California Public

Resources Code). Although monarch overwintering sites within the coastal zone are protected as ESHA, this designation is not widely known, and impacts to protected overwintering sites continue. Broader education efforts targeting groups whose activities may affect overwintering habitat—such as utilities, local land managers, and adjacent homeowners—are essential (OWH-S6-C).

Signage at overwintering sites can help identify overwintering habitat boundaries and prevent damage from unpermitted actions (OWH-S6-D). Where public identification of monarch habitat is a concern, landowners can install signs indicating that trees and site features are protected, with instructions to contact the owner prior to any work. At publicly accessible sites, signage also provides the opportunity for public education on monarch conservation. The [Western Monarch Trail](#) offers adaptable sign templates for various locations.

[High Priority Overwintering Sites](#)—sites where 98% of the population has occurred during the past 5-year period, as identified by the Xerces Society—are critical to the sustainability of the population, and it is important that they be recognized and protected. Sharing this information broadly with a variety of partners (OWH-S6-E) will help bring awareness to the contribution these sites make to western monarch conservation.

Key audiences for outreach include: agency biologists (e.g., CalFire), general public, land managers and homeowners in sites adjacent to overwintering sites, city and county planners, PG&E and other utilities, and biological consulting and forestry firms.

6.2 Breeding and Migratory Habitat

Effective conservation of the western monarch butterfly requires a coordinated approach across the diverse mosaic of land ownership types throughout its breeding and migratory range. In the core (seven-state) western region, more than 233 million acres of land are managed by federal agencies, with an additional 25 million acres under the stewardship of state natural resources agencies and over 30 million acres managed by Native American Tribes. These public and Tribal lands represent vast opportunities to restore, enhance, and connect breeding habitats for monarchs, as well as other pollinators. Private lands—both with and without conservation

easements—also play a critical role, especially in supporting monarch migration. Recent habitat suitability models have identified areas of high value for breeding habitat based on milkweed (*Asclepias* spp.) distribution (Dilts et al. 2019) and areas important for spring and fall migration (McIntyre et al. 2024). While a portion of the high-quality breeding habitat occurs on public or Tribal lands, these models indicate that most high-quality breeding habitat (>85%) is under private ownership. This section outlines opportunities for protecting and increasing breeding and migratory habitat (BMH) across different land ownership types.

BMH-S1: Promote incentive, easement, and grant programs that encourage private landowners to create or maintain high-quality monarch breeding, migratory, and pollinator habitat on agricultural lands.

BMH-S1-A: Foster collaboration between public and private partners to identify incentive and easement programs on agricultural, Tribal-managed, and private lands, emphasizing holistic approaches to support sustainability and landscape health.

BMH-S1-B: Share resources to raise awareness and increase participation in incentive programs offering financial and technical support for monarch breeding and migratory habitat projects, with a focus on rural and working lands, including Indigenous communities.

BMH-S1-C: Provide landowners with guidance on regulatory assurance options for voluntary conservation, particularly through incentive programs benefiting rural and working lands, including Indigenous communities.

BMH-S1-D: Partner with federal, state, and NGO programs in the West to deliver financial and technical assistance that helps working lands and rural communities adopt Integrated Pest and Pollinator Management (IPPM) strategies and reduce reliance on pesticides such as neonicotinoids and diamides.

The spatial distribution of breeding habitat on public lands and private lands supporting migrating monarchs underscores the necessity of strengthened public-private partnerships, collaborative planning, resource sharing, and technical support across all land stewardship types (BMH-S1-A, BMH-S1-B). To reach the goal of increasing the western monarch population, more landscapes need to be restored, enhanced, and maintained to benefit monarchs as well as many other coexisting species. Specifically, landowners and managers should undertake coordinated efforts to identify and conserve native milkweed species and diverse nectar resources on their lands while promoting the presence of structural habitat features required by monarchs (see Chapter 2.5 Habitat; RM-S2). They should also implement BMPs for grazing and other land uses in sensitive areas to protect and enhance monarch habitat.

At both agency and NGO levels, there is growing momentum to integrate landscape-scale habitat models into conservation planning. These models help identify priority areas for habitat improvement and support efforts to align land management with pollinator conservation goals. To ensure the successful establishment of monarch-friendly habitat, it is essential both to provide administrative support to landowners interested in participating in incentive and easement programs (BMH-S1-C) and to coordinate with partners facilitating these programs to incorporate integrated pest and pollinator management practices into their programs (BMH-S1-D).

BMH-S2: **Identify high-priority monarch breeding areas on natural lands and implement habitat protection, restoration, and enhancement.**

BMH-S2-A: Utilize the best available science, new research, Traditional Ecological Knowledge (TEK), and community-based data (e.g., observations, tagging) to identify high-priority breeding areas and migratory corridors and guide habitat restoration.

BMH-S2-B: After identifying priority areas, encourage municipalities to implement on-the-ground conservation actions, such as participation in pollinator-friendly landscape programs (e.g., Mayors’ Monarch Pledge, Bee City USA/Bee Campus USA, Homegrown National Park, Monarch City USA).

BMH-S2-C: Provide region-specific guidelines for managing and enhancing existing habitat areas, incorporating broad conservation goals and success metrics (e.g., benefits to multiple species, tracking via local ecological indicators).

BMH-S2-D: Engage Tribal wildlife agencies and leaders early in guideline development to integrate Tribal perspectives and land management knowledge for culturally significant lands.

BMH-S2-E: Foster information sharing and cooperation between federal, Tribal, state, and local land managers to promote monarch and pollinator habitat BMPs, monitoring resource sharing, educational programs, and Tribal land management perspectives.

Restoration and enhancement efforts are critical to promote resilient monarch breeding populations and are dependent on research and traditional knowledge to inform best practices and identify high-priority sites for implementation (BMH-S2-A). Once priority sites are identified, relevant municipalities can implement conservation actions, leveraging existing landscape programs and designations (BMH-S2-B). Across the breeding range, these programs should focus on increasing both the availability of regionally native milkweed species to support breeding activity and the

availability of diverse native nectar sources to provide energy and hydration to foraging adults. Recommended practices include planting native forb and grass mixtures with local ecotypes of milkweed species, interseeding native milkweeds into existing suitable habitat, and adaptive management practices as appropriate (e.g., prescribed burns, grazing, invasive species control; BMH-S2-C). Grazing management should avoid overuse in sensitive areas and be limited to recommended timeframes to protect productivity in mesic areas such as riparian zones, springs, and wet meadows. Tribal partners should be engaged early in the development of guidelines (BMH-S2-D), and information exchange between all stakeholders should be prioritized to identify key synergies and collaborative opportunities (BMH-S2-E).

- BMH-S3:** **Protect and restore habitat in high-priority migratory pathways, including riparian corridors.**
- BMH-3A:** Apply connectivity models (e.g., NRCS, Xerces/UNR/industry partners) developed for California’s Central Valley to identify priority migratory pathways and guide monarch habitat creation in agricultural areas, with plans to expand to other major agricultural regions in the West.
- BMH-S3-B:** Share state-specific lists of priority monarch migratory habitats for protection, restoration, or enhancement, using current habitat distribution models for spring and fall migration (e.g., McIntyre et al. 2024) and data from observation databases (e.g., Western Monarch Milkweed Mapper, Monarch SOS app, iNaturalist, Southwest Monarch Study).
- BMH-S3-C:** Provide regionally tailored management guidelines for enhancing migratory habitats, incorporating Traditional Ecological Knowledge (TEK) where possible. Consult Tribal leadership early in developing substantive management plans and align projects with broader conservation goals.

- BMH-S3-D:** Promote mechanical vegetation management over pesticide-intensive methods in landscapes serving as connecting habitat corridors.
- BMH-S3-E:** Schedule mowing to avoid peak flowering and periods of monarch and pollinator activity.
- BMH-S3-F:** Engage early with Tribal wildlife agencies and heritage programs to address heritage data sovereignty considerations, incorporating TEK-based, holistic BMPs.
- BMH-S3-G:** Strengthen partnerships among public, private, and Tribal programs, including in-person engagement, to maximize the reach and efficiency of habitat restoration along migratory pathways.

Spring—and especially fall—migration behavior depends on milkweed habitat suitability, nectar abundance, and the availability of coniferous forest and canopy cover, as well as proximity to streams, woody wetlands, and overall shrub cover across the western monarch range (McIntyre et al. 2024). Ensuring connectivity between riparian corridors and tall tree habitats with adequate shrub cover—such as cottonwood, willow, and rabbitbrush—can support migration stopovers and both daytime and nighttime roosting for adult monarchs. Several prominent riparian systems serve as migratory corridors and roosting rivers, including the Colorado, Green, Jordan, Rio Grande, Salt, San Pedro, Gila, Agua Fria, Little Colorado, Yampa, and Verde Rivers. Although seasonal use of these roosting sites varies by year due to weather and resource conditions, the availability of suitable migratory habitat likely determines the connectedness and use of high-quality breeding sites in the spring and the resilience of migrating adults in the fall. In California, connectivity models are being developed to direct targeted efforts to establish habitat within agricultural landscapes (BMH-S3-A), and an increased understanding of host plant density on monarch population dynamics is helping to inform habitat restoration in fragmented landscapes (Dilts et al 2023; Crone and Schultz 2021).

Ensuring that states are aware of the locations of critical monarch migratory habitats enables more targeted conservation actions (BMH-S3-B). Developing resources

and networks of key state partners will help facilitate the distribution of this information. Locally tailored management guidelines can further support effective management of these priority sites (BMH-S3-C). For example, the New Mexico Department of Wildlife has developed [BMPs for grazing in riparian areas](#) that address risks to native pollinators from livestock grazing and emphasize the importance of habitat connectivity, system complexity, and minimizing disturbance to floral abundance during certain times of year for protecting the state’s riparian corridors and pollinating wildlife (NMDGF 2023). Region-specific strategies—such as pesticide use (BMH-S3-D) and adjusting mowing schedules (BMH-S3-E)—can also help reduce direct harm to monarchs and native pollinators. Incorporating TEK into management guidelines can strengthen recommendations by drawing on cumulative knowledge and generations of environmental stewardship (Berkes 2018). Diverse partners should be engaged early in developing these guidelines (BMH-S3-F), and partnerships should be strengthened to improve both engagement and efficiency in implementing these conservation actions (BMH-S3-G).

BMH-S4: Provide BMPs and guidance to help landowners maintain diverse habitats for monarchs and other native pollinators across all land use types.

BMH-S4-A: Develop and distribute educational materials to farmers highlighting the benefits of increased pollinator diversity and visitation achieved by providing and maintaining diverse native pollinator habitat along field edges, riparian areas, ditches, fence rows, pivot corners, etc., with adequate sunlight, soil quality, and water access.

BMH-S4-B: Create and utilize demonstration sites in agricultural areas where Integrated Pest and Pollinator Management (IPPM) strategies are applied to encourage adoption by on- or near-farm and ranch habitat installation or enhancement efforts.

BMH-S4-C: Within priority western monarch breeding zones (see Chapter 3), incorporate and promote recommended targets when applying monarch- and pollinator-friendly management practices on working lands.

BMH-S4-D: Promote and distribute existing guidance materials and provide training, where appropriate, on best practices for pesticide application that minimize nontarget impacts (such as drift reduction, product selection, proper equipment maintenance, and IPPM strategies), especially in areas providing monarch breeding habitat.

BMH-S4-E: Promote and distribute regionally native flowering plant species lists formulated to optimize flowering periods with crop production schedules.

BMH-S4-F: Protect identified areas on rangelands containing milkweed and crucial late-season floral nectar resources through the application of BMPs compatible with grazing operations.

BMH-S4-G: Update existing BMPs for grazing on public lands, and implement these through the lease and contract process, where warranted.

BMH-S4-H: Utilize or customize already available grazing/pollinator habitat information.

BMH-S4-I: Create habitat in rangelands containing milkweed and crucial late-season floral nectar resources through the application of BMPs compatible with grazing operations.

A range of technical resources and BMPs are already available to help guide pollinator-friendly land management across the western monarch’s range. Key tools include [Managing for Monarchs in the West](#) (Xerces 2018), [region-specific planting](#) and [nectar plant guides](#), and searchable tools such as the [Native Plant, Seed, and Services Directory](#), which helps users source locally adapted plants from conservation-

minded suppliers. To maximize the impact of these tools, educational materials should be developed and distributed to stakeholders, describing key components of healthy monarch habitat and resources for successful implementation (BMH-S4-A). Leveraging existing community relationships can also help increase adoption of conservation practices through demonstration events (BMH-S4-B). Effective restoration should prioritize the use of locally adapted native plants, promote habitat heterogeneity in both plant composition and structure, and include keystone species like milkweed, along with a diversity of nectar resources to support monarchs and other pollinators throughout the season.

At both agency and NGO levels, there is growing momentum to integrate landscape-scale habitat models into conservation planning. When completed, these models will help identify priority areas for habitat improvement and support efforts to align land management with pollinator conservation goals. Promoting recommended practices in these priority areas and emphasizing the benefits of managing for pollinators on working lands within the western monarch breeding range will allow for targeted efforts with higher impact (BMH-S4-C). BMPs developed by the Xerces Society and others offer practical guidance on habitat-compatible approaches to grazing, mowing, prescribed burning, pesticide use, and invasive species management, as well as the appropriate timing of these actions to minimize impacts on monarchs (BMH-S4-D). Targeted plant lists can support land managers by providing species recommendations that will ensure floral coverage across the season (BMH-S4-E). Prescribed fire should be managed carefully to protect milkweed and nectar plants, enhance habitat heterogeneity, and support overall ecosystem resilience. Post-fire recovery assessments should explicitly consider monarch and pollinator habitat to inform restoration strategies.

In particular, rangelands represent a key land use type for the western breeding monarch population. Identifying and protecting priority areas in rangelands with robust monarch habitat and increasing awareness of management practices that promote the monarch within these sites are key first steps for uplifting and preserving rangeland habitats (BMH-S4-F). As new research emerges, grazing BMPs should be updated to incorporate the most recent science that captures the nuance of these complex systems (BMH-S4-G), and information should be made readily available to land managers (BMH-

S4-H). While protecting existing habitat is critical, it is also imperative to create new habitats in rangelands with essential monarch resources (BMH-S4-I). This can be accomplished by implementing monarch-friendly BMPs across additional rangeland sites.

BMH-S5: Integrate monarch conservation into land management activities, plans, and projects, promoting BMPs that support monarch-friendly habitat.

BMH-S5-A: Include monarch and pollinator conservation during the environmental review and planning stages for transportation projects, including regional and statewide Transportation Improvement Plans.

BMH-S5-B: Develop or update right-of-way management BMPs that incorporate monarch-friendly habitat practices, and distribute them to roadside managers, public and private utility programs, and adjacent landowners (e.g., solar, pipeline, and electric projects) to encourage adoption of these practices.

BMH-S5-C: Incorporate Integrated Pest and Pollinator Management (IPPM) practices into all relevant land management activities.

BMH-S5-D: Collaborate with land management partners and engage early, in person where possible, with Tribes to integrate monarch and pollinator conservation into new land management plans and decisions in breeding regions and along migratory pathways, as appropriate.

BMH-S5-E: Promote the inclusion of monitoring to evaluate the impacts of monarch-friendly habitat restoration conducted by management authorities, public and private utility programs, and private landowners.

Building monarch conservation into planning and review processes can ensure that key habitat and management outcomes are considered and prioritized. For example, state transportation agencies manage vast acreage across the West and therefore can have a significant

impact through their management of rights-of-way (BMH-S5-A, BMH-S5-B). In addition to protecting and establishing new habitat, management of existing habitat should implement integrated pest and pollinator management strategies whenever possible (BMH-S5-C). However, it is also important to acknowledge that land managers work within a diversity of systems and agencies, and each have their own unique priorities, limitations, and histories. When incorporating monarch conservation into land management plans, it is important to engage with partners early in the planning process to build relationships and trust in order to develop plans that advance monarch conservation, function effectively, and serve the land manager (BMH-S5-D). As more and more habitat is established on the landscape, we have an increasing need to understand the effectiveness of different strategies to better inform future habitat establishment. Wherever possible, projects involving habitat restoration work should build in monitoring protocols with metrics to allow for land managers to evaluate the impact of these projects (BMH-S5-E).

BMH-S6: **Incorporate conservation measures into regulatory and development planning and review to minimize impacts and provide benefits to monarchs.**

BMH-S6-A: Partner with irrigation companies, water development agencies, the U.S. Army Corps of Engineers, and municipalities to integrate monarch and pollinator habitat creation and enhancement into water conservation, wetland mitigation, and stormwater management projects.

BMH-S6-B: Collaborate with land development corporations, mining operations, and energy developers to conserve and manage existing monarch and pollinator habitat and to establish new habitat where feasible.

BMH-S6-C: Coordinate among local, state, and federal regulatory agencies and land-intensive industries (e.g., mining, development) to create, restore, and maintain monarch and pollinator habitat on industry-owned lands.

BMH-S6-D: Leverage technical service providers—including NRCS, extension agents, and the U.S. Army Corps of Engineers—to assist private landowners in creating habitat and to provide incentives for habitat establishment.

Landscape disturbance is an inevitable component of development projects across the West. While in the short term this represents a loss of habitat, it also presents a key opportunity to create high-value habitat. This includes water management projects, energy development, new construction, roadways, and other infrastructure projects (BMH-S6-A, BMH-S6-B). Including monarch habitat installation in project plans and reclamation processes can ensure that these projects ultimately have a positive impact on monarchs. While municipal processes can be updated relatively easily, effective implementation of habitat restoration on industrial lands will require collaboration across multiple regulatory scales (BMH-S6-C). Additionally, on private lands, technical service providers can be a resource to engage with private landowners and help incentivize habitat establishment (BMH-S6-D).

BMH-S7: **Conduct targeted outreach to municipalities, local land use agencies, landscape businesses, and private landowners within historic breeding ranges on simple, effective ways to add pollinator habitat.**

BMH-S7-A: Partner with schools, conservation corps, and faith-based groups to deliver monarch- and pollinator-focused programs that inspire and equip participants to take conservation actions benefiting local landscapes and ecosystem health.

BMH-S7-B: Expand and promote community science projects that build public support for monarch conservation and advance the goals and objectives of this Plan.

BMH-S7-C: Supply data, tools, and resources to local planning and zoning commissions, stormwater managers, water conservation districts, irrigation companies, and the U.S. Army Corps of Engineers (Corps) to encourage private developers to integrate monarch conservation, water-saving measures, and urban habitat improvements into their projects.

BMH-S7-D: Collaborate with regulatory agencies overseeing mining, corporate, and land development operations to educate operators on monarch and pollinator declines and highlight opportunities to incorporate beneficial reclamation practices.

One of the first steps for implementing effective monarch conservation is expanding awareness. If land managers and the public more broadly are not aware of monarch declines and how best to support their recovery, then conservation actions will not be implemented. A key starting point will be to target groups whose mission and values are already aligned with species conservation goals and provide education and resources to encourage engagement in monarch conservation actions (BMH-S7-A). Connecting interested community members to existing community science projects is a great opportunity to facilitate ongoing education, awareness of resources, and high-impact data collection (BMH-S7-B). An important method to engage these groups is to provide information about how monarch conservation actions positively impact entire ecosystems. Western monarch breeding and migratory habitat overlaps significantly with the ecological requirements of many other wildlife species, making monarch habitat conservation an effective strategy for advancing broader ecosystem restoration goals. Restoration of native plant communities and natural water flow patterns in wetland and riparian areas, particularly those used during monarch spring migration and summer breeding, can contribute to improved soil and watershed health, increased carbon sequestration, and enhanced biodiversity at landscape scales.

Other key groups to target are local commissions and service providers in urban landscapes (BMH-S7-C). With information on monarch BMPs, priority regions,

and co-benefits, these groups can begin building monarch conservation into their projects and workflows. For these groups, it will be key to identify and emphasize areas where monarch conservation uplifts and improves existing work (i.e., reducing water requirements to maintain a landscape, improving stormwater management, and stabilizing soil). For some land uses, like mining and development, the most effective route to implement monarch conservation will likely be through engaging local, state, and federal agencies responsible for regulation (BMH-S7-D). Similar to engaging with local municipalities, it may be useful to emphasize how monarch conservation may also advance recovery goals for other imperiled species, including the greater sage-grouse, southwestern willow flycatcher, bonytail chub, northern leopard frog, and little brown bat, by restoring native vegetation, increasing availability of arthropod prey, and improving overall habitat quality.

BMH-S8: Educate homeowners, developers, and energy producers on the impacts of insecticide and herbicide use and provide BMPs and alternatives.

BMH-S8-A: Distribute and promote the Xerces Society’s publication *Managing for Monarchs in the West—Best Management Practices for Conserving the Monarch Butterfly and its Habitat* to guide proper herbicide and pesticide use in habitat management.

BMH-S8-B: Provide insecticide/herbicide BMP training to technical service providers working with private landowners, municipalities, irrigation companies, and water conservancy districts.

BMH-S8-C: Share educational materials that demonstrate the benefits of adopting Integrated Pest and Pollinator Management (IPPM) practices.

A key threat to monarchs is the pervasive use of insecticides and herbicides on the landscape by a diversity of users outside of agricultural spaces. While reducing pesticide use in agriculture is a key objective, addressing pesticide application by other users requires separate strategies. Education is an important first step, providing existing resources to pesticide users to spread awareness of best practices for conservation (BMH-

S8-A). Further, providing training opportunities in pesticide BMPs will ensure that pesticide users have the technical expertise and experience to implement them effectively (BMH-S8-B). Finally, it is important for pesticide users to be aware of the diversity of alternative strategies for pest management that can be leveraged through integrated pest and pollinator management practices (BMH-S8-C). Educational materials should emphasize not only how to implement these strategies, but also highlight the co-benefits associated with IPPM practices for humans and wildlife alike.

6.3 Plant Materials

Plants are the foundation of monarch breeding, migratory, and overwintering habitat, making the use of appropriate plant materials (PM) essential in restoration efforts at every scale and in every ecological region. Diversifying the available nectar plants and milkweed species supports migrating monarchs and benefits other pollinators that depend on floral resources. However, critical shortages of plant materials—such as seeds and container plants—often hinder project implementation.

National, state, and local initiatives, many aligned with the [BLM's National Seed Strategy](#), have emerged to address plant availability. Seed cooperatives, which develop shared plant lists and make collective purchases, offer another way to secure locally appropriate plants. These co-ops and similar working groups bring together government agencies, native plant nurseries, seed farmers, private land managers, non-profits, and community members to address local challenges. By coordinating efforts, partners can overcome barriers to native plant material availability—for instance, by sharing propagation protocols and strategies to improve nursery and seed farm production of species such as milkweed, which can be difficult to propagate and outplant.

Ensuring plant materials are appropriate for a given location is crucial. In most cases, this means using native and locally sourced species. However, in certain overwintering and breeding sites, non-native trees may create suitable conditions for monarch overwintering clusters and/or shaded areas ideal for developing larvae. In addition, in many arid parts of the West, non-native plants serve as key late-season nectar resources for breeding and migrating monarchs and other pollinators. Therefore, native resources need to be established

before non-native plants are targeted by management. Using regionally appropriate plant materials (i.e., local ecotypes) improves habitat establishment and long-term persistence.

Best practices should guide every step of plant material development—from seed collection to use in restoration projects. Because propagules are removed from wild populations, it is essential to avoid over-harvesting, which can damage existing habitat and deplete the seed bank. It is equally important to prevent genetic homogenization by avoiding the widespread distribution of a narrow genetic pool, which can erase local adaptations. A prominent example is the genetic homogenization of the Texas bluebonnet (*Lupinus texensis*; Turner et al. 2018). National and state-level seed strategies provide guidance for developing robust plant materials sources while avoiding these pitfalls.

Since these plants are intended to support monarch habitat, minimizing pesticide contamination is also crucial. Many nurseries apply chemicals that are harmful to monarchs—even to plants labeled as “pollinator-friendly.” Increasing transparency in plant sales through certification programs and public education can help address this issue.

Given the importance of plant material appropriateness, it is vital to share this knowledge with both public and private land managers to maximize the benefits of restoration and enhancement projects. In some areas, city regulations may limit habitat creation; however, proven strategies and programs exist to improve urban pollinator habitat and can serve as models for expanding these efforts.

PM-S1: **Participate in state and national seed strategies to increase the availability of regionally appropriate plant materials.**

PM-S1-A: Collaborate with seed co-ops, native plant nurseries, plant societies, and seed strategy working groups.

PM-S1-B: Prioritize locally adapted milkweed and nectar species for restoration pipelines, including seed collection, propagation, and amplification.

- PM-S1-C:** Develop contracts that cover the full plant material development cycle, from seed collection to production.
- PM-S1-D:** Secure funding and contracts to support all stages of the outplanting process.
- PM-S6-E:** Facilitate shared access to planting equipment, such as cold storage, seed cleaners, and seed spreaders/drillers.

Locally appropriate native plant species are necessary to restore and create habitat for monarch butterflies. However, the availability of appropriate native plant materials is a widespread barrier to restoration efforts across the country. The root causes of native plant material shortages are complex and include scientific, economic, and practical challenges. The National Seed Strategy was published in 2015 by BLM to identify barriers, develop solutions, and foster collaboration among partners to increase the availability of native seed. Nevada and California both have state-level seed strategies that build off the national strategy. The goals of the seed strategies fall into four categories: 1) identifying and quantifying seed need; 2) undertaking research and improving technologies for seed production and use; 3) developing tools for land managers; and 4) ensuring good communication among partners.

Participation in seed strategy working groups and native seed co-ops offers opportunities to ensure that crucial species, such as early-season milkweed and diverse nectar species, are readily available across the monarch habitat range (PM-S1-A). Additionally, these groups provide forums to share best practices to improve propagation success of milkweed and nectar plants; to learn about and apply existing tools that address structural and funding barriers along the native seed supply pipeline to monarch-specific projects (PM-S1-C; PM-S1-D); to inform native seed producers and restoration practitioners about the importance of milkweed and nectar species (PM-S1-B); and to share equipment among partners to reduce costs (PM-S6-E).

PM-S2: Improve and share propagation protocols for native milkweed and nectar plants.

- PM-S2-A:** Test and refine propagation protocols for additional milkweed and nectar plant species.
- PM-S2-B:** Standardize propagation protocol formats, compile them into a single searchable resource, and distribute them widely.

The shortage of diverse and regionally appropriate milkweed and nectar species on the commercial market impacts the success of monarch habitat restoration projects. Only a limited number of the 37 milkweed species native to the Western U.S. are widely available for use in restoration projects, including species that are critical for early- and late-season breeding (Xerces 2015). The absence of reliable propagation protocols often prevents native plant nurseries and farms from offering milkweed species they have not worked with before. The refinement of existing and the development of new propagation protocols will reduce this barrier and facilitate the inclusion of new species in restoration projects. There is ample opportunity to scale up and support existing efforts to develop propagation protocols, such as the California Monarch Plant Materials Working Group, that will diversify milkweed and nectar plant availability across the Western monarch’s range (PM-S2-A). There is also a need to standardize protocol formats and ensure they are easily accessible (PM-S2-B), such as the effort that the California Native Plant Society has recently initiated.

PM-S3: Broaden restoration planting palettes to include a greater diversity of regionally appropriate species and ecotypes.

- PM-S3-A:** Partner with landscaping companies and native plant growers to produce and plant locally-sourced native milkweed and nectar plants.
- PM-S3-B:** Integrate TEK and Tribal priorities when selecting native plant materials.
- PM-S3-C:** Develop region-specific monarch-friendly native plant palettes, emphasizing nectar species.

- PM-S3-D:** In California, collect and distribute seed from early-season milkweed species to increase supply at native plant nurseries.
- PM-S3-E:** Create nectar plant palettes for overwintering sites, timed to bloom during the overwintering period.
- PM-S3-F:** Develop diverse tree palettes for monarch overwintering habitat.
- PM-S3-G:** Design planting palettes for urban and suburban landscapes.

Having a wide variety of species and local ecotypes available in the native plant materials market enables resource managers to restore the biodiversity needed for ecosystem resilience and to meet diverse restoration goals in varying landscapes. Barriers to the expansion of the native plant palette include identification of desired species, access to wild populations of native plants for seed and propagule collection, development and outreach of propagation, harvest, and seed processing protocols and proper equipment, and development of quality and/or certification standards for new species. Participation in seed strategy working groups (PM-S1) can facilitate the identification of key species, such as early-season milkweed and diverse nectar species, and share best practices (PM-S2) and infrastructure to enter new species into the restoration pipeline. In addition, investment in native plant producers and landscapers is needed to expand the expertise and infrastructure necessary to incorporate new species into their operations (PM-S3-A).

Incorporation of traditional ecological knowledge (PM-S3-B) can expand the knowledge base on native plant collecting, growing, harvesting, and storage while promoting both ecological restoration and cultural uses of native plants (Werdel et al. 2024). Given the diversity of landscapes in the seven WAFWA states and the unique habitat requirements of monarchs during different life stages, there is a need to develop native plant palettes that are tailored to each region and habitat type (PM-S3-C), with an emphasis on filling gaps like nectar plants at overwintering sites (PM-S3-E), increased diversity of trees supporting overwintering monarchs (PM-S3-F), and habitat creation in urban and suburban areas (PM-S3-G). The need for increased abundance and diversity of early-season milkweed in California has already been

identified, so collection and dissemination of seed from these species should be prioritized (PM-S3-D).

PM-S4: Advance policies and programs that promote the adoption of monarch-friendly habitat.

- PM-S4-A:** Create model ordinances for native plant use in municipalities.
- PM-S4-B:** Encourage participation in the Mayors' Monarch Pledge and Bee City USA programs.
- PM-S4-C:** Expand habitat kit programs to accelerate habitat installation

Conservation at the local level, such as at the city or county level, can impact regional pollinator populations. Thus, local engagement may have profound effects on how community members approach conservation activities. Locally-focused programs also have the benefit of encouraging adoption of approaches that are better adapted to local conditions. Municipal ordinances are one example of mechanisms that can encourage gardening with native plants and avoiding certain pesticides shown to be toxic to pollinators. The development of template language can provide assistance to citizens looking for opportunities to propose resolutions or ordinances to their local government (PM-S4-A). Certification programs also allow government entities to publicly demonstrate their commitment to the conservation of monarchs and other pollinators (PM-S4-B). The [Mayors' Monarch Pledge](#), a program of the National Wildlife Federation, requires cities to commit to specific actions they will take to support monarch conservation. Participating groups are held accountable through the submission of annual reports. Between 2015–2020, more than 600 mayors and heads of local and Tribal government across the U.S. took the Pledge. [Bee City USA](#) is another program that encourages pollinator conservation, where a city council makes commitments, such as increasing native plants on city lands (e.g., parks and other municipally managed spaces). Both programs require outreach and education to raise awareness about the importance of monarch and pollinator conservation.

Another successful model for creating monarch habitat involves offering free or reduced-cost plant kits to applicants who demonstrate a commitment to long-term

maintenance (PM-S4-C). These kits contain curated, regionally adapted plant materials that provide floral resources and host plants for a variety of pollinators, often including milkweed and nectar species favored by monarchs. The Xerces Society launched a [Habitat Kit program](#) in California in 2019, which has since supported 625 projects and distributed 243,068 plants. Due to its success, the program is expanding nationwide, including in the Pacific Northwest and Southwest. Similarly, the Utah Pollinator Habitat Program has developed its own habitat kit model and [offers guidance](#) on improving outcomes through site preparation, plant spacing, and weed management.

PM-S5:	Minimize pesticide exposure to monarchs by avoiding contaminated or treated plant materials.
PM-S5-A:	Coordinate with agricultural commissioners and partners to label pesticide-free plant materials.
PM-S5-B:	Engage big-box retailers to stock untreated (neonicotinoid-free) native nectar plants and milkweed.
PM-S5-C:	Work with nurseries to offer pesticide-free native milkweed plugs, seed, and nectar plants.
PM-S5-D:	Work with nurseries to offer pesticide-free trees appropriate for overwintering site restoration.
PM-S5-E:	Develop reference materials for land managers on using local, pesticide-free (especially neonicotinoids) native plants for restoration projects.

A 2022 study (Halsch et al.) tested milkweed samples collected from retail nurseries. They found 61 different pesticides in the milkweed samples, including in plants advertised as “pollinator-friendly.” While more research is needed to better understand the effects of specific active ingredients on monarchs (see Strategy RM-S5), the inadvertent exposure of monarchs to pesticides through plants purchased for conservation purposes is alarming. The 2022 Western Monarch Summit, convened by Senator Jeff Merkley (D-OR), identified this as a core issue and recommended the development of a certification program to prevent the mislabeling of plants treated with pesticides as beneficial

to monarchs and other pollinators. County agricultural commissioners or non-profit partners may be able to assist with the development of such a program (PM-S5-A). Until a certification has been developed and adopted, it is important to work directly with nurseries, including large retailers (PM-S5-B), to ensure that all plant materials used for monarch conservation projects, from milkweed to nectar plants to trees added to overwintering groves, are contaminant-free (PM-S5-C and PM-S4-D). Educational materials can also be developed and disseminated to help the public understand the issue and stimulate demand for pesticide-free plant materials (PM-S5-E).

PM-S6:	Educate the public on selecting and using native plant materials that support monarchs.
PM-S6-A:	Highlight the importance of early-season milkweed and late-season nectar resources in outreach.
PM-S6-B:	Communicate the risks of tropical milkweed (<i>Asclepias curassavica</i>) and its Class B pest status in California.
PM-S6-C:	Share resources on incorporating native plants into home gardens (see Resource section).

The monarch butterfly is a charismatic and widely recognized species that inspires public interest in conservation. Gardeners, landscapers, and community groups can contribute to monarch recovery by planting milkweed and nectar-rich flowers for pollinators. Choosing the most suitable plants in urban habitat landscaping—specifically native species adapted to local conditions—greatly improves conservation value and ecological benefits.

Using locally adapted native plants in restoration projects offers both environmental and economic benefits. They help restore or maintain natural fire intervals and fuel loads, provide essential food and shelter for native wildlife, limit the spread of non-native plants, and reduce soil erosion and sedimentation (USDA Forest Service 2018).

The source of native plant materials can also affect the success and value of restoration work for monarchs and other native pollinators. A lack of knowledge and

targeted information about appropriate plant materials often limits the conservation gains the public can achieve. For the greatest benefit, milkweeds and nectar-rich forbs and shrubs should be native to the restoration area and, whenever possible, locally sourced. Local ecotypes tend to establish more successfully and provide higher-quality resources for monarchs and other native pollinators.

There are publicly available resources to help identify suitable plant materials. The Xerces Society’s [Milkweed Seed Finder](#) is a national directory of milkweed seed vendors, while the Monarch Joint Venture maintains a [Milkweed and Wildflower Vendor Map](#). The Xerces Society has also developed [regional nectar plant guides](#) to help conservation practitioners select nectar plants that are appropriate for their region (PM-S6-C).

When selecting plant materials for landscaping and restoration projects, timing is just as important as species selection. Early-season milkweed is particularly necessary for overwintered monarchs, as it is often the first available host plant for egg-laying (PM-S6-A). Without it, monarchs may not survive long enough to utilize later-emerging species, or they may have reduced reproductive success later in their lifecycle ([Frischie 2023](#)). Likewise, late-season nectar-rich plants are a vital resource to breeding and migrating monarchs after peak bloom. These resources are especially important during the hot, dry conditions late in the breeding season and help fuel the final generation’s migration to overwintering sites.

While tropical milkweed (*Asclepias curassavica*) is widely available, easy to grow, and blooms for much of the year, it is non-native in the western monarch range, providing flowers throughout the growing season. Unlike native milkweeds, it does not die back seasonally, which allows it to harbor the monarch parasite *Ophryocystis elektroscirrha* (Oe) and increase disease risk for monarch caterpillars and visiting adults (Wheeler et al. 2018). Although research is ongoing to fully understand the risks and potential benefits of tropical milkweed, current guidance recommends avoiding it in favor of other milkweed species (PM-S6-B).

6.4 Research and Monitoring

This section outlines key research priorities necessary for the successful implementation, evaluation, and

future adaptation of the Western Monarch Butterfly Conservation Plan. Developed in part by the Western Monarch Conservation Science Group and the [Western Monarch and Native Insect Pollinator \(WMNIP\) Working Group](#), these priorities aim to address persistent data gaps that hinder effective conservation of the western monarch population. The overarching goal is to generate the information needed to inform policy, guide conservation action, and strategically direct funding and resources to reverse the ongoing population decline. Despite progress in recent years—including assessments of overwintering habitat, threats, and breeding distributions—critical uncertainties remain regarding monarch life cycle limitations, migration pathways, habitat quality, effectiveness of conservation actions, and the cumulative impact of environmental stressors.

Despite extensive study, monarch butterflies remain a species of ecological complexity, with substantial knowledge gaps concerning their population dynamics, seasonal movements, habitat use, and vulnerability to threats (Monarch Joint Venture Research Review 2024). Filling these gaps is not only vital for developing effective, evidence-based conservation strategies and fostering dialogue among interested groups, but also for acknowledging the broader environmental values monarchs represent. Collaborative research and monitoring—when rooted in shared priorities and inclusive processes—can enhance the relevance, trustworthiness, and practical utility of scientific evidence. These efforts help ensure that monarch and native pollinator conservation actions reflect diverse perspectives and contribute meaningfully to ecosystem health, climate resilience, and the stewardship of landscapes that are culturally and ecologically significant. In this context, several overarching questions continue to drive western monarch research efforts and shape the scientific foundation for conservation planning and recovery.

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

RM-S1-A: Quantify key survival and mortality rates for western monarchs, identify the main causes of mortality and low reproduction, and assess all life stages across diverse landscapes and habitats.

RM-S1-B: Build a full annual life cycle demographic model for western monarchs, conduct sensitivity analyses, and expand on the Breeding Phenology Project in collaboration with partners (e.g., WSU, Xerces, Tufts, DoD, and USFWS).

Understanding which life stage(s) are limiting western monarch population growth is a top conservation research priority (RM-S1-A). With recent population counts at critically low levels, identifying when and where the greatest mortality and lowest reproductive success occur is essential for designing effective conservation actions. It is imperative to first identify the specific life stages that are experiencing the highest mortality or lowest survivorship, and under which conditions (e.g., phenology disruptions due to warmer temperatures, mortality due to lack of suitable habitat). This information is necessary for developing demographic models, conducting sensitivity analyses, and targeting conservation interventions to the stages that have the greatest influence on population growth (RM-S1-B).

The Xerces Society-led Western Monarch Count recently implemented repeated surveys at monitored sites throughout the overwintering period, generating critical data on mortality, site fidelity, and differences across environmental gradients. A 2017 mortality monitoring study conducted at Lighthouse Field in Santa Cruz found that predation by wasps and birds accounted for more than half of adult monarch mortality (Ruiz 2018). There is some evidence that indicates the western population may also experience heavy mortality and low fecundity rates immediately following the overwintering season. A recent study suggests that warmer autumn temperatures contribute to monarch population declines by disrupting physiology and reproductive, migratory, and overwintering behaviors (Rich et al. 2025). Western population counts in 2022 and 2024 represented the lowest and second-lowest recorded numbers since monitoring began in 1997, with counts of 1,904 and 9,119 monarchs, respectively. The causes of these dramatic population drops compared to previous years, as well as when and where monarchs are most vulnerable during the breeding and migratory seasons, remain poorly understood.

RM-S2: Refine key habitat characteristics that support monarch breeding and migration in the West, focusing on factors that enhance reproduction and survivorship.

RM-S2-A: Conduct research to identify productive and suitable monarch breeding and migratory habitats based on vital rates in different settings, including urban gardens, and use results to improve habitat management and restoration guidelines.

RM-S2-B: Develop clear definitions of/for western monarch breeding and migratory habitat at multiple scales with partners to support broad adoption.

Identifying the characteristics of high-quality monarch breeding and migratory habitat across the diverse landscapes of the western U.S. is essential to inform effective and regionally appropriate conservation actions. Monarchs occupy a wide range of habitats—from coastal zones and riparian corridors to mountain ranges and desert basins—but the relative ecological value of these areas for breeding, migration, and habitat connectivity remains poorly understood.

Research is needed to quantify the habitat features that most strongly promote monarch reproductive success and survivorship (RM-S2-A). Key variables include milkweed density and species composition, nectar availability and diversity, habitat heterogeneity, shade and perching structures, and proximity to other essential resources. Land management practices—such as prescribed burning, mowing, grazing, and the application of agricultural chemicals—should be evaluated to determine their effects on monarch development and overall habitat quality. Understanding how habitat structure, quality, and availability vary across ecological regions will clarify spatial patterns in monarch habitat use, breeding success, and migration pathways. This knowledge will facilitate the identification of key dispersal corridors, climate-resilient habitats, and areas most vulnerable to land use and environmental change.

To ensure that research findings directly inform management, results should be integrated into the development of regionally specific restoration and

habitat management guidelines. A multiscale breeding habitat definition, incorporating the concept of a minimum habitat unit (MHU) based on milkweed density, estimated caterpillar productivity, and habitat connectivity across spatial scales, has been developed to support habitat quantification, strategic site selection, and long-term planning (RM-S2-B; see Chapter 2.5 Habitat – Western Monarch Breeding Habitat Principles). This data-driven framework will improve restoration outcomes and ensure that conservation resources are focused where they will have the greatest benefit for monarch recovery.

Building on these breeding habitat metrics, next steps should include developing a “milkweed conversion table” to account for regional variation among *Asclepias* species (since the current metrics are based on *A. fascicularis*). A more comprehensive definition of habitat quality is also needed, one that incorporates the spatial arrangement of key features within habitat complexes. Beyond milkweed, essential resources, such as nectar plants, shade, water, and pesticide-free conditions, should define “high-quality” breeding habitat. Additional priorities include setting regional connectivity targets and establishing principles for defining migratory habitat across the western monarch’s range.

RM-S3:	Map priority monarch breeding and migratory habitats in the West to target conservation actions where they will have the greatest impact.
RM-S3-A:	Incorporate land cover data into habitat suitability models and estimate the acres and locations of high-quality habitat occurring on public lands by jurisdiction.
RM-S3-B:	Ground-truth habitat suitability models with systematic research to refine regional models and to identify habitat improvement potential.
RM-S3-C:	Locate, map, and survey rangelands with milkweed, assessing plant abundance, density, and diversity.
RM-S3-D:	Update and expand habitat suitability models with new data and additional western states (Montana, Wyoming, Colorado, and New Mexico).

RM-S3-E: Integrate climate change projections into habitat suitability studies.

Building on efforts to define high-quality monarch breeding and migratory habitat (RM-S2), the next critical step is to prioritize geographic areas where conservation actions will yield the greatest benefit. Monarchs use a wide range of habitat types across the western U.S. during breeding and migration, but the relative value of these areas remains uncertain. Research is needed to identify the most beneficial locations—those that support high reproductive success, function as migratory and dispersal corridors, or provide climate-resilient refugia (RM-S3-E).

Prioritization should include evaluating both existing high-quality habitat and areas with restoration potential, including marginal or fragmented landscapes such as hedgerows, rights-of-way, and urban gardens (RM-S3-C). This strategy aligns with RM-S2 but emphasizes spatial analysis of habitat suitability to guide targeted conservation, restoration, and land management actions (RM-S3-A, RM-S3-D). Integrating habitat quality metrics with spatial planning tools will enable the development of a strategic, landscape-scale framework for western monarch recovery—ensuring that limited resources are directed where they can have the greatest long-term impact (RM-S3-B).

RM-S4:	Expand knowledge of monarch movement patterns in the West to inform identification of high-priority breeding and migratory conservation areas.
RM-S4-A:	Promote participation in community science projects tracking habitat resources and monarch movements, including IMMP, Western Monarch Milkweed Mapper, iNaturalist, Survey123 (being piloted in Idaho), and Journey North.
RM-S4-B:	Expand Western Monarch Milkweed Mapper data with State Natural Heritage Programs and community science-based inventory efforts and add new capabilities for reporting migratory stopover sites.

- RM-S4-C:** Continue and expand tagging studies (e.g., WSU, Southwest Monarch Study) to track monarch movements, focusing on data-deficient areas.
- RM-S4-D:** Expand the Motus network and use its data to track monarch migration routes and movements between overwintering sites.
- RM-S4-E:** Compile data from movement studies, habitat databases, and models to identify migration and habitat connectivity patterns and guide priority habitat protection and restoration (RM-S3).
- RM-S4-F:** Create and distribute a list of priority migratory pathways to partners to support habitat protection, restoration, and enhancement across working and natural landscapes.

Understanding how western monarchs move between overwintering, breeding, and migratory habitats is imperative for identifying functional habitat connectivity and informing conservation planning. Although monarchs are known to disperse from overwintering sites to multiple breeding areas, the extent and frequency of these movements—and how they vary by location, population size, or year—remain unclear. Research is needed to define what constitutes ecological “connectedness” among breeding and migratory patches and to determine how landscape features influence monarch movement and habitat use at both coarse and fine scales throughout the year (RM-S2). Improved monitoring tools and tracking efforts are necessary to fill these knowledge gaps.

Community science plays an important role in generating robust datasets on monarch habitat location and quality that can be analyzed to assess habitat connectivity (RM-S4-A). The [Integrated Monarch Monitoring Program](#) (IMMP) uses standardized protocols to assess milkweed and quantify monarchs at all life stages, enabling data comparison across the western and eastern ranges. [Journey North’s](#) International Monarch Monitoring Blitz invites participants to submit monarch observations during fall migration, though observations during other periods can also be reported. iNaturalist (iNat) is also a powerful tool for the submission of incidental encounters with monarchs and

milkweed that anyone who takes a photo can use. The information on iNat can be easily integrated into other databases. Idaho Fish and Game has recently developed a Survey123 app for use by volunteers to map the location, size, and health of milkweed patches statewide; these data will be used to track milkweed persistence into the future to better inform habitat management projects intended to benefit breeding and migratory monarch butterflies. The [Western Monarch Milkweed Mapper](#) (WMMM) maps monarch and milkweed observations across the West and has been used to identify early breeding zones and understand spring migratory behavior, in partnership with the [Western Monarch Mystery Challenge](#). Expanding WMMM functionality—such as tracking fall roosting sites—could provide critical movement and habitat use data (RM-S4-B).

Several studies and tools are helping to untangle monarch movement across the West. Sticker tagging—such as the Washington State University tagging program—has revealed connections between Pacific Northwest monarchs and California overwintering sites (James et al. 2018). Similarly, the Southwest Monarch Study tagging project has documented monarchs traveling to California, Mexico, or wintering as breeding and non-breeding residents in Arizona (Morris et al. 2015). Although these efforts are valuable and necessary to continue (RM-S4-C), they generally yield low resighting rates (typically <5%) and offer limited insight into intermediary stopover locations. To better understand movements between breeding and overwintering sites, additional and more precise technologies are needed. Emerging technology like the Blu+ transmitter, developed by Cellular Tracking Technologies and the Cape May Point Arts and Science Center, may help collect more precise movement data. The tags are integrated into a network of cellular-connected devices, weigh just 0.06g, and can be attached to monarch butterflies. Additional research to understand the impacts of these new tags on monarchs may also be warranted.



New Blu+ transmitter from Cellular Tracking Technologies being attached to a monarch butterfly, Dr. Leone Brown, James Madison University.

The Motus Wildlife Tracking System (Motus) is emerging as a key tool. Motus uses lightweight radio telemetry tags that can be affixed to insects and detected by a growing network of automated receiver stations. This system can track monarch location, distance, and flight speed, even where traditional GPS tracking is not feasible. While receiver coverage is currently sparse in key migratory routes and overwintering zones, efforts by state fish and wildlife agencies—including Arizona, California, Idaho, and Oregon—to expand and retrofit Motus stations are helping to close these gaps. Expanding the network and associated tagging efforts should further elucidate migratory routes and overwintering movements (RM-S4-D).

All of these tools have unique properties that can help answer the question of where monarchs move and, in turn, where habitat should be prioritized. Combining these tools with cardenolide fingerprinting, genomics, and stable isotope analysis offers a path to more clearly map monarch migratory routes and habitat use (RM-S4-E), which can be shared with partners to help them make on-the-ground conservation decisions (RM-S4-F).

RM-S5: **Assess the impacts of pesticides on monarchs, other native pollinators, and their habitats.**

RM-S5-A: Identify potential pesticide exposure pathways—including treated seeds, application rates, and other sources—in agricultural and non-agricultural areas to assess risks to monarchs and other native pollinators.

RM-S5-B: Conduct laboratory and controlled exposure studies to address key toxicological data gaps for monarchs and other native pollinators, evaluating the risks of various pesticides, adjuvants, and co-formulants.

RM-S5-C: Investigate how pesticide exposure interacts with other stressors—pathogens, poor nutrition, and temperature extremes—to affect monarch health and survival. Assess the impacts of simultaneous exposure to multiple pesticides, which is likely common for monarchs.

RM-S5-D: Assess the impacts of pesticides—particularly insecticides—on monarch populations, including effects on mortality, fitness, and habitat quality.

RM-S5-E: Survey host and nectar plants across diverse landscapes—especially protected areas—throughout all life history stages (breeding, migratory, and overwintering) to assess pesticide exposure risks to migratory monarchs throughout their life cycle and range.

RM-S5-F: Evaluate how pesticide application methods influence drift and other movement into adjacent monarch habitats—and identify effective techniques and buffer distances to reduce contamination.

RM-S5-G: Monitor pesticide residues in habitat restoration sites to determine whether BMPs for reducing contamination are effective or require updates to improve protection.

RM-S5-H: Model pesticide risk across the western landscape to guide placement of new monarch habitat.

Pesticide exposure is a significant concern for monarchs across their western range, yet critical knowledge gaps remain. Monarchs may encounter pesticides through direct contact or by ingesting contaminated nectar or leaf tissue, but common exposure pathways are still poorly understood (RM-S5-A). Milkweed in natural, urban, and agricultural areas is often contaminated with pesticides (Halsch et al. 2020). However, most toxicity studies rely on honey bees as surrogate study systems, which limits our understanding of how monarchs, particularly at different life stages, respond to insecticides, herbicides, fumigants, and adjuvants (RM-S5-B). Adjuvants—substances added to enhance pesticide effectiveness—are not federally regulated as pesticides and are rarely included in risk assessments, despite mounting evidence of their harmful effects on pollinators (Mullin et al. 2016; Mesnage and Antoniou 2018; Straw and Brown 2021).

Compounding the challenge is the widespread, real-world use of multiple pesticides in combination. Field

studies have documented pollinators with residues from 10-20 different pesticides, many of which can interact synergistically to increase toxicity (Hladick et al. 2016; Main et al. 2020; Iwasaki and Hogendoorn 2021). These chemical cocktails may suppress monarch immunity and digestion, making them more susceptible to disease and environmental stress. Future research must address these complexities by testing mixtures under field-realistic conditions and generating species-specific toxicity data for monarchs, particularly for both larval and adult stages (RM-S5-C). Additionally, understanding how pesticides affect monarch fitness is critical to developing targeted protections from certain chemicals (RM-S5-D).

Pesticides can be applied across different land use types, potentially exposing monarchs throughout their lifecycle. It is therefore important to evaluate exposure rates in different habitats and regions to improve understanding of where monarchs face the highest mortality risks (RM-S5-E). Pesticides can also drift from application locations, though the extent of contamination from drift is poorly understood. It is important to test how application methods and environmental conditions affect drift and develop appropriate BMPs to limit impacts to monarch habitat (RM-S5-F). Because of the ubiquity of pesticides in the environment, it can be helpful to test residues in restoration sites to determine exposure rates (RM-S5-G). Finally, to better protect habitats from pesticides, we recommend modeling exposure risk to identify locations for implementation projects (RM-S5-H).

RM-S6:	Evaluate the effectiveness of current BMPs to implement refined monarch and pollinator conservation.
RM-S6-A:	Partner with agricultural cooperative extension services and similar organizations to document and analyze current BMPs.
RM-S6-B:	Review existing BMPs to identify gaps and design new studies to improve BMP implementation.
RM-S6-C:	Produce a report identifying the most effective BMPs for monarch conservation and provide recommendations for discontinuing ineffective practices.

Improving monarch and pollinator conservation on agricultural and grazed lands requires a science-based, adaptive approach to land stewardship that incorporates continuous learning and refinement of BMPs. The development and implementation of BMPs on the landscape should be an iterative process in which recommendations are informed by the best available science and subsequently evaluated and refined based on implementation outcomes.

To support this process, researchers and land managers should monitor sites where BMPs are applied to identify predictors of success and inform future research priorities (RM-S6-A). When monitoring reveals gaps or suboptimal outcomes, these findings should be used to generate new studies and research questions grounded in real-world implementation (RM-S6-B). This iterative process allows land managers to access up-to-date information on the most effective strategies, context-specific guidelines, and practices that have not yielded desired outcomes (RM-S6-C).

RM-S7:	Investigate the role of predation, parasites, and disease in monarch population dynamics in the West.
RM-S7-A:	Collect and analyze <i>Oe</i> samples from the western monarch population, ensuring participants have required permits and supervised guidance in applicable states.
RM-S7-B:	Use new or existing research to evaluate the effects of <i>Oe</i> on western monarch fitness and mortality across overwintering, breeding, and migratory population locations.
RM-S7-C:	Continue research on the impacts of parasites and predators on monarchs.
RM-S7-D:	Develop methods to monitor and assess other monarch diseases in the West

To effectively conserve western monarch populations, it is critical to improve our understanding of natural threats—particularly parasites, predators, and disease—and how these factors influence survival across life stages and landscapes. It is generally estimated that fewer than 10% of monarch eggs survive to adulthood due to mortality from parasites, predation, and disease (bacteria, viruses, and fungi). These threats persist into

the adult stage, underscoring the significant and likely underestimated impact of predation, parasites, and disease on monarch population dynamics. Moreover, patterns of predation and disease interact with broader landscape-level changes such as climate change and urbanization. Understanding these dynamics in a changing landscape remains a key conservation priority.

One parasite of the monarch butterfly, *Ophryocystis elektroscirrha* (*Oe*), is well documented in the eastern population; however, substantial gaps remain in our understanding of disease dynamics in the western population (RM-S7-A). These gaps include questions related to disease prevalence among resident breeding versus migratory populations, overwinter survival of infected individuals, and the influence of non-native milkweed (e.g., *Asclepias curassavica*) on infection rates (RM-S7-B). Overall, additional research is needed to characterize parasitism and predation of the western monarch (RM-S7-C). For example, emerging evidence suggests that introduced paper wasps (*Polistes dominula*) may contribute to monarch declines in the eastern population. It is imperative to establish methods for detecting and tracking monarch predation and disease, particularly as novel pathogens and invasive species are introduced (RM-S7-C). Additionally, in many butterfly species, the role of viruses in shaping population dynamics is likely underestimated, highlighting the need to expand current detection and surveillance protocols.

RM-S8: **Improve understanding of how changing climate and weather affect monarch breeding and migratory habitat, behavior, distribution, and multi-trophic interactions (e.g., predators, parasites).**

RM-S8-A: Model potential monarch population distributions for each western state using various future climate projections (e.g., Svancara et al. 2019), applying habitat attribute data from RM-S2 to define high-quality breeding and migratory habitat.

RM-S8-B: Assess how increasing temperature and altered precipitation patterns affect plant phenology, butterfly phenology, and migratory cues, particularly during the first breeding period and final breeding generation.

RM-S8-C: Study habitat features—such as shade and structural refugia—that help monarchs withstand high temperatures, especially during fall migration.

To guide effective conservation, it is imperative to understand how changing climate and weather conditions influence monarch distribution, behavior, and interactions with host plants, nectar sources, and natural enemies—and to incorporate these insights into long-term planning and habitat management. Extreme heat, warmer winters, altered precipitation, and increased wildfire risk already affect monarch butterflies through multiple pathways. As these intensify over time, it is imperative to evaluate the consequences to monarch population dynamics under various future scenarios (RM-S8-A) and integrate these models into habitat suitability analyses (see RM-S3-E and RM-S12-I). Extreme heat can significantly reduce monarch survival, but it also suppresses the *Oe* parasite. Warmer winters may cause overwintering monarchs to deplete fat reserves too quickly, thus reducing overwintering survival. Drought and heat also impact milkweed and nectar plants, altering their phenology, nutritional quality, chemical defenses, and nectar availability. Changes in temperature and plant phenology can disrupt historical migratory cues, but more work is needed to understand the consequences for the fall migration and spring reproduction (RM-S8-B). During the summer, extreme temperatures are increasingly hazardous for monarchs, highlighting the need for increased understanding of the role that shade from structural refugia might play in increasing resilience of monarch populations (RM-S8-C). Collectively, these climate-related stressors likely interact in complex ways that shape monarch population dynamics from year to year (see RM-S5-C).

RM-S9: **Continue and expand Western Monarch Count monitoring efforts (www.westernmonarchcount.org).**

- RM-S9-A:** Maintain the Western Monarch Count—including the early- and late-season surveys—to provide consistent, long-term population data that drives recovery planning and guides habitat management.
- RM-S9-B:** Expand volunteer participation in the yearly Western Monarch Counts through targeted outreach and active promotion.
- RM-S9-C:** Establish a skilled volunteer network to monitor the top overwintering sites hosting 95% of the western population and train state wildlife biologists in standardized monitoring protocols and volunteer engagement.
- RM-S9-D:** Analyze count data to monitor monarch population trends using summary metrics and modeled statistics (e.g., 5-year running averages for sites representing 98% of 2015–2024 observations).

The Western Monarch Count (WMC) is a community science volunteer monitoring project managed by the Xerces Society and is currently the primary method of tracking trends in the western populations. Initiated in 1997, the WMC has provided population estimates for nearly 40 years, with trained community science volunteers surveying 200–300 of more than 400 known sites along the California coast each year (OWH-S1-F). Consistent monitoring of the overwintering population remains the most important data source for assessing the status of western monarchs.

The WMC includes three seasonal counts: an early-season count (mid-October, added in 2024) to track arrival patterns, a mid-season count (conducted in late November) to estimate peak abundance, and a late-season count in December/January (added in 2017) to assess overwintering mortality from predation and weather. In 2024, volunteers counted 9,119 monarch butterflies across 257 overwintering sites in the West—the final tally represented a 96% decrease from the previous year. More information is available at <https://westernmonarchcount.org/>. The continuation and possible expansion of these counts is essential to guide recovery and other management actions (RM-S9-A).

Data are compiled in the Xerces Society’s Western Monarch Overwintering Sites (WMOS) database, which also includes historic observations prior to 1997 (Xerces 2025). Increasing volunteer involvement (RM-S9-B) and providing training to state agency wildlife biologists and other conservation professionals (RM-S9-C) are necessary to fill gaps at critical sites and ensure reliable tracking of population trends for analysis and modeling (RM-S9-D). Incorporating new survey techniques to locate undiscovered overwintering sites (see RM-S10) will further reduce bias in annual counts.

RM-S10: Continue and expand research and monitoring infrastructure, technology, and planning within overwintering sites.

- RM-S10-A:** Install Motus towers and weather stations at overwintering sites to support research, including the multi-factor “super study” proposed at the Monarch Overwintering Science Meeting in 2023.
- RM-S10-B:** Increase use of fine-scale monitoring methods, such as those at Pismo State Beach, to track monarch movement within sites.
- RM-S10-C:** Test light detection and ranging (LiDAR) for habitat assessment and expand its use if results are favorable.
- RM-S10-D:** Continue research on Arizona and other dispersed interior wintering monarch populations.
- RM-S10-E:** Investigate the role of desert riparian and urban overwintering areas in supporting the overall monarch population.
- RM-S10-F:** Develop survey methods to locate undiscovered overwintering sites and reduce sampling bias.
- RM-S10-G:** Refine and expand models to assess whether management actions are achieving desired habitat outcomes.
- RM-S10-H:** Model potential overwintering locations under various future climate projections (e.g., Fisher et al. 2018).

Understanding the microclimatic conditions that influence monarch clustering will support site-specific management. Adding weather stations at overwintering sites (RM-S10-A) and improving methods for long-term cluster tracking (RM-S10-B) will generate valuable environmental data. While monarchs have been observed moving between overwintering sites (Griffiths 2014), the drivers and frequency of these movements remain largely unknown. Motus technology offers the opportunity to improve tracking of individual monarchs to better understand whether these locations function as a connected network (RM-S10-A).

Emerging technologies are providing new ways to assess overwintering habitat quality. Light detection and ranging (LiDAR) technology has recently been used to model canopy structure and shows potential for more precise evaluations of monarch habitats. Further testing is needed to confirm its value and expand its use for remote sensing and comprehensive habitat assessments (RM-S10-C).

Inland wintering sites in Arizona and California (see Chapter 2) remain poorly understood, partially due to their dispersed nature, and their relative contribution to the total population should be assessed (RM-S10-D and RM-S10-E). Additional undocumented overwintering locations may exist outside known search areas. A standardized methodology for identifying and evaluating new sites is needed to minimize search bias and ensure key habitats are not overlooked (RM-S10-F). As local weather conditions shift, monarchs may abandon existing sites in favor of more suitable ones. Fisher et al. (2018) modeled potential upslope shifts of overwintering sites in Santa Barbara County; expanding and updating this model could improve understanding of future overwintering distribution (RM-S10-G).

RM-S11: **Monitor and evaluate habitat restoration projects, techniques, successes, and failures to guide adaptive management for monarch and pollinator habitat restoration.**

RM-S11-A: Develop a standardized monitoring protocol for restored habitats to track key measures of native habitat restoration success.

RM-S11-B: Survey restored sites to record monarch and other native pollinator presence or absence.

RM-S11-C: Work with grantors and funders to ensure restored habitat projects include a monitoring component, conducted either by grantor or grantee.

RM-S11-D: Create a database to track implementation, evaluation, and success of habitat restoration, enhancement, and preservation projects.

Restoration efforts to develop, enhance, and expand monarch overwintering, breeding, and migratory habitat are essential to the conservation and recovery of monarch butterflies and other pollinator species. To maximize success, we must identify which restoration techniques perform best under varying abiotic and biotic conditions. Because outcomes depend on factors such as soil type, microclimate, disturbance regimes, and landownership, consistent monitoring and evaluation of restoration projects are critical.

To compare projects across sites, a standardized monitoring protocol should be created to track measurable targets (RM-S11-A, RM-S11-B). This will enable restoration practitioners and researchers to evaluate results, share lessons learned, and refine approaches.

Evaluating habitat restoration projects should include both *implementation monitoring*—to verify that projects were installed as planned and materials performed as intended—and *effectiveness monitoring*—to assess whether restored habitats are being used by monarchs and other target pollinators, determine monarch abundance and breeding status, and evaluate overall habitat response.

Early engagement with grantors and funding entities is critical to ensure all restoration projects include a monitoring component (RM-S11-C). Proposals should incorporate sufficient capacity and funding for both implementation and effectiveness monitoring.

To track restoration outcomes across the western states, we recommend developing a centralized database to

document project implementation and success (RM-S11-D). This resource will help partners identify and promote the most effective restoration approaches while capturing site-level successes.

RM-S12: Track the long-term trends of the monarch butterfly relative to other butterfly and pollinator species.

RM-S12-A: Use and expand long-term datasets (e.g., North American Butterfly Association annual counts, PollardBase, Art Shapiro's Butterfly Project) to track population trends of monarch butterflies and other pollinator species.

RM-S12-B: Establish and expand long-term monitoring studies across the western monarch range, prioritizing data-deficient areas and partnering with insect societies, museums, Tribes, and other organizations.

Long-term monitoring studies provide the empirical evidence needed to track the status of multiple butterfly species and other pollinators, enabling scientists to understand population trends over time. Such efforts can also help contextualize monarch trends. Insect decline has been a major research focus, reviewed by Wagner (2020), who summarized studies documenting worldwide insect losses. Identified threats include agricultural intensification, pesticide use, drought and precipitation extremes, among others. Expanding community science and research efforts are critical in building long-term datasets (e.g., North American Butterfly Association annual counts, PollardBase, Art Shapiro's Butterfly Project) that track the long-term trends in monarchs (RS-12-A, RS-12-B).

In 1972, Art Shapiro, a professor at the University of California, Davis, began monitoring butterflies along 10 transects spanning an elevational gradient of 0–2,775 m through California's Central Valley and Sierra Nevada Mountains, conducting bi-weekly presence/absence surveys. This dataset, covering more than 159 butterfly species, has been used to detect trends in butterfly species richness and range shifts associated with land-use change and climatic conditions (Forister et al. 2010; Forister et al. 2011). Currently, the University of Nevada, Reno is seeking support for this project, now the world's longest-

running butterfly study, with 54 years of continuous data collection co-managed by Shapiro and Forister. Such research corroborates monarch declines observed at overwintering sites and highlights the Central Valley as a priority conservation area. Continuation of this and other long-term monitoring efforts (e.g., North American Butterfly Association annual counts) will allow future detection of changes in monarch and other butterfly abundance and phenology in relation to shifting threats and conservation efforts (RM-S12-A).

Two recent studies (Forister et al. 2023; Edwards et al. 2025) utilizing community science data show striking evidence of butterfly declines linked to warming and drying trends in the context of climate change, pesticides, and habitat loss. For example, Edwards et al. (2025) analyzed 12.6 million individual butterfly records from more than 76,000 surveys across 35 monitoring programs to characterize species-specific and overall abundance trends across the contiguous U.S. Between 2000 and 2020, total butterfly abundance fell by 22% across the 554 recorded species. Without community science data, studies such as these would not be possible. While some long-term monitoring is in place, there remains substantial geographic bias in data sets (Edwards et al. 2025; Forister et al. 2023), and many species still lack monitoring data. This underscores the need to establish monitoring in underrepresented areas while supporting and maintaining existing long-term efforts (RM-S12-A, RM-S12-B).

RM-S13: Advance research and monitoring on biocultural, community, and social dimensions of western monarch conservation.

RM-S13-A: Support studies that document and analyze the spiritual, cultural, and symbolic meanings of monarchs and the ethnobotanical importance of monarch-friendly plants across Indigenous nations and other communities.

- RM-S13-B:** Support partnerships with Indigenous communities to integrate Traditional Ecological Knowledge (TEK) into conservation science, policy, management, funding opportunities, and incentive program criteria, while safeguarding sacred site information and upholding principles of data sovereignty.
- RM-S13-C:** Document and share lessons from Indigenous-led stewardship models, such as the TEAM coalition and other Tribal initiatives, that integrate cultural values with habitat restoration and intergenerational knowledge transfer.
- RM-S13-D:** Advance community-based conservation by addressing inequities in environmental education and promoting community science that empowers local communities.
- RM-S13-E:** Document community perspectives on monarch conservation, including views on federal protections, land ownership, and management of overwintering habitats, to inform best conservation approaches.
- RM-S13-F:** Encourage research on how public interest in monarchs can be leveraged to build broader support for pollinator conservation and incentive-based habitat programs.
- RM-S13-G:** Assess public understanding of captive rearing and transporting monarchs or other at-risk pollinators across jurisdictional boundaries to inform outreach and reduce misconceptions.
- RM-S13-H:** Explore and amplify techniques and applied practices that align biodiversity protection with human social justice and equitable participation.

RM-S13-I: Develop and disseminate experiential curricula for educators that integrate butterfly rearing as a tool to teach insect conservation, life cycles, and ecological and cultural value, while discouraging the release of commercially raised butterflies into natural habitats

Human relationships with monarch butterflies are diverse and enduring, shaped by centuries of spiritual practices, cultural traditions, and shared relationships with milkweed, flowering plants, and roosting trees. They also inspire public affection and wonder through their beauty, migration, role as pollinators, and function as ecological indicators of habitat health. Preserving monarchs therefore protects the species itself, its ecological role, and its status as a cultural icon, reinforcing human-nature connections (RM-S13-A).

Monarchs can foster conservation awareness as charismatic mascots of the natural world. Strengthening these human-monarch connections helps prevent the “extinction of experience” by promoting meaningful interactions with nature (cited in James 2024). Public engagement through planting monarch habitat and community science also promotes conservation justice by involving local communities, especially those directly affected by environmental change (Montgomery et al. 2024). By incorporating local knowledge and priorities, these projects can generate strategies that are more effective, sustainable, and equitable (Derrien et al. 2024). Public interest in monarchs often reflects broader concern about pollinator declines (Burkle et al. 2013) and support for innovative approaches that align conservation with economic values (Diffendorfer et al. 2013). Better understanding the general public’s awareness regarding conservation issues can inform willingness to support incentive-based programs, monarch-friendly gardening, and donations to groups restoring monarch habitat (RM-S13-F).

For many Indigenous communities, monarchs symbolize resilience, transformation, and connection to nature. Integrating TEK provides valuable guidance for conservation science, policy, and management of monarch habitat. Establishing frameworks that allow free discussion of landscape history, species movement, and cultural relationship—while respecting sacred sites and data sovereignty—is essential to cultivating trusting

and reciprocal partnerships (RM-S13-B, CP-S2, CP-S6). Indigenous-led conservation models, such as the [Tribal Environmental Action for Monarchs \(TEAM\) coalition](#), demonstrate effective stewardship by integrating TEK, sustainable economic development, science education, and cultural values (RM-S13-C). TEAM has restored thousands of acres of Native land for over a decade while passing down conservation practices to younger generations—with similar initiatives emerging across the West.

The potential federal listing of monarchs raises concerns among many communities regarding regulatory implications for private land, management of overwintering groves, and broader community and economic well-being. Documenting and recognizing these perspectives is essential for developing clear messaging and effective educational materials that address concerns, support outreach, and foster informed public engagement (RM-S13-E).

Although sometimes promoted as a way to boost populations, experts caution that captive rearing and transport of monarchs may disrupt migration, spread disease, and lower fitness (Xerces 2015; Trenger-Trolander 2023). For example, Trenger-Trolander (2023) reviews evidence showing how captive breeding can have negative effects on wild fitness, and instead of rearing monarchs for release, we should consider redirecting attention to restoring habitat and avoiding the use of pesticides where we can. In addition, handling or moving monarchs without permits is legally restricted (CDFW 2021; 7 CFR § 330), and in some states (e.g., Washington), it is unlawful to release animals with a permit (Washington Administrative Code 220-450-010). Assessing public understanding of these issues can inform outreach and reduce misconceptions (RM-S13-G).

Community-based advocacy groups have influenced protective policies and legislation for monarchs, though community access to environmental education has not historically been equitable. Challenges such as competing priorities, uneven influence in decision-making, and lack of trust can reduce engagement and perpetuate disparities. The establishment of protected areas, for example, has sometimes displaced communities and reduced sovereignty in the name of conservation. While legal protections for monarchs have gradually expanded across both eastern and western ranges, policies must

recognize diverse knowledge systems, uphold Indigenous rights, and integrate multiple perspectives (RM-S13-D). Re-examining environmental protection tools through the lens of social justice is essential to building legitimacy and ensuring equitable participation and benefit from monarch recovery and broader pollinator and insect conservation actions (RM-S13-H).

Finally, formative education experiences are invaluable for building ecological literacy among school-aged children. Supporting the development of curricula that align with K-12 science standards can provide students with experiential learning opportunities focused on insect conservation, life cycles, and the ecological and cultural significance of butterflies. Such curricula should emphasize observation and classroom-based rearing of butterflies as a teaching tool, while explicitly discouraging the release of commercially raised monarchs or other butterflies into the wild (RM-S13-I). A [recent blog post by the Washington Butterfly Association](#) demonstrates how educational resources, such as butterfly kits, can foster an early understanding of ecological systems, conservation ethics, and environmental stewardship.

6.5 Collaboration and Partnerships

Collaboration is essential to conserving wide-ranging migratory species like the monarch butterfly, which depends on habitats across private, federal, state, Tribal, and local lands in the West. Strong partnerships across these jurisdictions are critical to planning and implementing effective conservation strategies.

The conservation actions described above—covering breeding and migratory habitat, overwintering habitat, plant materials, and research and monitoring—highlight the collaborative efforts needed to achieve this Plan’s goals. The following collaboration and partnership (CP) strategies build on these actions, summarizing the key strategies and recommended actions that support their implementation.

CP-S1: Build and maintain collaborative partnerships to advance monarch conservation and share information.

Creating and maintaining conservation partnerships is essential to all aspects of monarch conservation.

Establishing partnerships allows for not just an exchange of information, but for a discussion of ongoing efforts that allows partners to increase effectiveness and reduce duplicative efforts through collaboration on priority actions. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S4-A, OWH-S5, OWH-S6**
- Chapter 6.2 Breeding and Migratory Habitat: **BMH-S1, BMH-S2, BMH-S3, BMH-S4**
- Chapter 6.3 Plant Materials: **PM-S1, PM-S5, PM-S6**
- Chapter 6.4 Research and Monitoring: **RM-S6, RM-S9, RM-S13**

CP-S2: Facilitate cooperation among land management entities (federal, state, local, and Tribal) to promote best management practices (BMPs), monitoring, resource sharing, and educational programs for monarch and pollinator habitat and conservation.

Information exchange and cooperation between local and regional land management entities allow for the development of cohesive conservation strategies across the landscape. This cohesion can result in more effective conservation efforts by all parties. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S4, OWH-S5, OWH-S6**
- Chapter 6.2 Breeding and Migratory Habitat: **BMH-S1, BMH-2, BMH-S4**
- Chapter 6.3 Plant Materials: **PM-S1, PM-S4, PM-S5**
- Chapter 6.4 Research and Monitoring: **RM-S6, RM-S13**

CP-S3: Partner with land management entities involved in development projects to integrate conservation measures that minimize impacts and provide benefits to monarchs.

It is important for various development permitting agencies (land management agencies, local municipalities, etc.) to be consistent with permitting requirements and conservation measures that seek to avoid, minimize, and/or compensate for effects to monarch butterflies and/or their habitat. Developing cooperative partnerships can help facilitate and encourage this consistency. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S1-C, OWH-S1-D, OWH-S3-B, OWH-S4, OWH-S5, OWH-S6**
- Chapter 6.2 Breeding and Migratory Habitat: **BMH-S2-E, BMH-S5, BMH-S6**
- Chapter 6.3 Plant Materials: **PM-S4, PM-S5**

CP-S4: Collaborate with partners to protect, restore, and enhance high-priority breeding, migratory, and overwintering areas for monarchs.

Partnering to protect and restore monarch habitat can result in more effective and cohesive efforts than individual entities can implement. Partnerships allow for increased communication regarding high-priority areas, promotion of effective methods for habitat protection and restoration, development and promotion of plant material and seed sources to aid restoration, collaboration on grant or other funding opportunities, and increasing visibility of conservation efforts and needs in order to garner support and action by local and state governments. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S4, OWH-S5, OWH-S6**

- Chapter 6.2 Breeding and Migratory Habitat: BMH-S1, BMH-2, BMH-3, BMH-S4, BMH-S5-D, BMH-6, BMH-S7, BMH-S8
- Chapter 6.3 Plant Materials: PM-S1, PM-S4, PM-S5, PM-S6
- Chapter 6.4 Research and Monitoring: RM-S9, RM-S11-B, RM-S13

CP-S5: Engage with private landowners, developers, utilities, agricultural producers, and other industries to promote incentives and information that encourage voluntary conservation of monarch habitats.

Develop partnerships with agencies, professional organizations, homeowners associations, and other organizations that can facilitate broader communication with private landowners, developers, utilities, agriculture, and other industries. Not only can important information and BMPs be shared through these channels, but they can also facilitate the promotion of funding opportunities and incentives that encourage monarch and/or habitat conservation efforts. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S4, OWH-S5**
- Chapter 6.2 Breeding and Migratory Habitat: **BMH-S1, BMH-S4, BMH-6, BMH-S7, BMH-S8**
- Chapter 6.3 Plant Materials: **PM-S4, PM-S5, PM-S6**
- Chapter 6.4 Research and Monitoring: **RM-S6, RM-S9, RM-S10, RM-S13**

CP-S6: Work with Tribal wildlife agencies and leaders to incorporate Tribal perspectives and knowledge into land and resource management for culturally significant Tribal lands within monarch habitat.

Engagement with Tribal wildlife agencies and leaders is essential to establishing respectful and collaborative

relationships with Native American tribes, leading to more effective and sustainable practices that align with Tribal values, perspectives, and traditions to promote mutual benefits. Initial and continued outreach will help provide opportunities for Tribal engagement, build enduring relationships to support collaboration on future opportunities, support agency advocacy to catalyze Tribal collaboration, and facilitate the incorporation of TEK and ecosystem-based management into project planning and implementation. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.1 Overwintering Habitat: **OWH-S6**
- Chapter 6.2 Breeding and Migratory Habitat: **BMH-S1-A, BMH-S2-D, BMH-S2-E, BMH-S3, BMH-S4-F, BMH-S4-G, BMH-S5-D**
- Chapter 6.3 Plant Materials: **PM-S3-B**
- Chapter 6.4: Research and Monitoring: **RM-S12-B, RM-S13**

CP-S7: Highlight partner achievements in creating, enhancing, and protecting pollinator-friendly landscapes.

Celebrating and promoting partner successes is an important, but often overlooked, aspect of collaboration that helps to maintain partnership momentum and can further conservation efforts by encouraging participation and expansion of collaborative efforts. Establishing a user-friendly mechanism for tracking partner successes can help facilitate and encourage partners to share their efforts. Subsequently, the development of materials for outreach and communication amongst partners is crucial to highlighting partner successes with the broader partner community. Detailed strategies and actions below include, but are not limited to, the following:

- Chapter 6.4 Research and Monitoring: **RM-S11-D, RM-S13-C**



Tara Johnson.



CHAPTER 7: Capacity, Funding, and Implementation



Edward K. Boggess.

7.1 Capacity and Funding

Since the approval of the Western Monarch Butterfly Conservation Plan (2019), monarch and pollinator conservation across the western U.S. has been strengthened through enhanced institutional capacity, the establishment of new funding mechanisms, and the enactment of new legislation in some states. Together, these developments provide a more durable foundation for long-term conservation and demonstrate increasing political and public commitment to the recovery of monarchs and other at-risk insect pollinators.

Several WMNIP Working Group member agencies have established or expanded staff capacity dedicated to monarch and pollinator conservation, including permanent positions in California and Colorado. State agencies now routinely incorporate monarch-specific or pollinator-friendly habitat considerations and align

management and outreach initiatives with the strategy actions set forth in this Plan.

Increases in capacity extend well beyond state fish and wildlife agencies. Tribes, non-governmental organizations (NGOs), academic institutions, private landowners, and community groups play a substantial role in advancing conservation. Public interest in monarch butterflies has mobilized a broad base of voluntary grassroots action, which remains an essential complement to agency-led initiatives. The WMNIP Working Group relies on this collective capacity to achieve conservation targets across the West.

Monarch recovery efforts have been supported by a range of federal, state, non-profit, and private funding sources. Key contributors include USFWS, BLM, NRCS, NFWF, Monarch Joint Venture, the Xerces Society, foundations with in-kind contributions from universities, state fish and wildlife agencies, and private

individuals. Additional opportunities for sustained support for monarch conservation include Farm Bill conservation programs, State and Tribal Wildlife Grants, Traditional Section 6 grants, and federal legislation such as the proposed Recovering America's Wildlife Act, which would provide \$1.3 billion annually to state agencies for conservation of at-risk species, including monarchs where they are designated as Species of Greatest Conservation Need (SGCN).

7.2 Implementation

WAFWA is uniquely positioned to maintain and support the implementation of the 50-year Western Monarch Butterfly Conservation Plan due to its membership structure (23 states and Canadian provinces), geographic reach, and institutional commitment to species management. Its 19 state members collectively encompass more than 2.5 million square miles, representing the core of the western monarch butterfly's range. Recognizing the urgent conservation needs of the monarch, WAFWA Directors established the Western Monarch Working Group in 2017, which was restructured in 2022 as the WMNIP Working Group. WMNIP is composed primarily of technical and scientific staff from member agencies and supported by *ex officio* partners. This structure provides the scientific expertise and interagency coordination necessary to guide monarch conservation at scale.

The WMNIP Working Group played the central role in revising the 50-year Plan and will continue to serve as the coordinating body for its implementation. Its responsibilities include: (1) tracking and reporting conservation accomplishments; (2) evaluating the effectiveness of strategies and actions; (3) recommending adaptive changes to ensure progress; and (4) periodically updating the Plan to reflect new science and emerging priorities.

This governance framework allows WMNIP to promote coordinated, ecosystem-based management at the landscape scale, advancing monarch and pollinator conservation across multiple jurisdictions. While WMNIP was initially convened to support near-term actions aligned with the USFWS Species Status Assessment for monarchs, its scope and structure were intentionally designed to sustain conservation into the foreseeable future. By leveraging the collective authority, capacity, and expertise of its member agencies, WAFWA

provides a durable and regionally integrated platform for hosting the 50-year Plan and ensuring its long-term implementation.

Plan implementation will occur at local, state, and regional levels, often requiring interdisciplinary collaboratives made up of technical experts from a variety of organizations, such as state fish and wildlife agencies, NRCS, Farm Service Agency, USFWS, land trusts, academia, and NGOs. This integrated framework enables WAFWA to coordinate landscape-scale, ecosystem-based management while ensuring durable, regionally tailored conservation outcomes for monarchs and other pollinators. The goal of the Plan is to identify key strategies paired with specific actions to support conservation of monarchs and pollinators, whereas it is the role of partners to lead implementation of on-the-ground conservation actions.

7.3 Tools for Tracking Western Monarch Conservation

A critical component of the successful implementation of the 50-year Plan is the ability to systematically track conservation actions within a standardized framework. Such a framework is necessary to evaluate effectiveness, identify geographic priorities, and support adaptive management. Without consistent, measurable tracking, it is difficult to demonstrate progress toward conservation goals or to adjust strategies in response to emerging needs.

Initial tracking efforts were recorded through the Crucial Habitat Assessment Tool (CHAT), which had previously been utilized by WAFWA for other regional species conservation initiatives. For monarchs, CHAT incorporated spatial occurrence and habitat suitability data to identify conservation priority areas and was later expanded with a Survey123-based reporting tool. While this framework allowed both public- and private-sector users to report conservation actions, its structure proved burdensome for end-users, database administrators, and WMNIP members. Moreover, the 2023 discontinuation of the CHAT program by WAFWA left the Monarch CHAT without technical or financial support, limiting its utility and sustainability.

Despite these challenges, the CHAT experience provided valuable lessons for structuring a more effective tracking system, as well as for defining more

inclusive conservation objectives for states outside of California. The Plan's early emphasis on California, coupled with a lack of defined objectives for other western landscapes, hindered consistent measurement of progress. Similarly, most recommended actions lacked measurable success criteria, complicating the design of a functional tracking tool. Clear, quantifiable objectives are essential, particularly those tied to habitat and population outcomes, while allowing sufficient flexibility for site-specific management approaches. Education and outreach actions, though vital, should be tracked separately from management actions, given their indirect relationship to population recovery targets.

To complement continent-wide monarch recovery efforts and align with the data curated in the USFWS's Monarch Conservation Database (MCD), future tracking systems must facilitate streamlined reporting to federal partners while also providing a public-facing summary of conservation activities. Such a tool should balance transparency with protection of sensitive information, ensuring privacy and data sovereignty where required. With this 2025 Plan revision, adequate tracking of progress and implementation remains a significant need. WMNIP will continue working with partners and resources available through WAFWA to develop a robust, user-friendly implementation tracking system for capturing data on western monarch recovery efforts, as well as conservation actions for other high-priority, at-risk species of insect pollinators. Several states, including Idaho and Colorado, have created or are developing Survey123-based online tools to track implementation of their SWAPs; once such tools are fully operational and available for external use, they may serve as models to replicate and adapt for use by WMNIP member organizations and the public to track accomplishments related to strategy actions outlined in this Plan.



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APPENDIX A.

Table of Strategies and Actions for Implementation

Strategies	Actions
CHAPTER 6: CONSERVATION STRATEGIES AND ACTIONS	
6.1. Overwintering Habitat	
<p>OWH-S1: Increase the frequency of habitat assessments and the number of management plans for overwintering sites.</p>	<p>OWH-S1-A: Conduct regular (at least every 10 years) habitat assessments at overwintering sites, focused on the sites that support 98% of the monarch population (see calculations in Chapter 3).</p> <p>OWH-S1-B: Provide habitat assessment training to increase the number of biologists who can conduct assessments.</p> <p>OWH-S1-C: Create new and update existing management plans to guide management actions at overwintering sites, focused on, but not limited to, sites that support 98% of the monarch population.</p> <p>OWH-S1-D: Provide existing grove management planning guidance and develop new resources for managers of overwintering sites.</p> <p>OWH-S1-E: Use adaptive management techniques such as validation monitoring to continue to develop and improve best practice guidance for grove management.</p> <p>OWH-S1-F: Develop and apply habitat modeling tools to predict long-term outcomes of tree planting and other vegetation management, using results to guide strategic planning and inform site-specific management decisions.</p>
<p>OWH-S2: Prevent future loss and degradation of overwintering habitat.</p>	<p>OWH-S2-A: Increase stand age diversity by planting additional trees to improve grove longevity, guard against simultaneous senescence, and expand suitable overwintering habitat.</p> <p>OWH-S2-B: Explore alternate tree species that can replace blue gum (eucalyptus) and pilot them in a suite of overwintering sites.</p> <p>OWH-S2-C: Increase nectar availability by planting additional nectar resources during the overwintering period in sites where they are lacking.</p> <p>OWH-S2-D: Improve wind breaks in the understory through additional planting as needed.</p> <p>OWH-S2-E: Actively manage canopy and stand density for appropriate microclimatic conditions and to reduce potential safety hazards in sites open to the public.</p> <p>OWH-S2-F: Increase conservation easements in overwintering habitat.</p>
<p>OWH-S3: Increase fire resilience in overwintering sites.</p>	<p>OWH-S3-A: Research the impacts of fuel reduction strategies on monarch overwintering habitat.</p> <p>OWH-S3-B: Generate and disseminate best practices for tree management and fuels reduction projects that occur within and/or near overwintering habitat.</p> <p>OWH-S3-C: Remove fuels from overwintering sites following best management practices.</p> <p>OWH-S3-D: Use adaptive management techniques, such as validation monitoring, to continue to develop and improve best practice guidance for fuel reduction strategies.</p>
<p>OWH-S4: Reduce pesticide exposure in overwintering sites.</p>	<p>OWH-S4-A: Collaborate with the California Department of Pesticide Regulation, which oversees pesticide applicator licensing and certification, and other instructors to raise awareness about practices that reduce monarch exposure to pesticides near overwintering sites.</p> <p>OWH-S4-B: Educate landowners adjacent to overwintering sites about the hazards of pesticides to monarchs during the overwintering period.</p> <p>OWH-S4-C: Publish and disseminate BMPs on pesticide application avoidance within overwintering sites.</p> <p>OWH-S4-D: Develop a protocol for how to test dead monarchs for pesticides.</p>

OWH-S5: Formalize and expand a network of land managers for the exchange of information regarding overwintering grove management.

OWH-S5-A: Develop an online information sharing and dissemination portal for overwintering grove land managers.

OWH-S5-B: Hold periodic workshops and/or in-person meetings/site visits to foster coordination of land managers and share biological outcomes from BMPs and habitat restoration implementation.

OWH-S5-C: Maintain the overwintering managers working group to continue to facilitate information exchange between managers.

OWH-S6: Educate key groups on the importance of overwintering habitat to stem habitat loss and degradation.

OWH-S6-A: Raise awareness about the importance, location, and management of monarch overwintering sites across a variety of partners to stimulate conservation and advocacy.

OWH-S6-B: Identify and engage regional and local government departments, biologists, tribes, and land managers that oversee, write, or approve development or vegetation management project proposals. Communicate the importance of overwintering habitat, and provide tools to view vital overwintering habitat locations, and provide access to other associated data.

OWH-S6-C: Educate public and private land managers about overwintering sites that are designated as Environmentally Sensitive Habitat Areas (ESHA).

OWH-S6-D: Increase signage at overwintering sites to reduce impacts while highlighting their importance and the monarch's plight to stimulate public involvement.

OWH-S6-E: Publicize the High Priority Overwintering Sites list and make the list accessible in a variety of formats.

6.2. Breeding and Migratory Habitat

BMH-S1: Promote incentive, easement, and grant programs that encourage private landowners to create or maintain high-quality monarch breeding, migratory, and pollinator habitat on agricultural lands.

BMH-S1-A: Foster collaboration between public and private partners to identify incentive and easement programs on agricultural, Tribal-managed, and private lands, emphasizing holistic approaches to support sustainability and landscape health.

BMH-S1-B: Share resources to raise awareness and increase participation in incentive programs offering financial and technical support for monarch breeding and migratory habitat projects, with a focus on rural and working lands, including Indigenous communities.

BMH-S1-C: Provide landowners with guidance on regulatory assurance options for voluntary conservation, particularly through incentive programs benefiting rural and working lands, including Indigenous communities.

BMH-S1-D: Partner with federal, state, and NGO programs in the West to deliver financial and technical assistance that helps working lands and rural communities adopt Integrated Pest and Pollinator Management (IPPM) strategies and reduce reliance on pesticides such as neonicotinoids and diamides.

BMH-S2: Identify high-priority monarch breeding areas on natural lands and implement habitat protection, restoration, and enhancement.

BMH-S2-A: Utilize the best available science, new research, Traditional Ecological Knowledge (TEK), and community-based data (e.g., observations, tagging) to identify high-priority breeding areas and migratory corridors and guide habitat restoration.

BMH-S2-B: After identifying priority areas, encourage municipalities to implement on-the-ground conservation actions, such as participation in pollinator-friendly landscape programs (e.g., Mayors' Monarch Pledge, Bee City USA/Bee Campus USA, Homegrown National Park, Monarch City USA).

BMH-S2-C: Provide region-specific guidelines for managing and enhancing existing habitat areas, incorporating broad conservation goals and success metrics (e.g., benefits to multiple species, tracking via local ecological indicators).

BMH-S2-D: Engage Tribal wildlife agencies and leaders early in guideline development to integrate Tribal perspectives and land management knowledge for culturally significant lands.

BMH-S2-E: Foster information sharing and cooperation between federal, Tribal, state, and local land managers to promote monarch and pollinator habitat BMPs, monitoring resource sharing, educational programs, and Tribal land management perspectives.

BMH-S3: Protect and restore habitat in high-priority migratory pathways, including riparian corridors.

BMH-S3-A: Apply connectivity models (e.g., NRCS, Xerces/UNR/industry partners) developed for California's Central Valley to identify priority migratory pathways and guide monarch habitat creation in agricultural areas, with plans to expand to other major agricultural regions in the West.

BMH-S3-B: Share state-specific lists of priority monarch migratory habitats for protection, restoration, or enhancement, using current habitat distribution models for spring and fall migration (e.g., McIntyre et al., 2024) and data from observation databases (e.g., Western Monarch Milkweed Mapper, Monarch SOS app, iNaturalist, Southwest Monarch Study).

BMH-S3-C: Provide regionally tailored management guidelines for enhancing migratory habitats, incorporating Traditional Ecological Knowledge (TEK) where possible. Consult Tribal leadership early in developing substantive management plans and align projects with broader conservation goals.

BMH-S3-D: Promote mechanical vegetation management over pesticide-intensive methods in landscapes serving as connecting habitat corridors.

BMH-S3-E: Schedule mowing to avoid peak flowering and periods of monarch and pollinator activity.

BMH-S3-F: Engage early with Tribal wildlife agencies and heritage programs to address heritage data sovereignty considerations, incorporating TEK-based, holistic BMPs.

BMH-S3-G: Strengthen partnerships among public, private, and Tribal programs, including in-person engagement, to maximize the reach and efficiency of habitat restoration along migratory pathways.

BMH-S4: Provide BMPs and guidance to help landowners maintain diverse habitats for monarchs and other native pollinators across all land use types.

BMH-S4-A: Develop and distribute educational materials to farmers highlighting the benefits of increased pollinator diversity and visitation achieved by providing and maintaining diverse native pollinator habitat along field edges, riparian areas, ditches, fence rows, pivot corners, etc., with adequate sunlight, soil quality, and water access.

BMH-S4-B: Create and utilize demonstration sites in agricultural areas where Integrated Pest and Pollinator Management (IPPM) strategies are applied to encourage adoption by on- or near-farm and ranch habitat installation or enhancement efforts.

BMH-S4-C: Within priority western monarch breeding zones (see Chapter 3), incorporate and promote recommended targets when applying monarch- and pollinator-friendly management practices on working lands.

BMH-S4-D: Promote and distribute existing guidance materials and provide training, where appropriate, on best practices for pesticide application that minimize nontarget impacts (such as drift reduction, product selection, proper equipment maintenance, and IPPM strategies), especially in areas providing monarch breeding habitat.

BMH-S4-E: Promote and distribute regionally native flowering plant species lists formulated to optimize flowering periods with crop production schedules.

BMH-S4-F: Protect identified areas on rangelands containing milkweed and crucial late-season floral nectar resources through the application of BMPs compatible with grazing operations.

BMH-S4-G: Update existing BMPs for grazing on public lands, and implement these through the lease and contract process, where warranted.

BMH-S4-H: Utilize or customize already available grazing/pollinator habitat information.

BMH-S4-I: Create habitat in rangelands containing milkweed and crucial late-season floral nectar resources through the application of BMPs compatible with grazing operations.

BMH-S5: Integrate monarch conservation into land management activities, plans, and projects, promoting BMPs that support monarch-friendly habitat.

BMH-S5-A: Include monarch and pollinator conservation during the environmental review and planning stages for transportation projects including regional and statewide Transportation Improvement Plans.

BMH-S5-B: Develop or update right-of-way management BMPs that incorporate monarch-friendly habitat practices, and distribute them to roadside managers, public and private utility programs, and adjacent landowners (e.g., solar, pipeline, and electric projects) to encourage adoption of these practices.

BMH-S5-C: Incorporate Integrated Pest and Pollinator Management (IPPM) practices into all relevant land management activities.

BMH-S5-D: Collaborate with land management partners and engage early, in person where possible, with Tribes to integrate monarch and pollinator conservation into new land management plans and decisions in breeding regions and along migratory pathways, as appropriate.

BMH-S5-E: Promote the inclusion of monitoring to evaluate the impacts of monarch-friendly habitat restoration conducted by management authorities, public and private utility programs, and private landowners.

BMH-S6: Incorporate conservation measures into regulatory and development planning and review to minimize impacts and provide benefits to monarchs.

BMH-S6-A: Partner with irrigation companies, water development agencies, the U.S. Army Corps of Engineers, and municipalities to integrate monarch and pollinator habitat creation and enhancement into water conservation, wetland mitigation, and stormwater management projects.

BMH-S6-B: Collaborate with land development corporations, mining operations, and energy developers to conserve and manage existing monarch and pollinator habitat and to establish new habitat where feasible.

BMH-S6-C: Coordinate among local, state, and federal regulatory agencies and land-intensive industries (e.g., mining, development) to create, restore, and maintain monarch and pollinator habitat on industry-owned lands.

BMH-S6-D: Leverage technical service providers—including NRCS, extension agents, and the U.S. Army Corps of Engineers—to assist private landowners in creating habitat and to provide incentives for habitat establishment.

BMH-S7: Conduct targeted outreach to municipalities, local land use agencies, landscape businesses, and private landowners within historic breeding ranges on simple, effective ways to add pollinator habitat.

BMH-S7-A: Partner with schools, conservation corps, and faith-based groups to deliver monarch- and pollinator-focused programs that inspire and equip participants to take conservation actions benefiting local landscapes and ecosystem health.

BMH-S7-B: Expand and promote community science projects that build public support for monarch conservation and advance the goals and objectives of this Plan.

BMH-S7-C: Supply data, tools, and resources to local planning and zoning commissions, stormwater managers, water conservation districts, irrigation companies, and the U.S. Army Corps of Engineers (Corps) to encourage private developers to integrate monarch conservation, water-saving measures, and urban habitat improvements into their projects.

BMH-S7-D: Collaborate with regulatory agencies overseeing mining, corporate, and land development operations to educate operators on monarch and pollinator declines and highlight opportunities to incorporate beneficial reclamation practices.

BMH-S8: Educate homeowners, developers, and energy producers on the impacts of insecticide and herbicide use and provide BMPs and alternatives.

BMH-S8-A: Distribute and promote the Xerces Society's publication *Managing for Monarchs in the West—Best Management Practices for Conserving the Monarch Butterfly and its Habitat* to guide proper herbicide and pesticide use in habitat management.

BMH-S8-B: Provide insecticide/herbicide BMP training to technical service providers working with private landowners, municipalities, irrigation companies, and water conservancy districts.

BMH-S8-C: Share educational materials that demonstrate the benefits of adopting Integrated Pest and Pollinator Management (IPPM) practices.

6.3. Plant Materials

PM-S1: Participate in state and national seed strategies to increase the availability of regionally appropriate plant materials.	<p>PM-S1-A: Collaborate with seed co-ops, native plant nurseries, plant societies, and seed strategy working groups.</p> <p>PM-S1-B: Prioritize locally adapted milkweed and nectar species for restoration pipelines, including seed collection, propagation, and amplification.</p> <p>PM-S1-C: Develop contracts that cover the full plant material development cycle, from seed collection to production.</p> <p>PM-S1-D: Secure funding and contracts to support all stages of the outplanting process.</p> <p>PM-S6-E: Facilitate shared access to planting equipment, such as cold storage, seed cleaners, and seed spreaders/drillers.</p>
PM-S2: Improve and share propagation protocols for native milkweed and nectar plants.	<p>PM-S2-A: Test and refine propagation protocols for additional milkweed and nectar plant species.</p> <p>PM-S2-B: Standardize propagation protocol formats, compile them into a single searchable resource, and distribute them widely.</p>
PM-S3: Broaden restoration planting palettes to include a greater diversity of regionally appropriate species and ecotypes.	<p>PM-S3-A: Partner with landscaping companies and native plant growers to produce and plant locally-sourced native milkweed and nectar plants.</p> <p>PM-S3-B: Integrate TEK and Tribal priorities when selecting native plant materials.</p> <p>PM-S3-C: Develop region-specific monarch-friendly native plant palettes, emphasizing nectar species.</p> <p>PM-S3-D: In California, collect and distribute seed from early-season milkweed species to increase supply at native plant nurseries.</p> <p>PM-S3-E: Create nectar plant palettes for overwintering sites, timed to bloom during the overwintering period.</p> <p>PM-S3-F: Develop diverse tree palettes for monarch overwintering habitat.</p> <p>PM-S3-G: Design planting palettes for urban and suburban landscapes.</p>
PM-S4: Advance policies and programs that promote the adoption of monarch-friendly habitat.	<p>PM-S4-A: Create model ordinances for native plant use in municipalities.</p> <p>PM-S4-B: Encourage participation in the Mayors' Monarch Pledge and Bee City USA programs.</p> <p>PM-S4-C: Expand habitat kit programs to accelerate habitat installation.</p>
PM-S5: Minimize pesticide exposure to monarchs by avoiding contaminated or treated plant materials.	<p>PM-S5-A: Coordinate with agricultural commissioners and partners to label pesticide-free plant materials.</p> <p>PM-S5-B: Engage big-box retailers to stock untreated (neonicotinoid-free) native nectar plants and milkweed.</p> <p>PM-S5-C: Work with nurseries to offer pesticide-free native milkweed plugs, seed, and nectar plants.</p> <p>PM-S5-D: Work with nurseries to offer pesticide-free trees appropriate for overwintering site restoration.</p> <p>PM-S5-E: Develop reference materials for land managers on using local, pesticide-free (especially free of neonicotinoids) native plants for restoration projects.</p>
PM-S6: Educate the public on selecting and using native plant materials that support monarchs.	<p>PM-S6-A: Highlight the importance of early-season milkweed and late-season nectar resources in outreach.</p> <p>PM-S6-B: Communicate the risks of tropical milkweed (<i>Asclepias curassavica</i>) and its Class B pest status in California.</p> <p>PM-S6-C: Share resources on incorporating native plants into home gardens (see Resource section).</p>

6.4. Research and Monitoring

RM-S1: Determine which part of the lifecycle is limiting population growth.	<p>RM-S1-A: Quantify key survival and mortality rates for western monarchs, identify the main causes of mortality and low reproduction, and assess all life stages across diverse landscapes and habitats.</p> <p>RM-S1-B: Build a full annual life-cycle demographic model for western monarchs, conduct sensitivity analyses, and expand on the Breeding Phenology Project in collaboration with partners (e.g., WSU, Xerces, Tufts, DoD, and USFWS).</p>
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RM-S2: Refine key habitat characteristics that support monarch breeding and migration in the West, focusing on factors that enhance reproduction and survivorship.

RM-S2-A: Conduct research to identify productive and suitable monarch breeding and migratory habitats based on vital rates in different settings, including urban gardens, and use results to improve habitat management and restoration guidelines.

RM-S2-B: Develop clear definitions of/for western monarch breeding and migratory habitat at multiple scales with partners to support broad adoption.

RM-S3: Map priority monarch breeding and migratory habitats in the West to target conservation actions where they will have the greatest impact.

RM-S3-A: Incorporate land cover data into habitat suitability models and estimate the acres and locations of high-quality habitat occurring on public lands by jurisdiction.

RM-S3-B: Ground-truth habitat suitability models with systematic research to refine regional models and to identify habitat improvement potential.

RM-S3-C: Locate, map, and survey rangelands with milkweed, assessing plant abundance, density, and diversity.

RM-S3-D: Update and expand habitat suitability models with new data and additional western states (Montana, Wyoming, Colorado, and New Mexico).

RM-S3-E: Integrate climate change projections into habitat suitability studies.

RM-S4: Expand knowledge of monarch movement patterns in the West to inform identification of high-priority breeding and migratory conservation areas.

RM-S4-A: Promote participation in community science projects tracking habitat resources and monarch movements, including IMMP, Western Monarch Milkweed Mapper, iNaturalist, Survey123 (being piloted in Idaho), and Journey North.

RM-S4-B: Expand Western Monarch Milkweed Mapper data with State Natural Heritage Programs and community science-based inventory efforts and add new capabilities for reporting migratory stopover sites.

RM-S4-C: Continue and expand tagging studies (e.g., WSU, Southwest Monarch Study) to track monarch movements, focusing on data-deficient areas.

RM-S4-D: Expand the Motus network and use its data to track monarch migration routes and movements between overwintering sites.

RM-S4-E: Compile data from movement studies, habitat databases, and models to identify migration and habitat connectivity patterns and guide priority habitat protection and restoration (RM-S3).

RM-S4-F: Create and distribute a list of priority migratory pathways to partners to support habitat protection, restoration, and enhancement across working and natural landscapes.

RM-S5: Assess the impacts of pesticides on monarchs, other native pollinators, and their habitats.

RM-S5-A: Identify potential pesticide exposure pathways—including treated seeds, application rates, and other sources—in agricultural and non-agricultural areas to assess risks to monarchs and other native pollinators.

RM-S5-B: Conduct laboratory and controlled exposure studies to address key toxicological data gaps for monarchs and other native pollinators, evaluating the risks of various pesticides, adjuvants, and co-formulants.

RM-S5-C: Investigate how pesticide exposure interacts with other stressors—pathogens, poor nutrition, and temperature extremes—to affect monarch health and survival. Assess the impacts of simultaneous exposure to multiple pesticides, which is likely common for monarchs.

RM-S5-D: Assess the impacts of pesticides—particularly insecticides—on monarch populations, including effects on mortality, fitness, and habitat quality.

RM-S5-E: Survey host and nectar plants across diverse landscapes—especially protected areas—throughout all life history stages (breeding, migratory, and overwintering) to assess pesticide exposure risks to migratory monarchs throughout their life cycle and range.

RM-S5-F: Evaluate how pesticide application methods influence drift and other movement into adjacent monarch habitats—and identify effective techniques and buffer distances to reduce contamination.

RM-S5-G: Monitor pesticide residues in habitat restoration sites to determine whether BMPs for reducing contamination are effective or require updates to improve protection.

RM-S5-H: Model pesticide risk across the western landscape to guide placement of new monarch habitat.

RM-S6: Evaluate the effectiveness of current BMPs to implement refined monarch and pollinator conservation.

RM-S6-A: Partner with agricultural cooperative extension services and similar organizations to document and analyze current BMPs.

RM-S6-B: Review existing BMPs to identify gaps and design new studies to improve BMP implementation.

RM-S6-C: Produce a report identifying the most effective BMPs for monarch conservation and provide recommendations for discontinuing ineffective practices.

RM-S7: Investigate the role of predation, parasites, and disease in monarch population dynamics in the West.

RM-S7-A: Collect and analyze Oe samples from the western monarch population, ensuring participants have required permits and supervised guidance in applicable states.

RM-S7-B: Use new or existing research to evaluate the effects of Oe on western monarch fitness and mortality across overwintering, breeding and migratory population locations.

RM-S7-C: Continue research on the impacts of parasites and predators on monarchs.

RM-S7-D: Develop methods to monitor and assess other monarch diseases in the West.

RM-S8: Improve understanding of how changing climate and weather affects monarch breeding and migratory habitat, behavior, distribution, and multi-trophic interactions (e.g., predators, parasites).

RM-S8-A: Model potential monarch population distributions for each western state using various future climate projections (e.g., Svancara et al. 2019), applying habitat attribute data from RM-S2 to define high-quality breeding and migratory habitat.

RM-S8-B: Assess how increasing temperature and altered precipitation patterns affect plant phenology, butterfly phenology, and migratory cues, particularly during the first breeding period and final breeding generation.

RM-S8-C: Study habitat features—such as shade and structural refugia—that help monarchs withstand high temperatures, especially during fall migration.

RM-S9: Continue and expand Western Monarch Count monitoring efforts (www.westernmonarchcount.org).

RM-S9-A: Maintain the Western Monarch Count—including the early- and late-season surveys—to provide consistent, long-term population data that drives recovery planning and guides habitat management.

RM-S9-B: Expand volunteer participation in the yearly Western Monarch Counts through targeted outreach and active promotion.

RM-S9-C: Establish a skilled volunteer network to monitor the top overwintering sites hosting 95% of the western population and train state wildlife biologists in standardized monitoring protocols and volunteer engagement.

RM-S9-D: Analyze count data to monitor monarch population trends using summary metrics and modeled statistics (e.g., 5-year running averages for sites representing 98% of 2015–2024 observations).

RM-S10: Continue and expand research and monitoring infrastructure, technology, and planning within overwintering sites.

RM-S10-A: Install Motus towers and weather stations at overwintering sites to support research, including the multi-factor “super study” proposed at the Monarch Overwintering Science Meeting in 2023.

RM-S10-B: Increase use of fine-scale monitoring methods, such as those at Pismo State Beach, to track monarch movement within sites.

RM-S10-C: Test light detection and ranging (LiDAR) for habitat assessment and expand its use if results are favorable.

RM-S10-D: Continue research on Arizona and other dispersed interior wintering monarch populations.

RM-S10-E: Investigate the role of desert riparian and urban overwintering areas in supporting the overall monarch population.

RM-S10-F: Develop survey methods to locate undiscovered overwintering sites and reduce sampling bias.

RM-S10-G: Refine and expand models to assess whether management actions are achieving desired habitat outcomes.

RM-S10-H: Model potential overwintering locations under various future climate projections (e.g., Fisher et al. 2018).

<p>RM-S11: Monitor and evaluate habitat restoration projects, techniques, successes, and failures to guide adaptive management for monarch and pollinator habitat restoration.</p>	<p>RM-S11-A: Develop a standardized monitoring protocol for restored habitats to track key measures of native habitat restoration success.</p> <p>RM-S11-B: Survey restored sites to record monarch and other native pollinator presence or absence.</p> <p>RM-S11-C: Work with grantors and funders to ensure restored habitat projects include a monitoring component, conducted either by grantor or grantee.</p> <p>RM-S11-D: Create a database to track implementation, evaluation, and success of habitat restoration, enhancement, and preservation projects.</p>
<p>RM-S12: Track the long-term trends of the monarch butterfly relative to other butterfly and pollinator species.</p>	<p>RM-S12-A: Use and expand long-term datasets (e.g., North American Butterfly Association annual counts, PollardBase, Art Shapiro’s Butterfly Project) to track population trends of monarch butterflies and other pollinator species.</p> <p>RM-S12-B: Establish and expand long-term monitoring studies across the western monarch range, prioritizing data-deficient areas and partnering with insect societies, museums, Tribes, and other organizations.</p>
<p>RM-S13: Advance research and monitoring on biocultural, community, and social dimensions of western monarch conservation.</p>	<p>RM-S13-A: Support studies that document and analyze the spiritual, cultural, and symbolic meanings of monarchs and the ethnobotanical importance of monarch-friendly plants across Indigenous nations and other communities.</p> <p>RM-S13-B: Support partnerships with Indigenous communities to integrate Traditional Ecological Knowledge (TEK) into conservation science, policy, management, funding opportunities, and incentive program criteria, while safeguarding sacred site information and upholding principles of data sovereignty.</p> <p>RM-S13-C: Document and share lessons from Indigenous-led stewardship models, such as the TEAM coalition and other Tribal initiatives, that integrate cultural values with habitat restoration and intergenerational knowledge transfer.</p> <p>RM-S13-D: Advance community-based conservation by addressing inequities in environmental education and promoting community science that empowers local communities.</p> <p>RM-S13-E: Document community perspectives on monarch conservation, including views on federal protections, land ownership, and management of overwintering habitats, to inform best conservation approaches.</p> <p>RM-S13-F: Encourage research on how public interest in monarchs can be leveraged to build broader support for pollinator conservation and incentive-based habitat programs.</p> <p>RM-S13-G: Assess public understanding of captive rearing and transporting monarchs or other at-risk pollinators across jurisdictional boundaries to inform outreach and reduce misconceptions.</p> <p>RM-S13-H: Explore and amplify techniques and applied practices that align biodiversity protection with human social justice and equitable participation.</p> <p>RM-S13-I: Develop and disseminate experiential curricula for educators that integrate butterfly rearing as a tool to teach insect conservation, life cycles, and ecological and cultural value, while discouraging the release of commercially raised butterflies into natural habitats.</p>

6.5. Collaboration and Partnerships

<p>CP-S1: Create and/or maintain collaborative partnerships to promote monarch conservation and exchange information</p>	<p>Breeding and Migratory Habitat: BMH-S3, BMH-S4</p> <p>Overwintering Habitat: OW-S4, OW-STA, OW-S-Edu</p> <p>Plant Materials: PM-S1, PM-S4, PM-S5, PM-Edu</p> <p>Research and Monitoring: RM-S6, RM-S9, RM-S11-B, RM-S13</p>
<p>CP-S2: Facilitate information exchange and cooperation between land management entities (federal, state, local municipalities, and Tribes) to encourage and recognize monarch and other pollinator habitat best management practices (BMPs), monitoring opportunities, resource opportunities, and educational programs.</p>	<p>Breeding and Migratory Habitat: BMH-S1, BMH-S4</p> <p>Overwintering Habitat: OW-S4, OW-STA, OW-S-Edu</p> <p>Plant Materials: PM-S1, PM-S4, PM-S5, PM-Edu</p> <p>Research and Monitoring: RM-S6, RM-S13</p>

<p>CP-S3: Develop cooperative partnerships with land management entities that permit development projects to provide guidance for the incorporation of conservation actions that minimize impacts and provide benefits to monarch butterflies.</p>	<p>Breeding and Migratory Habitat: BMH-S5, BMH-S6</p> <p>Overwintering Habitat: OW-1C, OW- 1D, OW-S4, OW-STA, OW-S-Edu</p> <p>Plant Materials: PM-S4, PM-S5, PM-Edu</p>
<p>CP-S4: Develop cooperative partnerships to promote protection, restoration, and/or enhancement of high-priority breeding, migrating, and overwintering areas for monarch conservation.</p>	<p>Breeding and Migratory Habitat: BMH-S7, BMH-S8</p> <p>Overwintering Habitat: OW-S4, OW-STA, OW-S-Edu</p> <p>Plant Materials: PM-S1, PM-S4, PM-S5, PM-Edu</p> <p>Research and Monitoring: RM-S9, RM-S11-B, RM-S13</p>
<p>CP-S5: Engage with private landowners, developers, utilities, agricultural producers, and other industries to share information and promote incentives that are designed to increase volunteer conservation efforts that maintain, enhance, and restore breeding, migratory, and overwintering habitat for the monarch butterfly.</p>	<p>Breeding and Migratory Habitat: BMH-S1, BMH-S4, BMH-S7, BMH-S8</p> <p>Overwintering Habitat: OW-S4, OW-S-Edu</p> <p>Plant Materials: PM-S4, PM-S5, PM-Edu</p> <p>Research and Monitoring: RM-S9, RM-S10-C, RM-S13</p>
<p>CP-S6: Support engagement with tribal wildlife agencies and leaders to incorporate tribes' perspective knowledge of land and resource management for culturally significant tribal lands within breeding, migrating, and overwintering areas.</p>	<p>Breeding and Migratory Habitat: BMH-2D, BMH-4F, BMH-4G</p> <p>Overwintering Habitat: OW-S-Edu</p> <p>Plant Materials: PM-S3-B</p>
<p>CP-S7: Promote and recognize partner successes when they implement conservation measures to create, enhance, and protect pollinator friendly landscapes.</p>	<p>Research and Monitoring: RM-S10-D, RM-15</p>

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 https://xerces.org/sites/default/files/2018-05/15-016_01_XercesSoc_Conservation-Status-Ecology-Monarch-US-web.pdf
U.S. Fish & Wildlife Service <https://www.fws.gov/savethemonarch/>
Monarch Conservation Webinar Series <https://monarchjointventure.org/events/monarch-conservation-webinar-series>
Pollinator Partnership <http://pollinator.org/>
WAFWA WMNIP Monarch Conservation Fact Sheets <https://wafwa.org/publications/monarch-publications/>
Monarch Conservation Science Partnership <https://www.usgs.gov/centers/upper-midwest-environmental-sciences-center/science/monarch-conservation-science>

Plans & Strategies

WAFWA 50-year Western Monarch Conservation Plan <https://wafwa.org/committees-working-groups/monarch-working-group/>
North American Monarch Conservation Plan <https://www.cec.org/files/documents/publications/2350-north-american-monarch-conservation-plan-en.pdf>
Mid-America Monarch Conservation Strategy <https://www.mafwa.org/monarch-conservation-strategy>
U.S. Geological Survey Pollinator Science Strategy, 2025-2035 <https://doi.org/10.3133/cir1556>
USFWS CPC, Pollinator Action Plan <https://www.fws.gov/sites/default/files/documents/2025-04/pollinator-conservation-action-plan-april-2025.pdf>
State of the Monarch Butterfly Overwintering Sites in California <https://xerces.overwintering.org/state-of-the-monarch-butterfly-sites-in-california/>
Protecting California's Butterfly Groves <https://xerces.org/publications/guidelines/protecting-california-butterfly-groves>
CDFW Conservation Lecture Series Archive <https://www.wildlife.ca.gov/Conservation/Lectures/Archive>

Conservation - Western Population

Managing for Monarchs in the West (Xerces 2018) <https://xerces.org/publications/guidelines/managing-for-monarchs-in-west>
Western Monarch and Milkweed Habitat Suitability Models Project V2 (Dilts et al. 2018) <https://www.monarchmilkweedmapper.org/habitatsuitabilitymodels/>

Milkweed & Nectar Resources

Monarch Nectar Plant Guides (regional) <https://xerces.org/monarch-nectar-plants/>
Milkweed Guides (regional/state) <https://xerces.org/milkweed/>
Milkweed Finder <http://xerces.org/milkweed-seed-finder/>
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/publications/guidelines/roadside-best-management-practices-that-benefit-pollinators
Roadside Habitat for Monarchs	https://monarchjointventure.org/mjvprograms/science/roadside-habitat-for-monarchs
Monarch Habitat Development on Utility Rights of Way	https://www.pollinator.org/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/publications/guidelines/how-to-help-your-community-create-effective-mosquito-management-plan
Ecologically Sound Mosquito Management in Wetlands	https://xerces.org/publications/scientific-reports/ecologically-sound-mosquito-management-in-wetlands
Rethinking Pesticide Use in Yards and Gardens	http://xerces.org/pesticides-in-your-garden/
Supporting Pollinators on Farmland	https://xerces.org/pollinator-conservation/farmland

Citizen Science Opportunities

Western Monarch Milkweed Mapper	https://www.monarchmilkweedmapper.org/
Western Monarch Count	https://www.westernmonarchcount.org/
Monarch Larva Monitoring Project	https://mlmp.org/
Project Monarch Health	http://www.monarchparasites.org/
Integrated Monarch Monitoring Program	https://monarchjointventure.org/mjvprograms/science/integrated-monarch-monitoring-program
Journey North	https://journeynorth.org/monarchs
Southwest Monarch Study	https://www.swmonarchs.org/
Monarch Butterflies of the Pacific Northwest	https://www.facebook.com/MonarchButterfliesInThePacificNorthwest/
iNaturalist – Monarch (<i>Danaus plexippus</i>)	https://www.inaturalist.org/taxa/48662-Danaus-plexippus

Education and Outreach

Field Museum Urban Monarch Conservation Guidebook	https://mjv.nyc3.cdn.digitaloceanspaces.com/documents/urban_monarch_guidebook_final_050217.pdf
Monarch Joint Venture Educator Resources	https://monarchjointventure.org/mjvprograms/education/monarch-conservation-education-resources
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
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/MayorsMonarchPledge/About/Pledge-Action-Items

Funding Opportunities

Grants

State	Program	Program Administer	Program Description	Website
All States	Monarch Butterfly and Pollinators Conservation Fund	National Fish and Wildlife Foundation	Grants awarded to projects that create or sustain interconnected monarch and pollinator habitats or increase capacity and coordination among organizations, states, and regions engaged in monarch and pollinator conservation.	http://www.nfwf.org/monarch/Pages/home.aspx
	Lepidoptera Conservation Grant	Pollinator Partnership		https://pollinator.org/grants
California	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 achieve CVJV goals to increase populations of six 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 not covered by other mandated programs. It 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
	Monarch and Pollinator Rescue Program	Wildlife Conservation Board	MPPRP provides grants and technical assistance to applicants to restore California prairie in an effort to recover and sustain populations of monarchs and other pollinators. The program also coordinates 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.	https://wcb.ca.gov/Programs/Pollinators

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/program/coastal
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/programs-initiatives/monarch-butterflies
	Conservation Stewardship Program (CSP)	CSP participants receive an annual land use payment for operation-level environmental benefits that 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 to 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 grasslands, 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. For working farms, ACEP helps farmers and ranchers keep their land in agriculture. ACEP also protects grazing uses and related conservation values by conserving grasslands, 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 the 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/delevan/what-we-do#easements
CDFW'S Comprehensive Wetland Habitat Program	Permanent Wetland Easement Program	Comp Wetlands administers this program with the Wildlife Conservation Board's Inland Wetland Conservation Program. The Permanent Wetland Easement Program 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, the right to hunt and/or operate a hunting club, and the 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 biannually 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/



**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 Wildlife
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