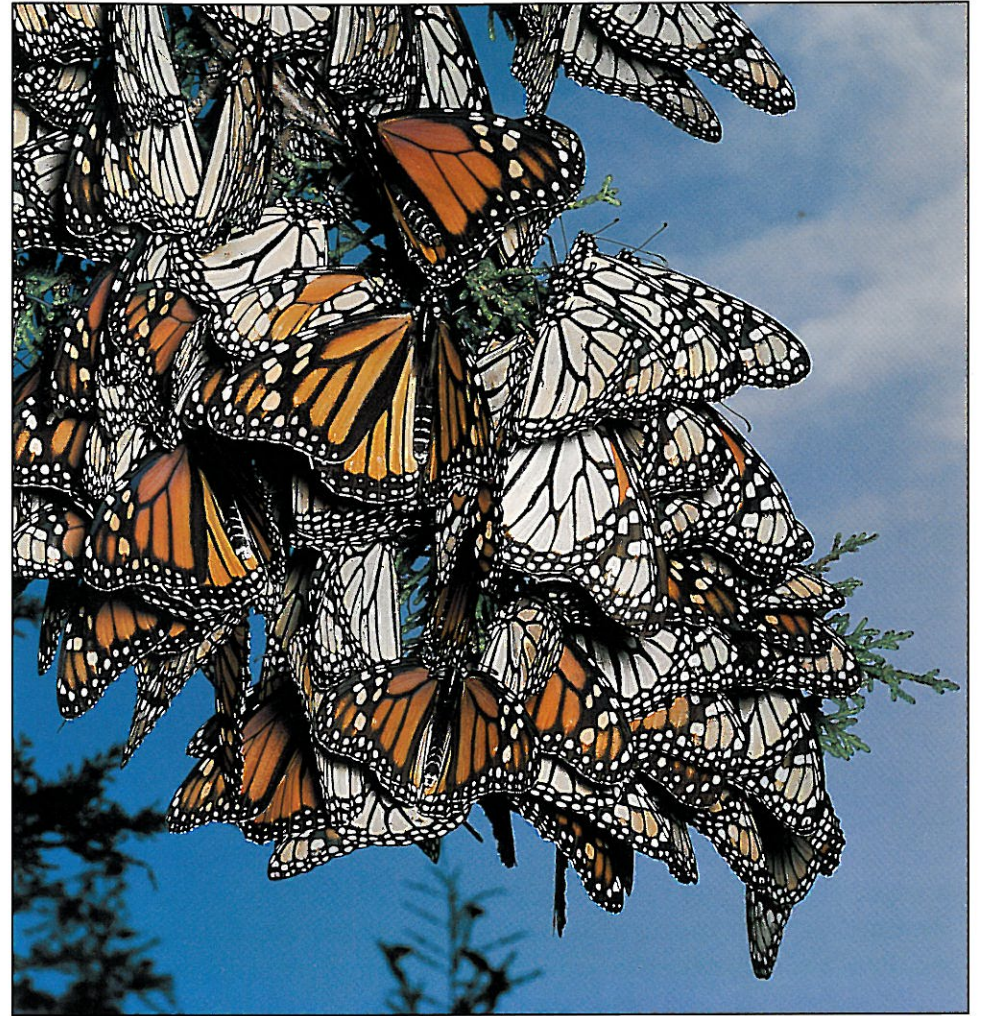


# THE MONARCH HABITAT HANDBOOK



*A California Landowner's Guide  
To Managing Monarch Butterfly Overwintering Habitat*

The Xerces Society

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*The cover photograph shows a Monarch winter cluster on Cypress. Photographed at Stinson Beach by Edward S. Ross.*



## ***Introduction***

This handbook is a guide for landowners who wish to practice wise stewardship over their Monarch butterfly habitat, preserving it for future generations to enjoy. We begin by describing the Monarch migration and current scientific knowledge of Monarch biology and overwintering. We then offer information about how best to manage and protect the overwintering habitat. We also offer suggestions for further activities and answers to commonly asked questions. On the back page is a list of individuals who are willing to share their knowledge of Monarch butterflies and their habitat.

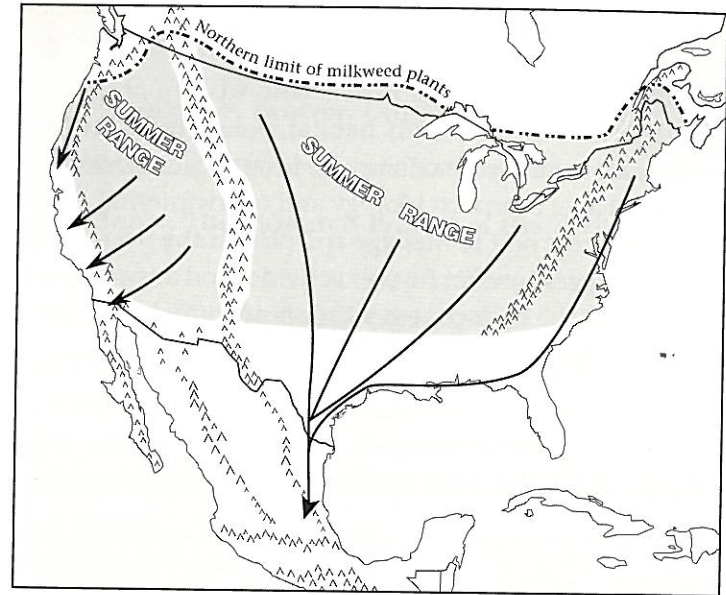
### ***The Monarch Migration: A Spectacular and Endangered Phenomenon***

Every fall, Monarch butterflies throughout North America migrate to overwintering sites in California or central Mexico. This migration is unique among insects. In fact, the North American Monarch butterfly is the only insect in the world known to make the same kind of annual, back-and-forth, long-distance migration as birds or whales.

Every fall the Monarchs fly west and south to the same overwintering sites, and frequently to the same trees. In California, the butterflies cluster in these sites from about October through February. Then in spring they depart, flying north and east to search for milkweed plants on which the females lay their eggs. The migrating butterflies die soon after they lay their eggs, which will become the first generation of spring butterflies. The spring and summer generations of Monarchs live only four or five weeks; individual females may lay as many as 400 eggs. Three or four of these short-lived generations arrive before fall, producing millions of Monarchs throughout North America. In the fall, the butterflies that emerge as the last generation of the season become the new migrants who will make the journey to the overwintering habitats.

Unfortunately, these overwintering habitats are profoundly endangered by land development, logging, and poor land management. Like the Xerces Blue butterfly, a California butterfly that became extinct in 1940 as a result of industrial and real estate development, the spectacular flight of the Monarchs may disappear with the loss of the overwintering habitats.

Because so much Monarch habitat in California and Mexico has been (and is continuing to be) destroyed or degraded, the International Union



*Fall migrations of the Monarch butterfly in North America. In the summer the Monarch ranges as far north as its main food plant, the milkweed, is found. Adapted from a map by Lincoln Brower, in "Understanding and Misunderstanding the Migration of the Monarch Butterfly (Nymphalidae) in North America: 1857-1994." Journal of the Lepidopterists' Society 49, 1995.*

for Conservation of Nature and Natural Resources in 1983 classified the migration and overwintering behavior of the Monarch butterfly as a "Threatened Phenomenon." The Monarch is the only insect listed in the Bonn Convention on the Conservation of Migratory Species of Wild Animals, an international treaty protecting a number of animal taxa.

Scientists believe that if overwintering habitats in Mexico and California are not successfully protected, the migration and overwintering phenomenon could disappear early in the next century. California is crucial to the preservation of the Monarch migration in North America because, as the pressure continues on dwindling forest resources on the Mexican overwintering sites, California may become the sole North American destination point of the Monarch migration. With dedication and collaboration among landowners, developers, and local governments, it is possible to protect this world-famous butterfly and its migration in harmony with the human use of California's coastal forests.

## *About Monarch Habitats*

Recognize that your Monarch habitat is rare. California is the only place in the United States where Monarchs overwinter in these spectacular aggregations. A dwindling number of groves along the California coast have the characteristics necessary to support overwintering butterflies. These characteristics include the type of trees and other vegetation in the grove, the way the grove may protect butterflies from wind and storms, and, most important, the climatic conditions that scientists call the "microclimate."

The term microclimate describes the specific temperatures, wind velocity, sunlight, and humidity inside the grove. A microclimate inside a Monarch habitat is often significantly different from the climatic conditions outside the grove. It is the key to understanding why the butterflies are clustered there.

Scientists have shown that overwintering groves generally have more stable temperatures, i.e., less variation between day and night temperatures than you'd find in exposed areas. Overwintering groves also have less direct sunlight, less wind, and more moisture in the air than groves where the butterflies choose not to cluster. The forest serves to insulate the butterflies from freezing temperatures and to protect them from prolonged exposure to direct sunlight.

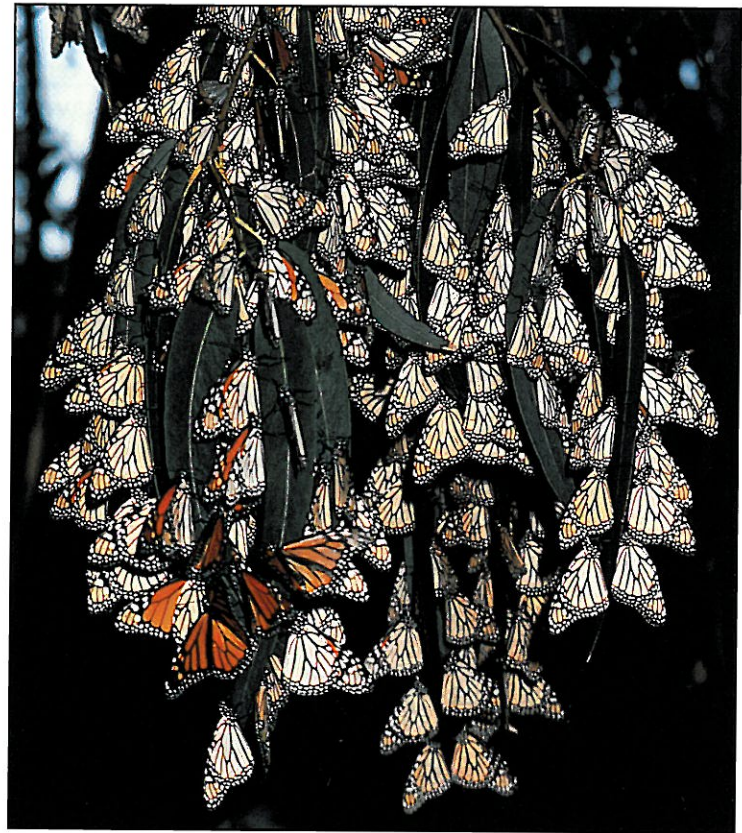
Monarchs generally overwinter in stands of Eucalyptus or Monterey pine, probably because those are predominant tree species along the California coast. The overwintering groves are often in a canyon or other drainage where butterflies have a source of water. There are other clues to look for in the topography that may tell why your grove is suitable for Monarchs. Sometimes the overwintering groves are in the lee of the prevailing winter wind, or you may notice a dense stand of trees that protects butterflies from gusty storm winds. You may also notice that the Monarchs move around the grove during the course of the winter. They may move to lower, more protected vegetation during a storm, and they may move in a kind of circular pattern around the grove as the sun rotates through the winter sky. Scientists believe that Monarchs seek more direct sunlight in mid-winter's cold, and avoid direct sunlight as the days begin to warm.

Scientists are now finding that overwintering habitats tend to have what they call "edge vegetation." This is a leafy border around a grove, which prevents the wind from sweeping through tree trunks. Edge vegetation may be low bushes around the border of the grove, or it can be smaller trees or tree



shoots. In Eucalyptus habitats, leafy Eucalyptus shoots are quite common around the border or on the lower trunks of border trees.

Your habitat may be one the Monarchs visit for just a few weeks or a couple of months. These are also important habitats—we call them autumnal roost sites. They generally host smaller populations of Monarchs in the fall and early winter, or they may serve an important role as feeding habitats, where Monarchs replenish their fat reserves before winter sets in. Researchers have also found that some sites are nectaring bivouacs. These areas may have a consistent flow of Monarchs in and out of the site, as butterflies nectar and return to their clusters elsewhere. All three kinds of habitats—overwintering habitat, autumnal roost site, and nectaring bivouac—play an important role in sustaining the Monarch migration.



*Monarch butterflies clustered on Eucalyptus trees in Natural Bridges State Park, Santa Cruz. Frans Lanting, Minden Pictures.*

## *Managing Monarch Habitat*

You can presume that each tree and each piece of vegetation in your habitat contributes in some way to its suitability for Monarchs. Removing or pruning trees or vegetation may alter the temperature and humidity in the grove and increase the roosting butterflies' exposure to direct sunlight, winds, and storms, making the habitat unsuitable for overwintering.

Scientists have an old adage that says the best management for a Monarch overwintering habitat is benign neglect: leave the sites alone and they will survive. This is a good general rule for individual landowners, unless disease strikes or storms knock down trees or break branches. The old adage isn't quite enough, however. Protected habitats change as they age. As older, taller trees lose their lower branches, the grove may slowly become more open and less suitable for Monarchs. Landowners must take a few steps to preserve and nurture their Monarch sites.

Here we recommend some easy ways to maintain and enhance your habitat, and simple monitoring tasks. Monitoring the habitat will give you information about the characteristics of your grove, and will help show why Monarchs overwinter there. Monitoring can also detect early problems, which is helpful for managing the habitat successfully over time.

The recommendations below are broadly applicable guidelines for all Monarch habitats, and cover a variety of the problems and conditions that commonly arise in Monarch habitat preservation. These recommendations are intended to guide landowners in protecting their habitats. "Resources" (page 16) is a list of knowledgeable people who can help landowners with site-specific management problems requiring a more detailed response.

**Do not spray or apply pesticides, herbicides, or insecticides.** It cannot be emphasized enough that these chemicals directly or indirectly harm the butterflies.

**Ask a Monarch biologist to look at your habitat before you prune, trim, or remove major vegetation from it.** (Again, the people listed under "Resources," page 16, are knowledgeable and have offered to help landowners.) Removing a tree limb or any major vegetation can harm the habitat. Landowners occasionally have to remove hazardous trees or new growth, particularly Eucalyptus, which becomes brittle with age and can be invasive. If you must remove vegetation, do so between March and September, when the butterflies are not clustering in your habitat.



**Allow downed trees and standing dead trees which are not hazardous to remain in the grove.** Cavity-nesting birds and other wildlife use standing dead trees. Rotting trees contribute to the growth of a layered understory, which enhances Monarch habitat.

**If the trees are thinning and not revegetating naturally, ask a Monarch scientist to help you decide how to replant the grove.** Vegetation may thin out as trees grow old. Replanting could sustain the habitat.

**When replanting a Monarch habitat, use a tree species compatible with those already present, even if it's non-native.** Although Monarch experts fully support planting native species, Monarch habitats are too threatened to risk losing one by replanting existing groves with different species, even native ones.

**Grasses and ground cover vegetation may be removed without consulting a Monarch scientist, provided they are replaced.** Grasses and ground cover contribute to microclimate and may reduce butterfly mortality. Consider using native plant species for replacement.

**Keep some of the bushy border around a grove intact.** When removing new growth to control Eucalyptus, don't leave the border of the habitat open by removing all new shoots and lower branches.

**Plant a butterfly garden with fall and winter nectar sources in and near the Monarch grove. Include native California milkweeds.** Fall nectar will attract the butterflies; winter nectar will sustain them as they deplete their fat reserves, and thus aid their survival through extreme weather. Milkweed imparts a toxic chemical to the Monarch caterpillar, which makes adult Monarchs unpalatable to birds. See "Common Questions" (page 13) for lists of nectar plants and recommended milkweed species to plant in California.

**Remove any non-vegetational debris that may be piled under the trees.** One Monarch habitat deteriorated when black culverts were stored under the clustering butterflies, capturing heat and raising the temperature in the grove. Vegetational debris, by contrast, is helpful to Monarch habitats.

**Protect streams near your habitat.** Allow mud to remain. Water the grass and ground vegetation. Habitats in Marin County commonly have problems with dehydration, so keep them moist enough to maintain healthy vegetation and to provide a water source for butterflies.





*Monarch adult emerging from its chrysalis.  
Frans Lanting, Minden Pictures.*

**If the soil under the Monarch habitat is heavily compacted, consider spreading mulch.** This will reduce erosion and help water penetrate to the tree roots more efficiently, keeping your trees healthier.

**Do not allow smoke to drift into Monarch habitats when the butterflies are clustering.** Nearby burning may allow prevailing winds to carry the smoke into overwintering clusters, which causes the butterflies to fall out of their clusters. If local park rangers plan a controlled burn near your Monarch habitat, request that it be done before the Monarchs arrive or after they leave. New homes constructed near habitats should not have wood-burning fireplaces.

### ***Using a Land Trust to Protect a Habitat***

Land trusts may provide landowners with the legal means to protect their Monarch habitat from development in perpetuity. With a "conservation easement," a landowner can legally restrict the type and amount of devel-

opment that may take place on the property. At the same time, landowners can retain ownership of the property, and can tailor their conservation easement to retain specific rights to their property. Conservation easements can also offer landowners various types of tax breaks. For example, a landowner may sell or donate the development rights over a Monarch habitat to a land trust, while retaining the rights to walk on the land, conduct scientific research, and maintain the vegetation. In return, the landowner may receive reductions in property or income taxes. Land trusts may also purchase land, or they can buy land for government agencies.

**Contact a land trust for help in devising a legal means of protecting the Monarch overwintering habitat in perpetuity.** Write conservation easements to protect the Monarchs as well as scenic and conservation values on the property.

**Establish an appropriate protected area, with varied vegetation and a wide buffer zone.** Monarch habitat includes trees the butterflies cluster on and sufficient surrounding vegetation to shelter the butterflies. When you're mapping out an area to protect with a conservation easement, include a wide buffer between the clustering butterflies and any tree or vegetation that requires pruning. This will ensure adequate wind protection. If you're considering an easement, it would be useful to wait a winter or two, to observe how the butterflies use the habitat and where they cluster at various times of winter.

### *Developing Near a Monarch Habitat*

California law requires landowners to file an environmental impact report before developing property near Monarch overwintering habitat. The Xerces Society has prepared a booklet which outlines the steps necessary to produce the report and describes useful mitigations. *Conservation and Management Guidelines for Preserving the Monarch Butterfly Migration and Monarch Overwintering Habitat in California* is available for \$15 from the Xerces Society (see page 2 for our address and telephone number) or from the Muir Woods National Monument (contact Mia Monroe, Resource Management Specialist, at 415-388-2596). General recommendations include:

**Be sure to evaluate the expertise of any Monarch biologist you are considering as a consultant.** Important considerations: An advanced degree



in biology with research experience on Monarch overwintering biology; quantitative research on Monarch biology and overwintering; and publication on Monarch butterflies in peer-reviewed scientific journals.

**Get Monarch survey information showing the location of overwintering sites in the area.** Legislation approved in 1987 mandated a survey of all Monarch overwintering habitats in California. The list and maps are available from the Natural Diversity Database, maintained by the California Department of Fish and Game. Call 916-324-3812 to order copies.

**When preparing an environmental impact report, plan to conduct the Monarch habitat study for one full overwintering season.** An overwintering season runs from October 1 through February 28. It is not possible to assess adequately the impacts of a proposed development on a Monarch habitat without delineating the boundaries of the habitat based on the locations of the Monarch clusters throughout the entire season.



*Monarchs sunning on a pine tree in Michoacan, Mexico. Frans Lanting, Minden Pictures.*



**To preserve the habitat in perpetuity, create a conservation easement.** Monarch habitats do survive near developments, and a conservation easement provides the legal structure for monitoring changes and managing the habitat.

### ***Volunteer Activities***

Monarch conservation in California has happened through the initiative of people and organizations who took on the task, did the research, and went to the hearings to speak out for Monarch conservation. Be bold!

**Help monitor butterfly sites or tag butterflies.** Contact Mia Monroe at Muir Woods National Monument, (415) 388-2596.

**Work to get Monarchs protected under the California Environmental Quality Act.** The biggest gap in Monarch habitat preservation is that no statewide law explicitly requires these habitats be protected.

**Lobby your local park rangers.** About half the protected Monarch habitats are on public land, and park rangers take seriously the comments of area residents. When your local park land use plan is revised, get information about Monarch habitats into it.

**Work for the adoption of a Coastal Commission policy to protect Monarch habitats.** Current Coastal Commission decisions have not protected Eucalyptus groves under the riparian zone policy.

**Lobby your county or city to amend its local coastal plan and general land use plan to protect Monarch habitat.** If your local government doesn't protect Monarchs explicitly, lobby for changes that do. For sample local ordinances, consult a copy of the *Conservation and Management Guidelines for Preserving the Monarch Butterfly Migration and Monarch Overwintering Habitat in California* (see page 10).

**Lobby your regional Fish and Game department, asking them to request your county or city to amend its local coastal plan and general land use plan to protect Monarch habitat.** Fish and Game personnel review environmental impact reports, and can urge local jurisdictions to protect habitats, even if those are not threatened or endangered species' habitats. Give your Fish and Game department information about Monarch habitats in your area.

**Promote fundraising activities that involve the business community, because in many areas this sector benefits financially from the presence of the Monarch overwintering habitats.** Programs such as "Adopt a Monarch Butterfly" or "Adopt a Tree" have been used effectively. Promote a Monarch month when the butterflies arrive, during which local businesses donate a percentage of their profits to benefit a local habitat.

### *Common Questions*

**How do the butterflies know how to return every year to the same overwintering sites?** Scientists theorize that the butterflies recognize suitable microclimates. They return to the same sites as long as the conditions of the grove ensure their survival through winter storms and cold.

**How can you tell the difference between a male and female butterfly?** Males have thinner black lines on their wings, and a small black scent spot on each hind wing. Females have thicker black lines, and no scent spots.

**What do butterflies die from during the winter?** Cold and predators (including birds, wasps, and mice). Monarchs caught on the ground overnight may freeze to death. Low vegetation is important because Monarchs that fall to the ground can climb grass or bushes to escape cold and predation.

**What legal protection exists for Monarch sites in California?** The California Department of Fish and Game and the California Coastal Commission have labeled Monarch sites "of special concern." The California legislature in 1987 recognized the Monarch's migration and winter aggregation as a natural resource and encouraged the protection of its winter habitat. However, except where local land use plans specifically protect Monarch habitat, the butterflies have little legal protection in California. Aggressive development, excessive tree trimming, poor or neglectful management, tree aging and disease, and overuse by visitors have already destroyed critical overwintering habitat for the butterfly, particularly on private lands, where more than 60 percent of the habitats are located.

**Which nectar plants do Monarchs like?** Fall-blooming natives: mule fat, coyote brush, and composites such as daisies, sunflowers, and thistles. Winter-blooming natives: willows. Fall blooming non-natives: English ivy. Winter-blooming non-natives: blue gum Eucalyptus (*Eucalyptus globulus*), German ivy, bottlebrush, and Pride of Madeira.



*Monarch caterpillar on milkweed plant.*  
*Frans Lanting, Minden Pictures.*

**Which milkweed species should I plant?** Milkweeds are all *Asclepias* species. We recommend *Asclepias fascicularis*, *Asclepias speciosa*, *Asclepias vestita*, *Asclepias eriocarpa*, and *Asclepias cordifolia*. *Vestita* and *eriocarpa* are the most toxic species, and therefore provide Monarchs with the most protection. *Fascicularis* is the most widespread native California milkweed.

### ***Suggested Ways to Study a Monarch Habitat***

These suggestions are based on what biologists do to understand Monarch habitat and its characteristics. Studies have shown that Monarch habitats have a certain microclimate, so scientists believe ongoing monitoring of those characteristics may reveal problems as they develop in a habitat.

**Measure the temperature inside and outside the Monarch habitat.** Hang a thermometer on a tree where the Monarchs cluster, about five feet off the ground. Make sure the thermometer is out of direct sunlight and that its base isn't touching the tree, so that you get a reading of the air tempera-



ture. Then compare the temperature with a thermometer closer to your home, in an open area but out of direct sunlight. You can get the best information with a high/low thermometer (made by Fisher or Taylor and available in most hardware stores) which automatically registers the high and low temperature for a 24-hour period. Because the thermometer must be manually reset, it is important to record the temperatures at the same time every day.

**Measure the rainfall inside and outside the Monarch habitat.** You can post one rain gauge on or near a Monarch tree, and another in an open area. Then compare daily, weekly, or monthly rainfall.

**Measure humidity inside and outside the Monarch habitat.** Take two small glass jars and make holes in the metal lids large enough to fit snugly around a standard lantern wick. Fill the jars to the top with water and insert a wick in each so that it touches the bottom of the jar and extends one inch beyond the top of the lid. Put one jar inside the habitat, attached to the tree near your thermometer. Put the other jar outside the habitat, near your other thermometer. Record how fast the water evaporates from each jar and compare to determine the difference in humidity between the air in the habitat and the air outside it.

**Measure the wind speed and direction.** This is done with an anemometer, which is a more expensive instrument than a thermometer or rain gauge. You need only one anemometer, which you can use to take wind measurements both inside and outside the habitat.

**Make a map of your Monarch habitat.** Show the shape of the grove, where the biggest trees are growing, and how many trees there are. Show where the other major vegetation is, indicating dense or sparse vegetation areas. Show where the butterflies cluster, and how they may move around the grove both through the course of the winter and in unusual weather, such as storms.

**Observe butterfly behavior and record it in a journal.** When do the butterflies arrive and when do they leave? When are they the most quiet, remaining in clusters, and when do they fly around a lot? What is the weather like during these times? Note when there are storms. Watch the butterflies, and get to know what conditions exist in the grove. You'll become an expert on your own Monarch habitat and what makes it successful.

## *Resources*

The individuals listed below are knowledgeable about Monarch butterflies and familiar with Monarch habitat in California. They have agreed to help answer questions you may have.

**Monarch biology and microclimate.** Dr. Lincoln Brower, Professor of Zoology, University of Florida, Gainesville, FL 32611, Fax: 904-392-3704.

**Monarch biology and how to take care of Monarch habitat.** Mia Monroe, Resource Management Specialist, Muir Woods National Monument, Mill Valley, CA 94941, 415-388-2596.

**Tagging and marking programs throughout California; statewide database; monthly newsletter for members.** David Marriott, The Monarch Program, P. O. Box 178671, San Diego, CA 92177, 619-944-7113.

**Habitat restoration, habitat preservation, and microclimatic studies.** Dr. Kingston Leong, Department of Biological Studies, California Polytechnic Institute, San Luis Obispo, CA 93407.

**Habitat management and protecting a habitat near a proposed development.** Walter Sakai, Santa Monica City College, 1900 Pico Boulevard, Santa Monica, CA 90405, 310-450-5150, extension 9702.



*Monarch butterfly photographed at Stinson Beach by Edward S. Ross.*