



Recovering the Western Monarch Butterfly Population

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MEETING REPORT: EDF'S KEY TAKEAWAYS

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On February 28, 2019, key partners in western monarch butterfly and pollinator conservation convened at the Recovering the Western Monarch Butterfly Population Workshop at the University of California, Davis. The workshop, hosted by Environmental Defense Fund (EDF), brought scientists, restoration practitioners, agricultural producers, land managers, and agency staff together to share knowledge, build relationships, and identify key opportunities and challenges for recovering the western monarch population. The western monarch population is in crisis—the most recent population surveys indicate that the monarchs overwintering on the central coast have declined 86% since last winter, which means the total population has dropped to 0.5% of its historical average¹. Evidence suggests that over the long term, the western monarch population has been impacted by factors including destruction of overwintering sites on the coast, pesticide exposure, climate change, parasites, diseases, and a reduction in breeding and nectar habitat. However, there is uncertainty around the relative importance of drivers of the western monarch's decline; this makes it difficult to determine which strategies are most important to pursue in the short-term.

To save the western monarch butterfly, the monarch conservation community will need to collaborate to build a multi-faceted conservation strategy that addresses the threats affecting the population. This need is balanced with a powerful need for near-term action, to save a population that is on the brink of collapse. A key goal of this workshop was to identify “no regrets” conservation strategies—strategies that can be implemented in the near-term and are supported by the best science available, given the uncertainty surrounding the drivers of the population's decline. These near-term, no regrets strategies should be integrated into longer-term strategies that address multiple drivers.

Scientists, agricultural producers, land managers, conservationists, and government agencies are already working to save the western monarch population from extinction. At this workshop, participants shared expert knowledge and identified strategic, collaborative opportunities for monarch conservation, including opportunities for restoring monarch butterfly habitat at scale in the California Central Valley's agricultural landscape.

The purpose of this summary report is to capture the knowledge, ideas, and discussion generated by the workshop's participants, and provide a catalyst for scaling up collaborative efforts to recover the western monarch population in California. This report describes the workshop's key points and

¹ Pelton, Emma. “Early Thanksgiving counts show a critically low monarch population in California.” *The Xerces Society for Invertebrate Conservation*, 29 Nov. 2018, <https://xerces.org/2018/11/29/critically-low-monarch-population-in-california/>.

takeaways, which will help inform future conservation initiatives and resource allocation strategies to achieve conservation outcomes effectively and efficiently.

The following information in this summary report represents EDF's perspective only, and has not been reviewed or approved by any workshop participants or panelists. EDF hopes that workshop attendees will provide feedback and/or clarification to assist in our understanding of this complex conservation challenge. Any questions should be directed to Dan Kaiser at dkaiser@edf.org.

ENVIRONMENTAL DEFENSE FUND'S KEY WORKSHOP TAKEAWAYS

Approximately 40 attendees participated in the single-day workshop, representing agricultural producers, agency staff, legislative staff, conservation organizations, restoration practitioners, land managers, native seed suppliers, and scientists. There were three primary meeting components: 1) a summary of the current state of scientific knowledge on the western monarch population and the causes of its decline; 2) sharing of knowledge, experience, and expertise on habitat restoration efforts, and; 3) breakout groups to identify and discuss opportunities and challenges for improving and scaling up western monarch conservation in California.

The following sections capture EDF's synthesized takeaways from the workshop, organized by agenda topic.

- **The Western Monarch's Decline.** A panel of scientists deeply engaged in monarch conservation efforts shared their current understanding of the habitat needs and multi-faceted drivers behind the decline of the western monarch butterfly population.
- **Restoration Best Practices.** A panel of restoration practitioners and farmers shared their perspectives, experiences, and lessons learned from their experience with monarch and pollinator habitat restoration in the Central Valley.
- **Ideas for Connecting Science with Practice.** A facilitated breakout session, wherein small groups brainstormed and shared ideas for scaling up monarch habitat restoration in the Central Valley around specific topics.

I. The Western Monarch's Decline

Monarch butterfly and pollinator scientists described their current understanding of the western monarch butterfly population's decline, including potential drivers and existing knowledge gaps. Speakers included Sarina Jepsen from the Xerces Society, Dr. Louie Yang from UC Davis, Dr. Art Shapiro from UC Davis, and Karen Miner from the California Department of Fish and Wildlife. Sarina Jepsen also presented on the work of Dr. Matt Forister from the University of Nevada, Reno.

EDF identified the following key takeaways from the panel's discussion and input from all participants. These takeaways can help the monarch conservation community as it works to develop its approach to western monarch conservation. These takeaways will inform how EDF works with partners to develop strategies for scaling up habitat conservation and restoration for the monarch butterfly and other native pollinators. As the scientific community continues to hone its understanding of the key drivers of the monarch's decline, EDF will continue to update its strategies to ensure that its restoration work is grounded in the best science available.

Multiple Factors are Driving Population Declines

- **The relative importance of the drivers of the western monarch population's decline remains uncertain, and it's likely that multiple factors are driving the monarch's decline.** Evidence suggests that over the long term, multiple threats are contributing to population declines, including loss and degradation of overwintering sites on the coast, pesticide exposure, climate change, parasites, disease, and a reduction in breeding and nectar habitat. There are several theories for the cause of the western monarch's decline, each of which suggest the decline has multiple drivers. No one, single factor is likely the cause; therefore, strategies that address only one threat are likely to be incomplete.
- **Additional research is needed to improve our understanding of the drivers of the western monarch's decline.** We need to develop monarch butterfly life tables that provide data on age-structured survivorship and mortality data across a range of habitat areas of varying suitability, so that we can better understand the drivers of the monarch's decline. Conservation efforts would also benefit from enhanced information about the consequences of milkweed availability at the landscape scale, as well as additional science to build understanding of the relationship between climate change and the western monarch's breeding phenology. We need to build our scientific understanding of the multi-faceted threats that are affecting monarchs.
- **More science is needed to understand macro-scale threats.** Monarchs are not alone in their decline. Many butterfly species across California and beyond are in trouble, and some butterfly species are declining more rapidly than the western monarch. Insect biomass is declining rapidly across the globe. These declining trends across butterfly and insect species suggest that macro-scale drivers are affecting butterfly and insect populations; such drivers may include large-scale land use change, use of neonicotinoids and other pesticides, and climate change. We need to increase our scientific understanding of these systemic, large-scale threats in order to better address them.

No-Regrets Strategies

- **We must develop conservation strategies that address the multiple threats impacting monarchs.** The best available science suggests that there are multiple threats that are contributing to the western monarch's decline. It appears that not all threats are currently being addressed by the conservation community. Habitat restoration can increase the monarch's resilience to other threats in the near-term; however, the conservation community needs to collaborate to develop comprehensive, long-term strategies that address all relevant threats. The collective strategy of the conservation community must be multi-faceted in order to succeed in meaningfully addressing the drivers contributing to the western monarch's decline.
- **To build resilience for monarch populations and contribute to the western monarch's recovery, landowners, wildlife agencies, and restoration practitioners must work together to protect and restore breeding and migratory habitat in California.** The Western Association of Fish and Wildlife Agencies (WAFWA) wrote a [Western Monarch Butterfly Conservation Plan](#) that set a near-term goal of providing over 50,000 additional acres of monarch-friendly habitat in the California's Central Valley and adjacent foothills by 2029². Despite uncertainty around drivers and strategies, there is consensus that the western monarch population is in crisis and action is needed; habitat restoration can increase resilience for the western monarch population in the near-term, as the conservation community continues to build strategies that address the multiple factors that are likely driving the population's decline. Near-term habitat restoration

² Western Association of Fish and Wildlife Agencies. 2019. Western monarch butterfly conservation plan, 2019-2069. Version 1.0.

strategies should focus on California's Central Valley, Coast Range, and Sierra foothills. These priority regions are key natal areas that support early generations of monarchs.

- **Monarch habitat restoration efforts should be designed to benefit a range of species, including native pollinators.** Restored habitat for monarchs should be diverse, and should include an ecologically appropriate mix of wildflowers and milkweed that also supports a range of native pollinators and beneficial insects.
- **Evidence suggests that western monarchs are highly vulnerable during the late winter/early spring, when the first generation of monarchs begins its migration. Particular effort should be made to provide breeding and nectar habitat during this part of the monarch's life cycle.** Scientists have observed phenological mismatches between the monarch's movements and the availability of milkweed and nectar during the early spring, possibly due to climate change impacts. Specifically, monarchs have been observed leaving overwintering grounds earlier, when many varieties of milkweed have not yet sprouted or grown enough to be usable. There is also evidence of gaps in milkweed and nectar availability in the late fall, when monarchs are returning to their overwintering sites—it's possible that monarchs are making their return migration later in the year, when milkweed has already been eaten or has begun dying down for the winter. Near-term habitat conservation strategies should prioritize habitat restoration that supports monarchs during these phases of their migration. When planning habitat projects, emphasis should be placed on providing milkweed and nectar resources that will be available in the late winter/early spring, and in the late fall. Providing plentiful nectar and milkweed during these periods will also increase resilience by helping monarchs breed and migrate successfully despite any changes in monarch and/or milkweed phenology that may result from climate change.
- **The western monarch is highly vulnerable during overwintering, and remaining overwintering habitats on the central coast are at risk of further destruction and degradation. These areas would benefit from additional protection and restoration.** Overwintering habitat areas provide monarchs with the specific microclimates that they need to survive through the winter. Once lost, these overwintering sites cannot be replicated in the near-term, as suitable trees can take decades to regrow. Since the 1980s, over fifty overwintering sites have been lost. Since 2017, at least a dozen sites have been destroyed or made unsuitable for monarchs' use. Overwintering sites are in need of protection, restoration, and long-term management. There are hundreds of overwintering sites along the coast—the Xerces Society has made a list of the top 50 priority overwintering sites, which can be found in their 2016 report, [State of the Monarch Butterfly Overwintering Sites in California](#). Priority overwintering sites are located on both private and public lands, which poses a challenge for developing an overwintering site conservation strategy—any plans to protect and restore overwintering sites must create incentives and drivers that are appropriate for different types of land ownership and land management.

II. Restoration Best Practices

Restoration practitioners and landowners have already begun work to support the western monarch butterfly population through habitat protection and restoration. During the workshop, farmers and restoration practitioners shared their experiences with monarch and pollinator habitat projects on working and managed lands. Panel speakers included Rex Dufour from the National Center for Appropriate Technology, John Brennan from Davis Ranches, Jerry Dion from River Partners, Angela Laws from the Xerces Society, and Reyn Akiona from Bowles Farming.

EDF identified the following key takeaways from the panel's discussion and input from all participants. This on-the-ground experience and learning from farmers and restoration practitioners will be instrumental in creating successful habitat projects within the agricultural landscape of the Central Valley. These best practices and takeaways should be considered during strategy development and implementation, in order to develop successful projects/programs that both increase monarch resilience and work within landowners' management and/or agricultural production plans.

Getting the Incentives Right for Landowners

- **When farmers are considering a habitat project, three important factors in decision-making are cost, complexity, and certainty.** By addressing these factors, we can make monarch and pollinator habitat projects easier for landowners to implement.
- **We need to make it easier for farmers and ranchers to take advantage of funding opportunities for monarch habitat projects.** This includes making grant applications and requirements simpler. In many cases, landowners simply do not have the time to identify available funding opportunities and fill out applications. Landowners already deal with numerous regulations and requirements, and often cannot spare time to pursue voluntary habitat opportunities. Simplifying grant application processes and reporting requirements can increase opportunities for a greater number of farmers and ranchers.
- **There are many technical resources available to help reduce the complexity of projects for farmers and land managers.** EDF has recently released a step-by-step guide to creating habitat for monarchs and pollinators on farms and ranches in California, titled [Monarch Butterfly Habitat Creation in California: A Technical Field Guide](#). The Xerces Society has developed a wide variety of guides and resources, including [Managing for Monarchs in the West](#), which provides best management practices for conserving the monarch and its habitat. Monarch conservation partners should work to make sure that these guides are utilized in helping landowners plan and implement projects, and should try to identify and fill any gaps in existing technical guidance.
- **Advocates for the western monarch need to better communicate the real co-benefits that monarch habitat provides for farmers, ranchers, and other landowners.** Monarch habitat can provide multiple benefits to farmers, and habitat plantings can be customized to enhance values such as soil health, support for native pollinators and other beneficial insects that help control pests, carbon sequestration, water filtration, and aesthetics. We need to make these co-benefits clear, so that they are factored into landowners' decision-making.

Innovative Partnerships Can Reduce Limiting Factors

- **We need to explore new methods to scale up production and bring down costs for seeds and transplants.** Milkweed and other suitable, native wildflowers can be expensive and difficult to procure for monarch habitat projects. This can make projects too expensive or logistically difficult for landowners, and creating an added barrier to habitat restoration. However, innovative partnerships can bring down project costs, and increase the feasibility of incorporating milkweed and native wildflowers into farming and land management plans. For example, River Partners has successfully partnered with a high school to grow milkweed seedlings for transplanting at minimal cost. River Partners provided the trays, seed, and \$500 to a local high school, which successfully grew 10,000 seedlings. Restoration groups and conservation organizations should consider growing out large quantities of milkweed seedlings, and providing them to landowners to plant for free or for a reduced cost.
- **Evidence indicates that early-sprouting milkweed and early-blooming wildflowers are especially beneficial for monarchs in California.** Particular effort should be made to ensure

that these early-sprouting and early-blooming species are widely available, and to encourage landowners and restoration practitioners to incorporate them into habitat plantings. The Xerces Society's [Project Milkweed](#) is already working to increase the availability and diversity of available milkweed seeds and seedlings. Groups working to increase milkweed availability should collaborate with farmers, schools, and native seed suppliers to make sure that these early sprouting milkweeds and early blooming wildflowers are included in efforts to scale up the milkweed supply.

Existing Conservation Projects are Opportunities for Scaling Restoration

- **A key opportunity for scaling up monarch habitat restoration is incorporating monarch habitat into existing and planned restoration projects.** As an example, there are thousands of acres of planned floodplain restoration along the San Joaquin and Sacramento Rivers—by incorporating milkweed and suitable wildflowers, that habitat could also support monarchs. Similarly, monarch habitat could be integrated into a wide range of planned habitat projects, including any habitat projects with hedgerow or native grass components. Adding monarch habitat to existing projects reduces complexity and time; these projects already have funding and stakeholder buy-in, and it is easier to extend an existing grant or permit than to start a new process from scratch. We need to be intentional about including monarch in planned restoration projects, and provide the resources and technical guidance needed to add milkweed and suitable wildflowers to multi-benefit restoration projects.
- **Existing restoration sites provide opportunities for research, monitoring, and data collection.** Studying these sites could help us learn more about the drivers of the monarch's decline, and about successful restoration practices. Restoration groups such as River Partners and the Xerces Society have done thousands of acres of habitat restoration for monarchs and pollinators, in contexts ranging from working farms to nature preserves. Scientists could utilize these acreages for monitoring to increase our understanding of the factors contributing to the monarch's decline. Similarly, the restoration community can use these sites to better understand the factors that make restoration projects successful or not.

III. Opportunities and Challenges for Western Monarch Habitat Restoration

Workshop attendees discussed key challenges and opportunities for scaling up monarch and pollinator habitat restoration in the Central Valley in the context of five specific topics.

- **Farm Production Practices & Technology.** Are there changes to farm practices that would make restoration more likely, or would unlock new acreage for restoration?
- **Public, Reserve, & Set-Aside Lands.** How can non-agricultural managed landscapes contribute more monarch habitat?
- **Policy & Funding.** Is there a need for new local, state, or federal policy? How can we make better use of current policies (e.g. California's Monarch and Pollinator Rescue Program funding)?
- **Restoration Costs & Techniques.** How can the cost of seed be reduced so that this barrier to restoration is lowered? Are there restoration techniques that could make restoration easier and more widespread?
- **Collaboration & Coordination.** Envision a world in which the activities of many organizations are working in unison toward a collective goal. How would those organizations work together? What is needed to catalyze this collective action (e.g. capacity)?

Participants brainstormed potential opportunities, and then performed a deep dive on one scalable idea, discussing potential challenges, stakeholders who would need to be involved in implementation, and possible next steps. Several promising ideas and opportunities emerged during the brainstorm and break out discussion, including potential tactics for scaling up monarch and pollinator conservation.

EDF's key takeaways around actionable, scalable ideas for habitat restoration are below. EDF and partners should consider the role that they can play in the vetting and implementation of these ideas for scaling up monarch habitat restoration in California. It is also important to note that the ideas below are near-term strategies, focused on the addressing the loss of overwintering, breeding, and migratory habitat as a driver—this is only one of several drivers that are likely contributing to the monarch's decline. As we work to make conservation strategies more comprehensive and multi-faceted, we should consider holding similar brainstorming and discussion sessions to gather ideas that address multiple and/or different threats.

Habitat Restoration Techniques & Opportunities

- **Incorporate monarch- and pollinator-supporting plantings into cover cropping systems.** By adding suitable native wildflowers into cover crop plantings, farmers will be able to support monarchs and native pollinators by providing them with an additional source of nectar. This will increase the benefits already provided by cover crops, while increasing the amount of habitat acres that can support monarchs and pollinators within the agricultural landscape. As the conservation and agriculture communities explore this opportunity, we should consider factors such as 1) which wildflowers would be best to include in cover crop plantings, and 2) how to ensure that risks of pesticide exposure are mitigated. We should also explore existing cover cropping programs, and learn from the barriers and opportunities that they have faced in scaling up adoption.
- **Plant habitat for monarchs and other native pollinators into young, non-bearing orchards.** Pecan orchards are an especially promising opportunity—it takes approximately five years for a pecan orchard to reach maturity and begin to produce a harvestable crop. Planting habitat into young orchards would provide access to acreages that were previously unfeasible for monarch habitat projects. These sites could potentially provide large amounts of habitat during non-bearing years.
- **Incorporate monarch habitat plantings into existing and planned restoration projects.** Partners should work to integrate supplemental milkweed and nectar plantings into the thousands of acres of planned restoration projects across the state. Complementary plantings for floodplains and other habitat types should be explored and pursued, and the conservation community should consider how to provide the funding and/or materials necessary to incorporate monarch habitat into multi-benefit restoration projects.
- **Leverage partners to grow and distribute 50,000-100,000 milkweed seedlings.** Restoration groups could work with partners (such as school groups, farmers, seed suppliers, etc.) to grow and distribute seedlings to farmers and other land managers interested in doing restoration projects, for free or for a reduced price. Demand appears high enough that any available seedlings would be used, and providing seedlings to farmers directly would reduce the cost and complexity of planting monarch habitat. As demonstrated by River Partners, seedlings can be grown at a greatly-reduced cost through innovative partnerships.

Funding & Policy

- **Launch policy initiatives to improve the protection and management of overwintering sites along California's coast.** As noted above, overwintering sites along the coast are in need of

additional protection. New policies could provide legal protection for priority overwintering groves and/or provide additional resources for their protection, restoration, and long-term management. In addition, agencies such as the Coastal Conservancy have funding available to them from Propositions 1 and 68, and could be directed to prioritize granting or expending some of those funds to protect overwintering sites on private property that are currently unprotected. Any policy initiatives would need to be appropriate for different land ownership types.

- **Initiate policies charging state agencies to review and update their internal guidance and policies to support monarch populations, whenever possible.** Relevant agencies would look for opportunities to contribute to monarch conservation and research, and have an opportunity to highlight work they are already doing to support monarchs and pollinators. Within their purview, land management agencies could seek opportunities to protect and restore monarch habitat, while wildlife agencies could look for ways to incorporate monarch habitat into other compatible wildlife restoration projects.
- **Leverage existing funding mechanisms such as the Monarch and Pollinator Rescue Program and the Healthy Soils Program.**
 - The Monarch and Pollinator Rescue Program will provide \$3 million in funding for monarch butterfly habitat projects this year. The program will be administered by the Wildlife Conservation Board, which has recently released its program [guidelines](#) and is finalizing its project solicitation process. EDF and partners should spread the word about this funding opportunity to applicants that would be a good fit, and serve as a resource for both WCB and applicants to increase the effectiveness and efficiency of allocation of funds. Local conservation organizations should also start considering ideas for projects with landowners in their networks. Procuring additional resources (from both public and private sources) to support the Monarch and Pollinator Rescue Program would multiply benefits into the future—the program’s available funding will be disbursed this year, but could be supplemented to support grants for monarch habitat restoration into the future.
 - The [Healthy Soils Program](#) is coordinated by CDFA, and offers grants for a range of practices that reduce greenhouse gas emissions and increase soil health. The program offers grants of over \$2,200/acre for conversion of cropland to conservation cover that benefits monarchs. It also covers a range of practices that could easily incorporate planting of milkweed and nectar-producing wildflowers, such as hedgerow planting and establishment of riparian herbaceous cover.

Collaboration & Coordination

- **Both near-term and long-term conservation efforts will benefit greatly from increased collaboration.** The western monarch is facing multi-faceted threats, and addressing them will require a multi-faceted approach. Without effective coordination amongst the groups working to save the monarch, it will be difficult to ensure that the collective strategies of the conservation community properly address the suite of relevant threats. There is an opportunity to increase collaboration toward mutual goals for western monarch recovery. However, the role of organizing and fostering such collaboration is currently vacant. Members of the monarch conservation community should work to identify both the correct partner to fulfill such a role and funding to support it.

CONCLUSIONS AND NEXT STEPS

At this workshop, participants discussed many ideas for restoring habitat to build the western monarch population's resilience as a near-term strategy. However, conservation of the monarch and other native pollinators will not be successful unless the conservation community works to: 1) support monarch scientists as they improve our understanding of key threats, and; 2) develop collaborative, comprehensive conservation strategies that address the multiple threats that are likely driving the western monarch's decline.

Conservation goals for the western monarch butterfly in the next 10 years are necessarily ambitious. To reach the 50,000-acre goal for monarch habitat set by WAFWA, EDF and partners will need to mobilize a range of diverse actors including landowners, policymakers, and the general public. In order to scale up habitat restoration to meet conservation goals, EDF and partners will explore innovative and experimental solutions for integrating habitat into working and managed landscapes, while also increasing the funding and technical resources available for habitat protection and restoration. To ensure strategies are effective, adaptive management, project-level monitoring, and additional research science will be necessary. EDF and UC Davis are currently working on a monarch conservation network analysis, which will analyze social networks within the monarch conservation landscape to improve coordination, collaboration, and uptake of conservation practices. WAFWA is also planning a western monarch summit this summer, to launch their Western Monarch Butterfly Conservation Plan.

EDF hopes that the experiences and ideas shared during the *Recovering the Western Monarch Butterfly Population Workshop* can inform the development of the monarch conservation community's strategies for scaling habitat restoration to save the western monarch butterfly. We also hope that they can be helpful in future efforts to develop multi-faceted conservation strategies, which address all the threats impacting the western monarch. EDF is currently using the findings summarized in this report to hone our approach to western monarch conservation, and to consider how future collaborative projects and partnerships could take place to address the drivers of the western monarch population's decline. We greatly appreciate the participation of the workshop's attendees—we thank you all for your time, ideas, and insights, and look forward to working with you as we expand our collaborative work to save the western monarch and support native pollinators across California.