



Fuel management recommendations

in monarch overwintering sites

The western monarch butterfly (a population of the species *Danaus plexippus plexippus*) migrates to coastal California each year from breeding grounds spread throughout the western U.S. From approximately October to March, they cluster in groups of trees known as “overwintering” sites. The combination of long-term declines in the number of overwintering western monarchs, development and habitat loss, and an increased risk of high intensity wildfires along the coast highlights the importance of balancing monarch habitat needs and wildfire fuel management.



To determine whether a location has previously hosted documented monarchs, consult the [California Natural Diversity Database](#) or the [website for the Western Monarch Count](#), a 25+ year monitoring effort developed by The Xerces Society for Invertebrate Conservation.

Over 500 locations have been identified to potentially support overwintering monarchs in California¹. However, different sites can support varying numbers of individuals and monarchs have been documented to move between sites throughout the overwintering period. Within an overwintering site, it can be difficult to identify and map all of the trees that monarchs utilize or are important in maintaining the appropriate conditions to support monarchs. The core, shelter, and support zones model (as defined by the [Overwintering Sites Boundary Delineation Project](#); figure below) can help better understand general habitat types within and adjacent to an overwintering site as well as the resources and key characteristics of the zones:



Core zone: The area within an overwintering site that contains the trees where monarchs cluster (known as “cluster trees”).

Shelter zone: The area where vegetation, topography, or structures provide wind protection and contribute to creating other microclimate conditions that support monarch clustering and/or aggregation. The shelter zone delineates the outer boundary of an overwintering site and encompasses the core zone.

Support zone: A 500-foot buffer surrounding the shelter zone can provide essential resources for monarchs, such as nectar plants, hydration sources, and protective windbreaks or other landscape features.

Key components of overwintering habitat

While overwintering habitat is still being studied, sites often contain²:

- A core zone of trees with an **open interior** where winds may be lower compared to outside the site
- **Windbreak trees** in the support or shelter zone that buffer the core zone from prevailing winds, which may originate from multiple directions during storms
 - Midstory (i.e., shorter than the species that comprise the canopy or overstory) native species on the exterior of the core zone that can provide increased protection from wind
- A **mosaic of microclimates** including, but not limited to, openings in groups of trees and branches to allow for dappled sunlight
- Nearby **nectar sources**, particularly within the shelter or support zone, available October–March. Adult monarch butterflies feed on nectar from a variety of plants all year and nectar is particularly important during the overwintering period
- A nearby **water supply**, particularly within the overwintering site, in direct or dappled sunlight

Fuel and hazard management within overwintering sites

Monarchs have been documented to use a variety of native tree species. However, they often overwinter on stands of non-native eucalyptus trees (*Eucalyptus* spp.) due to their tall stature, full canopy, nectar resources, and widespread presence along the coast. Eucalyptus are susceptible to entire tree dieback and can produce an abundance of branch, leaf and bark litter that may increase fuel loads within a site if not actively managed.

Fuel management within all types of overwintering

sites should include site-specific planning³ with a biologist with expertise in monarch life history, survey techniques, overwintering site structure and habitat, and required permits, as needed.

Consider the following recommendations when balancing monarch needs and fuel management within overwintering sites:

- **Conduct work between April and September** (i.e., outside of monarch overwintering season), while avoiding adverse impacts to other local, sensitive species (e.g., birds, bats, etc.).
 - If work within a site is necessary during the overwintering period, work with permitting agencies as needed to develop avoidance and mitigation measures. This may include the presence of a monitor with expertise in monarch biology during project activities.



Before (left) and after (right) a fuel reduction treatment near Elkhorn Slough in Monterey County, CA. Photos courtesy of CDFW and Xerces Society.

- **Create a site map that identifies core, shelter, and support zones using field surveys and other available data** (e.g., [Western Monarch Count](#) data). The absence of monarchs during a surveyed season does not preclude presence in subsequent years. Observations in the afternoon prior to a morning survey can help identify evening cluster locations (see [Xerces survey protocols](#)).

- Share core and shelter zone boundaries with all personnel conducting treatments.
 - Physically flag cluster and key windbreak trees to ensure they are properly avoided as well as buffered from equipment staging.
- Conduct a tree risk analysis prior to any site work.
 - When appropriate, use a qualified arborist or forester to assess tree condition.
 - A biologist with expertise in overwintering site structure, habitat, and management should compare the tree risk analysis to the monarch site map to minimize potential impacts to the core and shelter zones as much as possible.
 - When possible, prioritize necessary hazard limb removal that can prevent whole tree removal, especially before winter storms.
 - Impacts to known cluster branches and trees should be avoided unless there is an imminent safety issue or the action is determined by a biologist with monarch expertise to improve conditions within the site for monarchs.
 - If no other alternatives are feasible and a hazard tree must be removed, consult with permitting agencies and a biologist with monarch expertise as needed to develop approaches to minimize or avoid impacts to surrounding core and shelter zone trees.
 - When necessary and approved by permitting agencies as needed, **shedding *Eucalyptus* spp. bark and limbs at 10 ft and lower may be removed with minimal impacts to habitat**. Generally, monarchs typically cluster above 10 ft. from the ground.
 - **Retain limbs above 10 ft.** to protect clusters and wind protection capacity.
 - Retain some healthy saplings and midstory trees within the shelter and core zone to ensure tree succession as well as the continued maintenance of microclimate conditions – consider how the growth of retained trees may impact future habitat (e.g., wind protection, sunlight penetration).
 - Excessive ground litter can be removed with minimal impacts to monarch habitat, but note that some understory substrate near cluster trees can help dislodged butterflies move off the ground.
 - **Avoid insecticide use at overwintering sites⁴ and limit herbicide application, particularly during the overwintering period.**
 - The least persistent and least toxic options that can accomplish the site objectives should be selected. Consider residence time and minimize the risk of drift.



Before (left) and after (right) a fuel reduction treatment at Natural Bridges State Beach in Santa Cruz, CA. Photos courtesy of Groundswell Ecology.

- Between October and March, herbicide treatments should only be applied under the supervision or guidance of a biologist with monarch expertise – avoid herbicide application while plants are in bloom to the greatest extent possible.
- **If pile or broadcast burning must occur, burning should be conducted outside of the core zone.**
 - If prescribed burns must occur during the overwintering season, develop comprehensive mitigation measures for smoke and other potential impacts in conjunction with the operations team.
- **Ensure that any generated biomass does not impact resources in the support zone** (e.g., avoid placing biomass on key nectaring plants and water sources).
- If replanting trees or nectaring plants, **consider regionally appropriate native species** and their drought tolerance during species selection.
 - In groves of dense *Eucalyptus* spp., consider planting native species along grove edges where survivorship is more likely.

Potential permits & other approvals for treatment of overwintering sites

(subject to change; consult your local government or appropriate agency)

- Local city or county governments may require a tree removal or significant pruning permit.
- If the site is within the [California Coastal Zone](#), treatment may need a permit via the California Coastal Commission or the Local Coastal Program.
- Activities in and around waterways may require a Lake and Streambed Alteration permit from the California Department of Fish and Wildlife, or a permit from the State or Regional Water Board.
- Potential for significant impact may need to be evaluated in an applicable California Environmental Quality Act (CEQA) document.
- If the primary purpose of the project is restoration but actions include fuel reduction, then a Restoration Management Permit through CDFW's Cutting the Green Tape Program may be applicable if there is potential for [take](#) of monarchs or other species.
- Review regulations governed by the Federal Endangered Species Act and critical habitat and consult with the United States Fish and Wildlife Service as appropriate.

References

1. Xerces Society Western Monarch Count. 2026. Western Monarch Count Data, <https://westernmonarchcount.org/>
2. The Xerces Society (2017). *Protecting California's Butterfly Groves: Management Guidelines for Monarch Butterfly Overwintering Habitat*. https://westernmonarchcount.org/wp-content/uploads/2014/11/2017-040_ProtectingCaliforniaButterflyGroves.pdf
3. City of Goleta. (2025). Monarch Butterfly Winter Habitat Stewardship: A Guide for Private and Public Land Managers. <https://www.cityofgoleta.org/play/parks-recreation-open-spaces/ellwood-mesa-and-monarch-butterfly-habitat/ellwood-improvement-projects/butterfly-habitat-plan-implementation#docaccess-ab4cc3b4c1ad594bf925e6b44b596e89>.
4. Cibotti, S., Hladik, M. L., May, E., Pelton, E., Bargar, T. A., Johnston, N., & Code, A. (2025). Pyrethroid insecticides implicated in mass mortality of monarch butterflies at an overwintering site in California. *Environmental Toxicology and Chemistry*, 44(10), 2716-2724.

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