



United States Department of Agriculture

Conservation and Management of Monarch Butterflies: A Strategic Framework



Forest Service

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Monarch Migration Phenomenon	1
Tri-National Policy Changes	2
Migration and Breeding	2
Monarch Forage	3
<i>Sidebar: Monarch Butterflies of the Hiawatha’s Peninsula Point</i>	4
Monarch Population Statistics	5
Management Tools To Restore Monarch Habitat	6
Diseases and Parasites	7
Availability of Seeds and Plants Important to Monarch Butterflies	7
<i>Sidebar: Oak Woodland Restoration</i>	8
Research Needs and Initiatives	8
Habitat Management Needs	9
Public Outreach Needs	10
Engage	11
Citizen Science	11
Public and Private Partnerships	12
<i>Sidebar: Invasive Swallow-Wort Assessment and Control at Peninsula Point</i>	13
<i>Sidebar: Ouachita Mountains</i>	15
Management	17
Conservation Actions for Monarch Butterfly	17
<i>Sidebar: Management of Monarch Butterfly Overwintering Groves on the Los Padres National Forest</i>	18
The Way Forward	20



MONARCH MIGRATION PHENOMENON

Monarch butterflies (*Danaus plexippus* L.) are one of the most recognizable and charismatic insects of North America. Ranging across Canada, Mexico, and the United States, monarchs are especially noted for the long-distance, seasonal migrations they undertake each year from overwintering areas in the coastal California and Oyamel fir (*Abies religiosa*) forests of central Mexico to their northernmost range in southern Canada.

Like many other pollinators, monarch butterfly populations are facing serious declines. The amazing annual migrations through Mexico, the United States, and Canada capture the hearts and minds of communities along their path and bring countries together for the cause of monarch conservation. As autumn approaches and the availability of flowering plants becomes limited in northern areas, monarch butterflies leave the nectar-rich areas of native habitat they depend on during most of the year to seek areas for winter layovers. From inland mountains and meadows in the Western United States, monarch butterflies flock to critical forest habitat along coastal California, where they cling to the leaves of eucalyptus, Monterey pine, and other trees, and then to each other, forming long cascading tendrils of fluttering black and orange wings. Similarly, monarch butterflies from Eastern Canada and the Eastern United States migrate southward to high mountain forests in Mexico to spend the winter, clustering tightly on Oyamel fir tree trunks and branches. As spring approaches, monarch butterfly populations return

northbound to flower-rich areas in the Southern and Western United States, and three to four generations later, arrive at the northeastern limits of their range. Monarchs mate along their migration routes and lay eggs on milkweed plants across the Nation. Eye-catching yellow, black, and white caterpillars feeding on milkweed will morph inside a gold-flecked, lime-green chrysalis into a stunning orange, black, and white adult butterfly. The mysterious cycle of migration continues annually, with newly hatched monarchs instinctively knowing where to head for the next stage of the migration phenomenon. When fall arrives, the great-great-grandchildren of the original overwintering monarch butterflies embark on the migration route of their ancestors, finding the same forests to spend the winter in that their predecessors had found generations ago. How they consistently flock to the same locations during migration remains to this day one of science's unsolved mysteries.

Not long ago, accumulated masses of monarch butterflies on fir trees in Mexico were heavy enough to cause entire branches to break. For more than a decade, monarch butterfly numbers have been declining yearly and population estimates for 2014 are at record low levels—so low that scientists fear the migration phenomenon and monarch butterfly populations as a species are at heightened risk of extinction. Monarch butterflies need our intervention to continue to exist on the planet.



Tri-National Policy Changes

On February 19, 2014, the White House released the “Joint Statement by North American Leaders—21st Century North America: Building the Most Competitive and Dynamic Region in the World.” Under the section, “New Areas of Opportunity,” U.S. President Barack Obama, Canadian Prime Minister Stephen Harper, and Mexican President Enrique Peña Nieto issued the following statement:

We will continue to collaborate in the protection of our region’s biodiversity and to address other environmental challenges, such as wildlife trafficking and ecosystems at risk. Our governments will establish a working group to ensure the conservation of the Monarch butterfly, a species that symbolizes our association.

On June 20, 2014, the White House released a “Presidential Memorandum—Creating a Federal Strategy To Promote the Health of Honey Bees and Other Pollinators.” The memo’s introduction states the following:

The number of migrating Monarch butterflies sank to the lowest recorded population level in 2013-14 and there is imminent risk of failed migration.

Further,

Sec. 2 Mission and Function of the Task Force. Within 180 days of the date of this memorandum, the Task Force shall develop a National Pollinator Health Strategy (Strategy), which

shall include explicit goals, milestones and metrics to measure progress. The Strategy shall include the following components:

- (a) Pollinator Action Plan.
 - (iii) assessments of the status of native pollinators, including the Monarch butterfly...

A statement released by Bob Periciasepe, Deputy Administrator, Environmental Protection Agency, and Krysta Harden, Deputy Secretary, U.S. Department of Agriculture (USDA), emphasized that—

The memorandum also requires federal agencies to lead by example, taking specific measures to substantially expand pollinator habitat on federal lands and to build on federal efforts with public-private partnerships.

With this direction, the Forest Service, as an agency of USDA, issues this timely and critically needed document, *Conservation and Management of Monarch Butterflies: A Strategic Framework*. This framework will guide the Forest Service to effectively and efficiently use available resources and engage public and private partnerships in taking action for the conservation of the monarch butterfly.

Migration and Breeding

Two major populations of monarch butterflies occur in the United States. The eastern population generally occurs east of the Rocky Mountains. The western population is primarily located in California, with some outlier populations in Oregon, Nevada, and Arizona.



In the Western United States, annual migration patterns for monarch butterflies are related to areas where milkweed (*Asclepias* spp.) grows. Abundance of adult monarchs is driven by annual precipitation that supports late-season milkweeds suitable for caterpillars, and by suitable temperature regimes that allow for completion of the monarch life cycle.

Each spring, monarch butterflies of the eastern population migrate north from their overwintering sites in the States of Michoacán and México and lay eggs in northern parts of Mexico and southern Texas. Survival of the first generation is the most important. Adult monarch butterflies of the next generation fly farther north until they reach their breeding areas, which include the Central and Eastern United States and as far north as southern Canada. The Corn Belt in the Midwestern United States is the most important area for breeding.

During late summer and fall, monarch butterflies migrate back toward Mexico, primarily through a “central flyway” from southern Ontario, Canada, through Kansas, Missouri, Arkansas, and Oklahoma; then south through Texas and central Mexico. The fifth monarch generation of the year occurs in Texas, borne from adults that originated in northern breeding areas. Adults arriving on overwintering grounds in autumn are generations distant from those that originally left the same overwintering grounds the previous spring.

A nonmigratory population of monarch butterflies resides in southern Florida along the Gulf Coast. This resident population breeds continuously throughout the year on a tropical milkweed species, *Asclepias*

curassavica, which is a common introduced species often cultivated in gardens that survives through autumn.

Monarch Forage

Along their migration routes and on their summer ranges, monarch butterflies require two suites of plants: (1) host plants for monarch caterpillars, which are primarily milkweeds (*Asclepias* spp.) within the family Apocynaceae upon which adult monarchs lay eggs; and (2) nectar-producing flowering plants of many other species that provide food for adult butterflies. Having both host and nectar plants available from early spring to late fall and along migration corridors is critical to the survival of migrating pollinators.

Within the plant family Apocynaceae, several species of the invasive European species, *Vincetoxicum* (often taxonomically placed in *Cynanchum*), attract female monarch butterflies to oviposit, or lay eggs, on their stems and leaves. This leads to imminent starvation of emerging monarch caterpillars, because they are unable to survive on the foliage of this nonnative plant.

Important nectar sources during the fall migration include late-flowering genera of the plant family Asteraceae, including goldenrods (*Solidago* spp.), asters (*Symphyotrichum* spp. and *Eurybia* spp.), gayfeathers (*Liatris* spp.), and coneflowers (*Echinacea* spp.) in the north and frostweed (*Verbesina virginica*) in Texas. Cultivated alfalfa, clover, and sunflowers are also critical nectar sources for monarchs.

Changes in climate will impact the distribution and availability of plant species important to monarch populations. Increasingly threatened Oyamel fir



MONARCH BUTTERFLIES OF THE HIAWATHA'S PENINSULA POINT

In late summer and early autumn, one generation of monarch butterflies undergoes a mysterious transformation, pausing their development into mature adults. The butterflies become the generation that migrates up to 2,000 miles to their overwintering grounds in Mexico, where they will transform into adults the following spring.

When the monarch butterflies begin their southern journey, they rely on topographical features to navigate, such as the Great Lakes shoreline, and they congregate where the land juts into points. One point in particular, Peninsula Point, Michigan, has a large annual congregation of migrating monarch butterflies. Although never previously making a migratory trip, these great monarch butterflies somehow seem to know Peninsula Point affords them the shortest distance across the open waters of Little Bay de Noc and Green Bay to Wisconsin's Door Peninsula.

In the early 1990s, C.J. Meitner made an inquiry into the importance of the annual congregation of monarch butterflies at Peninsula Point in a study funded by Wildlife Unlimited of Delta County. This study concluded that Peninsula Point was a nursery and a migration gathering area for monarch butterflies. Peninsula Point has become a unique area to study two important aspects of the wondrous monarch butterfly's life history—reproduction and migration.

Volunteers from a wide variety of career backgrounds exclusively conduct studies. Together, they collect scientific data used by researchers at several universities across the Midwestern and Eastern United States. Despite the

remote nature of Peninsula Point, more than 65 individuals have volunteered since 1993. For periods of 12 years and up to 18 years, several hard-working, dedicated volunteers have been maintaining the research program and actively conducting monarch butterfly research.

Every week from June through September, a small group of volunteers walks random transects through two wildlife openings that are managed to provide suitable nectaring sources and milkweed for egg-laying monarch butterflies. Clipboards in hand, the volunteers count each milkweed plant along with the number of monarch eggs and caterpillars. The stage of the development of the caterpillars (instars) are counted and recorded. Weather data are also collected, which help researchers track local differences in climate over time. This data collection is a part of the Monarch Larval Monitoring Program (MLMP) that is based at the University of Minnesota. Data from Peninsula Point comprise one of the longest datasets in this program. Protocols developed at the site have been replicated across the United States at more than 1,025 other MLMP research sites.

As summer progresses into autumn and days turn to nights, monarch butterflies roost in the cedar trees along the shoreline. They become active as the morning sun warms and dries the dew from their wings. During this time, when the monarch butterflies are preparing for the start of their journey, volunteers run a mid-day census route to count the roosting monarch butterflies. If the roost numbers are high, before the butterflies depart on light



northerly breezes and follow a cool front, volunteers use a net to temporarily capture the butterflies. Volunteers gently apply a small adhesive sticker with a serial number on the hind wing of the butterfly. The volunteers record the serial number, date, and sex of the butterfly on a datasheet. If butterflies are recovered, the tag information aids researchers in understanding regional migration patterns, the effect of weather on migration, the successful arrival of migrants, and the routes that the butterflies use, and the information helps researchers estimate fall populations.

Tagging data are sent to Monarch Watch, a program under the direction of O.R. (Chip) Taylor at the University of Kansas. Throughout the entire time of the Monarch Watch program, more than 16,000 recoveries have been made. More than 21 tag recoveries have been made from monarch butterflies tagged at Peninsula Point and from locations as far away as 1,950 miles.

The butterflies' annual appearance also coincides with visits by hundreds of monarch butterfly fans from across the country to watch the butterflies gather in late summer and early fall. The best month is August, although migration continues throughout September when the peninsula's hardwoods begin to take on their fall colors.

forests of Mexico may vanish by the end of the century, which will necessitate intervention through assisted migration (managed relocation) of tree species to adapt their ranges to future climatic conditions. Assisted migration of plants may be required at the northern edge of the monarch's range, as well, to accommodate changes in the ranges of desired milkweed and other native flowering plants important to monarch survival.

Monarch Population Statistics

Annual surveys of the western monarch population overwintering on the California coast reveal a nearly 90-percent decline during the past decade. The eastern monarch population overwintering in Mexico was at an all-time high in the winter of 1996–97, and at an all-time low in the winter of 2013–14, which is represented by a 97-percent decline in occupied overwintering habitat. Approximately 70 percent of monarch butterflies that migrate to Mexico may be feeding on milkweed plants growing on agricultural land in the United States.

Because the population numbers of monarchs in the Midwest United States are positively correlated with counts of the subsequent overwintering population in Mexico, reduced overwintering populations are likely to be the result of the loss of milkweeds in the Midwest. Loss of milkweed is coincident with the increased use of glyphosate herbicide for transgenic glyphosate-resistant corn and soybean crops, otherwise known as "Round-Up Ready" plants. Degradation and elimination of habitat in Mexico and extreme weather events at overwintering sites have also been implicated as contributing factors to the decrease in monarch population size. Many scientists maintain that the loss of milkweed plants in the Midwest is due to the





adoption of genetically engineered, herbicide-resistant crops is paramount—rather than climate change or forest degradation in Mexico (Jepsen et al.).

Droughts in Texas may also have effects on monarch populations. High spring precipitation in Texas is associated with the largest annual population growth of monarchs in Ohio, suggesting that spring droughts in Texas likely have a negative impact on the important, first generation of monarch butterflies arising during northbound migration.

Management Tools To Restore Monarch Habitat

Roadside weed control practices can affect forage and breeding habitat for monarch butterflies. Poorly timed mowing can interfere with monarch breeding and egg-laying. Applying herbicides could remove milkweeds and other important native plants along the monarch migration route.

Prescribed fire has been shown to be an effective management tool for improving habitat for monarch butterflies and other pollinators. In the tallgrass prairies of Oklahoma, summer burning regenerates milkweed plants that are highly desired by southbound breeding adult monarchs, providing important late-season breeding opportunities for the generation en route to Mexico. In forest habitats, prescribed burning to maintain shortleaf pine savannahs in Arkansas has improved the abundance of nectar sources for monarch butterflies and threatened fritillary butterflies. Forested stands in eastern Texas and Arkansas that have been regularly burned to support endangered red-cockaded woodpeckers have improved forb abundance in the understory that supports nectar feeders,

including monarch butterflies. In the Western United States, burned patches and fuel breaks support greater butterfly diversity.

Grazing, another management tool used for restoring habitats such as grassland prairies, often is used in conjunction with prescribed fire treatments. The intensity of grazing affects butterfly abundance and diversity. In remnant prairie in Iowa, monarch butterflies have been found in higher densities in lightly grazed units compared with burned-only units and burned-plus-grazed units. Monarch butterflies in grasslands in Iowa and Missouri have been found in lower densities in excessively grazed-and-burned units, compared with burned-only units. The stocking rate of cattle on the landscape is a critical variable to consider when using grazing as a management tool for habitat restoration for butterflies.

Timber harvest also can be used as a tool to improve habitat conditions for monarch butterflies. Thinning dense forest stands creates canopy gaps and allows for more sunlight to reach the forest floor, stimulating growth of herbaceous vegetation that can serve as host and nectar sources for monarch butterflies. Regeneration harvest creates large openings of early successional habitat that can provide host and flowering plants for several years, until the regenerating forest shades out the herbaceous component. Restoration of savannahs and woodlands is an excellent tool for monarch conservation. Savannahs and woodlands are managed for fewer trees and more herbaceous vegetation, with trees widely scattered so they do not shade out the herbaceous component. All ground-based timber harvests require roads, skid trails, and log landings; and these areas are seeded with a monarch-friendly seed mix after harvesting is completed.



Diseases and Parasites

Monarch butterflies are susceptible to a variety of diseases caused by parasites and are preyed upon by parasitoids and general predators. The best studied monarch parasite is the specialist protozoan, *Ophryocystis elektroscirrha*, whose spores are found on the scales of monarch adults and are spread from adults to larvae. Parasite spores on monarch adults are deposited or scattered onto eggs and milkweed and then ingested by their larvae. The parasite can reduce larval survival, butterfly size, life span, mating success, and ability to fly. The prevalence of infection by *O. elektroscirrha* increases with monarch density at local scales and is negatively correlated to ability to migrate. Infection prevalence is highest in sedentary monarch populations, such as those in southern Florida, with about 70 percent of individuals being heavily infected. Infection with the protozoan decreases in migratory populations of monarchs, and approximately 30 percent of western monarch individuals and 8 percent of eastern monarch individuals are heavily infected. Other parasites that have been observed in wild and captive monarch populations include a nuclear polyhedrosis virus, *Pseudomonas* bacteria, microsporidian *Nosema* species, and horsehair worms in the phylum Nematomorpha. Parasitoid insects deposit their eggs in host individuals and the developing parasitoid larvae consume the host from the inside, killing the host. Parasitoids on monarch butterflies include flies and wasps that parasitize the monarch larvae. The parasitism rate from tachinid flies varies from 5 to 20 percent in localized monarch populations.

Pesticide and herbicide use reduces butterfly abundance and survival. In southern Florida, mosquito control activities were associated with declines of several

butterfly species. Recent work indicates that butterflies are more susceptible than honeybees to insecticides used for mosquito control; therefore, butterflies should be considered in insect testing of pesticides.

Availability of Seeds and Plants Important to Monarch Butterflies

Among the 70 to 76 species of milkweed native to the United States (depending on the taxonomy used), about 30 of them have been documented as monarch larval hosts. In North America, the total number of species is about 110, and at least 29 milkweed species occur within the critical habitat of the Central United States. The most widely used monarch host plant in the Northern United States and Southern Canada is the common milkweed, *Asclepias syriaca*. This species readily occupies disturbed areas and has expanded its range in the Central and Northeastern United States and Southeastern Canada due to conversion of grasslands and forests to agriculture. As many as 70 percent of the monarch butterflies that migrate to Mexico may have fed on milkweed growing on agricultural land in the Midwestern United States.

Of the 30 or so milkweed species known to host monarch larvae, only 19 species have known details on seed availability. Seeds are publicly available by the pound for only seven species, by the ounce for another five species, and in small packets (suitable for home gardens) for three more species.

In 2014, The Xerces Society for Invertebrate Conservation published a listing of the availability of regionally sourced seeds. In Western United States, availability ranges from very limited to limited for all areas except California. In the Central United States, seed



OAK WOODLAND RESTORATION

The staff of George Washington and Jefferson National Forests in Virginia and West Virginia work with a number of partners to restore and maintain habitat that is favorable to monarch butterflies. Using tools such as silvicultural, open lands, prescribed fire, and roadside management, habitat that is critical for this species is found at a landscape scale across the 1.8 million acres that the staff administers.

Open woodland communities, young forest habitat, grasslands, shrublands, and open wetland communities each provide unique habitat beneficial not only to monarch butterflies, but also to other rare and declining pollinators, such as the Appalachian grizzled skipper, diana fritillary, and frosted elfin.



supply is limited in the northern Great Plains, good in the southern Great Plains, and very good in the Great Lakes region and the Midwestern United States. In the Eastern United States, the mid-Atlantic region has good seed availability but the Northeastern United States seed supply is very limited.

Based on Bailey's (1995) ecoregions, Monarch Watch developed provisional seed zones in 2014 and currently has supplies of seeds available for five species of milkweed: *Asclepias incarnata*, *A. syriaca*, *A. tuberosa*, *A. viridis*, and *A. speciosa* in eight ecoregions. Of these ecoregions, five (221 [*A. incarnata*], 231 [*A. incarnata*, *A. syriaca*, *A. viridis*], 331 [*A. speciosa*], M331 [*A. speciosa*], and 342 [*A. speciosa*]) appear to encompass Forest Service-managed forests and grasslands.

Quality control in the transfer of seeds within and between different ecoregions is necessary to ensure that genetically appropriate, locally adapted native plant materials are available and used for restoration of habitat.

Research Needs and Initiatives

- Document status of U.S. milkweed species distribution and availability to support monarch larvae.
- Provide multiyear data for eastern and western monarch populations to generate dynamic models that combine adult movement patterns with population dynamics, climate, and changes in land use to more effectively identify areas for restoring habitat and to identify additional factors that may influence monarch population dynamics. The models should link migratory connectivity across the landscape with local population dynamics driven by climate and resource availability.



- Analyze patterns of abundance throughout the monarch annual migration cycle for both eastern and western monarch populations.
- Assess milkweed abundance and distribution on Forest Service-managed forests and grasslands.
- Conduct studies of farmland pesticide impacts on monarch larvae and adult butterflies (and other species of butterfly) in North America to add to existing research primarily from Europe.
- Conduct more definitive work on *Bacillus thuringiensis* effects on a larger suite of Lepidoptera, including monarch butterflies.
- Establish basic seed biology and seed handling protocols for all North American milkweeds; for example, minimum number of individuals needed to sustain milkweed populations, self-fertilization versus out-crossing, seed-cleaning techniques, germination requirements, collection guidelines, number of seeds per pound of seeds, appropriate short- and long-term seed storage conditions, and causes of poor seed setting in isolated milkweed populations.
- Conduct common garden studies for prolific and resilient milkweed species to assess adaptive traits.
- Identify and implement dynamic seed transfer guidelines suitable for current and predicted climate conditions.
- Provide milkweed (and other native flowering forbs) establishment techniques using seeds and seedlings in farm filter strips, riparian buffer zones, and highway and utility rights-of-way. Include information on optimal seedling type(s), seedling storage, optimum out-planting periods, weed control, and optimum regional species blends.
- Develop control techniques (integrated pest management, best management practices) for plant fungal diseases during nursery production and seed increase of milkweeds. Update the milkweed section of the Agriculture Handbook 165 published in 1960.
- Conduct more work on monarch egg/larvae vulnerability and biology of predators. Anecdotal observations in the Western United States suggest a high predation of eggs.
- Increase rhizome production/efficiency for out-planting and subsequent success of milkweed.
- Study the effects of prescribed burn seasonality and intensity on forb abundance and composition in a variety of forest/savannah/prairie ecosystems along the central flyway, the longleaf pine zone, and the Mid-Atlantic zone.
- Study the effects of prescribed burn block size on monarch habitat availability and suitability for both larvae and adults. Reduce forest stand densities to allow for development of herbaceous understory, which will include host and nectar plants.

Habitat Management Needs

- Reduce forest stand densities to allow for development of herbaceous understory, which includes host and nectar plants.
- Accelerate restoration of prairies, savannahs, and woodlands on appropriate sites.



- Develop local monarch-friendly seed mixes for restoration efforts, soil stabilization, wildlife openings, and other resource opportunities.
- Manage the landscape to provide host and nectar sources from spring to fall.
- Maximize benefits to monarch butterflies without compromising their safety by controlling the timing of mowing wildlife openings and roadsides (best mowing time is in late winter).
- Time prescribed burning so that it does not coincide with migration. This approach is extremely important in the Southern Region, where first-generation monarch butterflies migrate north and last-generation monarch butterflies migrate south into Mexico.
- Accelerate efforts to control nonnative invasive plant species to increase abundance and diversity of butterflies and native bees.
- Develop local milkweed seed production areas.
- Reduce the amount of grass mowed by establishing pollinator gardens at administrative and recreation sites. Ensure that interpretation signs are provided at these pollinator gardens for better public understanding.
- Describe potential use of milkweeds in informal and formal landscapes, especially within pollinator gardens and corridors.
- Develop and encourage use of locally adapted milkweed seed sources (and other native forbs) and discourage long-distance transfer of germplasm by entities seeking to distribute single-species milkweed nationwide.
- Engage and leverage technical expertise within the Forest Service (for example, National Center for Reforestation, Nursery, and Genetic Resources; National Agroforestry Center; National Seed Laboratory; State and Private Forestry).
- Work with tribal governments through the Intertribal Timber Council and Intertribal Nursery Council to promote out-planting and conservation of milkweeds.
- More effectively disseminate provisional seed transfer guidelines (i.e., easy to access and easy to use) for native plants in general and milkweeds in particular.
- Engage the public in monarch conservation through the Forest Service State and Private Forestry and Urban and Community Forestry programs. This approach is very important in the East, where less than 10 percent of the land base is in public ownership.
- Develop pollinator conservation exhibits to use in conservation education programs.

Public Outreach Needs

- Reduce public perception of milkweed as “weedy” by providing information about its benefits to pollinators.
- Describe better pasture management practices to avoid potential problems with livestock toxicity.



ENGAGE

Citizen Science

Numerous citizen-science opportunities currently exist within the United States and Mexico to track monarch migrations, establish status of overwintering sites, and monitor larval populations on milkweed. Successful citizen-science programs have protocols in place that may be standardized as universally recognized methods to monitor monarch populations. The Forest Service will contact the program leads to identify commonly used tools or will develop a new protocol that will be shared with monarch monitors in the public and private sectors.

National Efforts in the United States

- **MonarchNet** has been a centralized resource of monarch monitoring data from a number of butterfly- and monarch butterfly-focused citizen-science programs since 2009.
- **Monarch Watch** has implemented an internationally accepted tagging method that gives even untrained observers the opportunity to report encounters with marked monarch butterflies in any location they are found. The dataset currently has more than 1 million tagged monarch butterflies and more than 16,000 reported tag recoveries.
- **The Butterfly and Moth Information Network** hosts Butterflies and Moths of North America, or BAMONA, a Web site to provide general information about nearly 6,000 *Lepidoptera* species with high-quality photos and identification tools.
- **The North American Butterfly Association** hosts a butterfly count program for citizen scientists to collect data about any North American butterfly population.

- **Journey North** tracks certain migratory species, including monarch butterflies, to record seasonal and climate-related changes.
- **eButterfly** enables citizen scientists across North America to report butterfly sightings and upload and store their photos in a personal profile.
- **The Monarch Larva Monitoring Project**, since 1997, has used citizen scientists to track monarch eggs and larvae on milkweed across North America during the breeding season.
- **Project Monarch Health**, a collaborative study between citizen scientists and the University of Georgia, seeks to better understand *Ophryocystis elektroscirrha*, a microscopic protozoan parasite of monarch butterflies, more commonly known as OE.

Regional and Local Efforts in the United States

- **Peninsula Point Monitoring Project**, managed by the Forest Service, monitors monarch larvae and conducts migration counts at an important stop-over site on the northern shore of Lake Michigan.
- **Monarch Monitoring Project/Cape May Monitoring Project** records Atlantic coast migrations in the fall at locations in West Cape May and Cape May Point, NJ.
- **The Southwest Monarch Study** tracks migration and breeding patterns of monarch butterflies in the Southwestern United States, most notably Arizona, where both eastern and western migratory populations are seen.



- **Monarch Alert** focuses primarily on sampling and tagging overwintering clusters found in San Luis Obispo and Monterey Counties, CA.
- **The Western Monarch Thanksgiving Count**, which has been staged by The Xerces Society since 1997, observes and collects data on monarch butterflies overwintering along the California coast during the weeks of Thanksgiving and New Year.
- **The Illinois Butterfly Monitoring Network** is a citizen-science-based population monitoring program in Illinois.
- **The Ohio Butterfly Monitoring Program** of the Ohio Society of Lepidopterists focuses on long-term monitoring of butterfly populations in the State.

Public and Private Partnerships

Forest Service public and private partnerships are essential to successfully implement monarch butterfly habitat restoration and overall monarch conservation. Primary partnership with the Monarch Joint Venture (MJV) enables Federal and State agencies, nongovernment organizations, academic programs, and private industry to coordinate efforts that support collaborative monarch conservation initiatives associated with protecting and restoring monarch habitat and improving migration within the United States. MJV is an extensive collaboration that supports habitat; maintains and enhances monarch butterfly habitat; improves and restores areas; and provides improved access to and delivery of education, research, and monitoring activities.

Some current and traditional partners under the MJV include—

- National Forest Foundation.
- The Nature Conservancy.
- Private industry.
- Private citizens.
- Schools and universities.

Partnerships with national nonprofit organizations (e.g., the Pollinator Partnership) are important in helping to elevate collaborative conservation efforts in areas such as utility rights-of-way, monarch habitat development on corporate lands, and education initiatives related to the importance of host and nectar plants for monarch butterflies. These organizations facilitate mutually beneficial partner relationships that fulfill the needs of monarch butterflies, share valuable resources, and enhance partnerships.

Forest Service partnerships with longstanding collaborators, such as Prince William Network, National Project Learning Tree-GreenSchools!, National Science Teachers Association, North American Association of Environmental Educators, and the Ad Council's Discover the Forest Campaign, have been vital in interfacing with a broad public, from schoolchildren and their educators to community members who are interested in conservation and having the opportunity to take actions that help.

The Forest Service continues to enhance opportunities through innovative partnership agreements and partnership authorities that serve as models in supporting these types of fruitful collaborative efforts.



INVASIVE SWALLOW-WORT ASSESSMENT AND CONTROL AT PENINSULA POINT

According to a study on monarch butterfly oviposition on swallow-worts by Casagrande and Dacey (2007), female monarch butterflies will lay eggs on black swallow-wort even when it is in the same field as common milkweed. Laboratory tests have shown that monarch caterpillars cannot feed on black swallow-wort, which means that swallow-worts act as dead-end hosts and those monarch butterfly eggs are essentially wasted. As if that was not enough, black swallow-wort also comes with all the bad attributes and symptoms of most invasive species, such as reduction of biological diversity, crowding out native milkweeds, invading open grasslands, and allelopathy. All these effects hinder not only the monarch butterfly population, but they also affect the grass-nesting birds, insect diversity, and the overall ecological integrity of any environment in which black swallow-worts exist. Fortunately, this problem is being recognized and actions are beginning to take place.

The Central Upper Peninsula Cooperative Weed Management Area (CUPCWMA) has received funding this year from the Monarch Joint Venture, which will fund project efforts through 2016 to study treatment methods for black

swallow-wort at Peninsula Point in the western Hiawatha National Forest. The money will also fund additional surveying for possible unknown populations. Work associated with this project will be completed by staff from the Hiawatha National Forest and Superior Watershed Partnership, entities that are CUPCWMA partners. The treatments being tested will be the mechanical pulling of swallow-wort and the use of prescribed burns. The Forest Service is planning to establish test plots where the effectiveness of treatment methods can be monitored and analyzed for effectiveness.

After this treatment and subsequent monitoring process has been completed, CUPCWMA hopes to have a clear idea of what best management practices are most suitable for black swallow-wort control and to form a database on its locations along Peninsula Point. This project will be important in protecting a sensitive monarch butterfly breeding and research site at Peninsula Point and in providing a model for future control of these species in the crucial Corn Belt breeding range for eastern North American monarch butterflies.



New Areas of Opportunity

The future of successful monarch butterfly conservation lies in the ability to nurture current partnerships and to develop nontraditional partnerships that enable new perspectives, viewpoints, and opportunities to connect with nontraditional audiences. New nontraditional audiences and partners may have the capacity and capability to influence residents in their communities and create positive changes within them.

- Develop partnership programs with youth conservation leaders and engage these youth in partnership-driven efforts, which will allow for increased visibility and interest in future generations.
- Create connections with nontraditional stakeholders.
- Create more partner connections with health and wellness organizations and governmental agencies, because pollinator conservation is related to healthy foods and healthy living.
- Improve Spanish-language education and outreach materials to promote partnerships among Mexican communities that may have a direct tie to the monarch butterfly through its migration routes.
- Improve multilingual materials in partnership with nontraditional groups to reach broad and diverse audiences with information about the monarch conservation issues.
- Work with Forest Service International Programs to create stronger mutually beneficial partnerships between countries.

Expanding and Coordinating Existing Public Education Efforts

Existing efforts that could be expanded include the following.

- **Forest Service Celebrating Wildflowers Web pages.** “The Monarch Butterfly in North America” Web page contains detailed public education information and links to external online resources under several topics: biology, migration and overwintering, habitat needs, citizen science, conservation, things to do, teachers and students, and monarch resources (with 13 technical papers, 18 books, 6 field guides, and 16 publications oriented toward children). http://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/index.shtml.
- **MonarchLIVE.** The Forest Service Conservation Education and International Programs staffs, the Prince William Network, and multiple partners coordinate “MonarchLive—A Distance Learning Adventure.” MonarchLIVE is an online repository of education and informational resources, webinars, and live broadcasts around the theme of monarch butterflies. The project integrates distance-learning methods with hands-on activities to promote conservation and foster student-led research with 500,000 students in classrooms across Canada, Mexico, and the United States. <http://monarch.pwnet.org/>.
- **Online training course by MJV, Monarchs in the Classroom, and the Monarch Larva Monitoring Project.** The online training course teaches volunteers about natural history and monitoring.



This course can be broadly advertised to encourage additional volunteers and land managers to engage in active monitoring and conservation of monarch butterflies.

- **MJV-funded partnerships and factsheets.** Core funding for the MJV is provided by the Forest Service.
 - ◆ MJV-funded public education partnerships include—
 - Monarch Citizen Science Training and Outreach (University of Minnesota Monarch Lab).
 - Monarch Larva Monitoring Project Online Training (University of Minnesota Monarch Lab).
 - North American Butterfly Association Web site update.
 - Promoting Citizen Science Monitoring of Monarchs and Milkweed in Texas (Cibolo Nature Center).
 - Wild for Monarchs Campaign (Wild Ones, Native Plants, Natural Landscapes)
 - ◆ MJV factsheets include—
 - Milkweed Information Sheet.
 - Gardening for Monarchs.
 - Monarch Rearing Instructions.
 - Potential Risks of Growing Exotic Milkweeds for Monarchs.
 - Invasive Species Alert: Swallow-Wort.
 - Monarch Conservation Talking Points.
 - 2009–14 Summary of MJV Accomplishments.

OUACHITA MOUNTAINS

The shortleaf pine-bluestem ecosystem restoration project began in 1991. The purpose is to restore ecosystem function to this ecosystem in the Ouachita Mountains of Arkansas and Oklahoma. Management actions include prescribed burning, timber harvest, both thinning and regeneration, and mid-story reduction. Management actions are coordinated with a massive research effort involving the Forest Service Southern Research Station and numerous colleges and universities. This coordination enables the Ouachita National Forest to adapt its management actions based on sound science. The total project area is nearly 350,000 acres, with more than 100,000 acres already in a restored condition. In 2013, more than 54,000 acres were prescribed burned, 4,600 acres had basal areas reduced through thinning, 1,000 acres of shortleaf pine were regenerated, and more than 7,000 acres had mid-story removal. It takes multiple treatments to reach a restored condition. Some of the research has focused on monarch migration and nectar resources. Areas that are undergoing restoration activities support increased abundances of nectar resources and migrating monarch compared with areas with untreated control activities.



Coordination efforts that could be expanded include the following.

- **Existing partnerships.** The Forest Service will expand coordination with existing partnerships, such as Prince William Network, Project Learning Tree, National Science Teachers Association, National Association of Environmental Educators, and the Ad Council's Discover the Forest Campaign to update existing monarch butterfly education materials and identify the broadest audiences with which to share monarch conservation resources.
- **Internal staffs.** Internal coordination through an assigned Forest Service task force will be established among staffs in Rangelands Management and

Vegetation Ecology; Watershed, Fish, Wildlife, Air and Rare Plants (including the NatureWatch Program); Conservation Education; Recreation, Heritage, and Volunteer Resources (including interpretive services and volunteers); and the Office of Communications.

- **External groups.** The Monarch Conservation Specialist Group, founded by Monarch Watch, coordinates monarch ambassadors consisting of regional experts from across the United States. This group provides an invaluable educational resource for monarch conservation by giving local monarch presentations and advising citizens, land managers, and researchers and could be a key partner in disseminating current information.





MANAGEMENT

Conservation Actions for Monarch Butterfly

The Monarch Joint Venture is a partnership of Federal and State agencies, nongovernment organizations, and academic programs working together to support and coordinate efforts to protect monarch butterfly migration across the lower 48 United States. For several years, the Forest Service has generated MJV reports describing the Forest Service's accomplishments as a partner with the MJV. The Forest Service management actions that support monarch conservation include habitat restoration, maintenance, and enhancement; public education; research; and monitoring. In addition to providing milkweed host plants, one of the Forest Service's key objectives is to provide nectar sources across both regions, from spring through fall, to fuel monarchs during the migration. The following list summarizes some MJV activities within the Eastern and Southern Regions of the Forest Service.

- During fiscal year (FY) 2013, the Forest Service Southern Region improved nearly 1 million acres of habitat for pollinators, including the monarch butterfly. These restoration efforts included pre-commercial and commercial timber sales, prescribed burning, nonnative invasive species control, and planting. About 40 percent of this habitat is in good condition, either restored or nearly so, and is immediately available to pollinators. The remaining acres are at some stages of restoration: some suitable but not optimal for pollinators, and some were treated but are yet to be of use to pollinators. Considerable attention is being given to locally sourced seed and plants to best maintain the genetic integrity of the region's native plants.
- The Forest Service conducted several pollinator workshops in the Eastern Region, with Southern Region personnel also in attendance. More of these workshops are scheduled to be held in FY 2015—and beyond. A main focus of the workshops is the development of citizen-science opportunities and partnerships for work on behalf of the country's native pollinators, such as the monarch butterfly. <http://www.fs.fed.us/wildflowers/regions/eastern/index.php>.
- The Forest Service has developed three monarch butterfly brochures in cooperation with the Butterfly Conservation Initiative (Florida Museum of Natural History) for public outreach and education. These brochures are available at http://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/documents/MonarchButterfliesEasternUS.pdf.
- The Forest Service recently worked with the MJV to provide the Invasive Species Alert: black swallow-wort (*Cynanchum louisea*) and pale swallow-wort (*C. rossicum*). The MJV subsequently helped the Hiawatha National Forest control swallow-wort at the Peninsula Point Lighthouse (Michigan), which is an important and significant staging area for monarch migration.
- The Forest Service has monitored and tagged monarch butterflies at several key locations for decades. This information is shared with the monarch program at the University of Minnesota (Karen Oberhauser) and with Monarch Watch at the University of Kansas (Chip Taylor).



MANAGEMENT OF MONARCH BUTTERFLY OVERWINTERING GROVES ON THE LOS PADRES NATIONAL FOREST

Monarch butterflies have historically aggregated en masse in the fall and winter at numerous sites scattered along 620 miles of the California coast from northern Mendocino County to as far south as Baja California and Mexico. Most of the sites are within 2.37 kilometers (about 1.5 miles) from the Pacific Ocean, which moderates temperature fluctuations. Local topography and forest structure determine the microclimate within monarch butterfly overwintering habitat. Many groves exist in wind-sheltered areas, such as bays, coastal inlets, deep stream beds, ravines, drainages, or mountain valleys. In California, monarch butterflies have been known to cluster in groves that contain Monterey pine (*Pinus radiata*), blue gum eucalyptus (*Eucalyptus globulus*), red river gum eucalyptus (*E. camaldulensis*), Monterey cypress (*Cupressus macrocarpa*), coast redwood (*Sequoia sempervirens*), coast live oak (*Quercus agrifolia*), western sycamore (*Platanus racemosa*), willow (*Salix* spp.), and acacias (*Acacia* spp.).

Using funding from the Monarch Joint Venture in the winter of 2011–12, The Xerces Society (Xerces) surveyed the three known monarch butterfly overwintering sites on Los Padres National Forest and thoroughly searched for new sites at 15 potential locations. Xerces staff found one potential new

transient overwintering site on Los Padres National Forest. They completed full monarch butterfly counts and habitat assessments at the known sites and the newly discovered site on Forest Service lands.

In the winter of 2012–13, Xerces staff conducted a comprehensive site analysis at the largest known overwintering site on Los Padres National Forest, Plaskett Creek Campground. This site has been surveyed most years since the 1990s and has been monitored for a number of years by Monarch Alert out of the California Polytechnic State University. This site has historically had large numbers of monarch butterflies, with the highest count of 35,000 recorded in January 1998. Recent surveys show that Plaskett Creek Campground has hosted more than 1,000 monarch butterflies within the past 5 years.

Three monarch butterfly overwintering sites are known to exist on lands managed by Los Padres National Forest: Plaskett Creek Campground, Prewitt Creek, and Sycamore Canyon. In 2012, Xerces staff identified a fourth potential site known as the Cal Trans Grove. This site is potentially on shared land between the California Department of Transportation and the Forest Service, and ownership needs to be confirmed.



Plaskett Creek Campground is the largest site on Los Padres National Forest land and is currently 1 of the 45 largest sites in California. The southern half of the site functions as a campground, while the northern portion houses the Pacific Valley School, a K–12 school for children who live in the region.

Prewitt Creek and Sycamore Canyon are transient sites that monarch butterflies use as a temporary refuge in fall and early winter. Monarch butterflies may use these sites for only a portion of the season in years with normal weather conditions but may occupy this habitat throughout the fall and winter in years with milder weather. Monarch butterflies may also use these sites in the fall as stopovers on their way to different sites in southern California for the winter.

The Monterey Ranger District staff met with The Xerces Society staff and collaboratively established a conservation and management plan for the Plaskett Creek Campground site. The plan focuses on three separate groves within the Plaskett Creek Campground site complex: (1) the current overwintering grove directly south of the entrance of the campground between the driveway and California Highway 1, (2) a historic overwintering grove directly to the east of the campground, and (3) what is thought to be a transient or autumnal grove between the school and California Highway 1.

The plan provides a site description and site threats, and it describes management needs for each site. The goal is to manage the roost sites and overwintering monarch butterflies with minimum effect to the existing vegetation or camping resources.

- With more than 100 native plant and pollinator gardens, the Forest Service is now in an excellent position to provide outreach and education within these important topic areas. These gardens also provide the agency with much coveted locally native plant materials, seeds, or other propagules, which are needed for ecological restoration and rehabilitation. In concert with the gardens, the Forest Service also offers numerous posters, interpretative panels, signage, etc., related to the monarch butterfly and other pollinators. These materials have been tremendously important for public outreach and education regarding the needs and threats of native pollinators. <http://www.fs.fed.us/wildflowers/features/panels.shtml>.
- The Forest Service is actively attempting to add native milkweed seeds (*Asclepias* spp.) and other native plants useful to native pollinators to the various seed mixes that are used in different management efforts, such as along roadways, openings, meadows, log landings, landscaping at facilities, and much more. Detailed information regarding MJV-Forest Service Accomplishments is located at http://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/conservation/mjvaccomplishments.shtml.

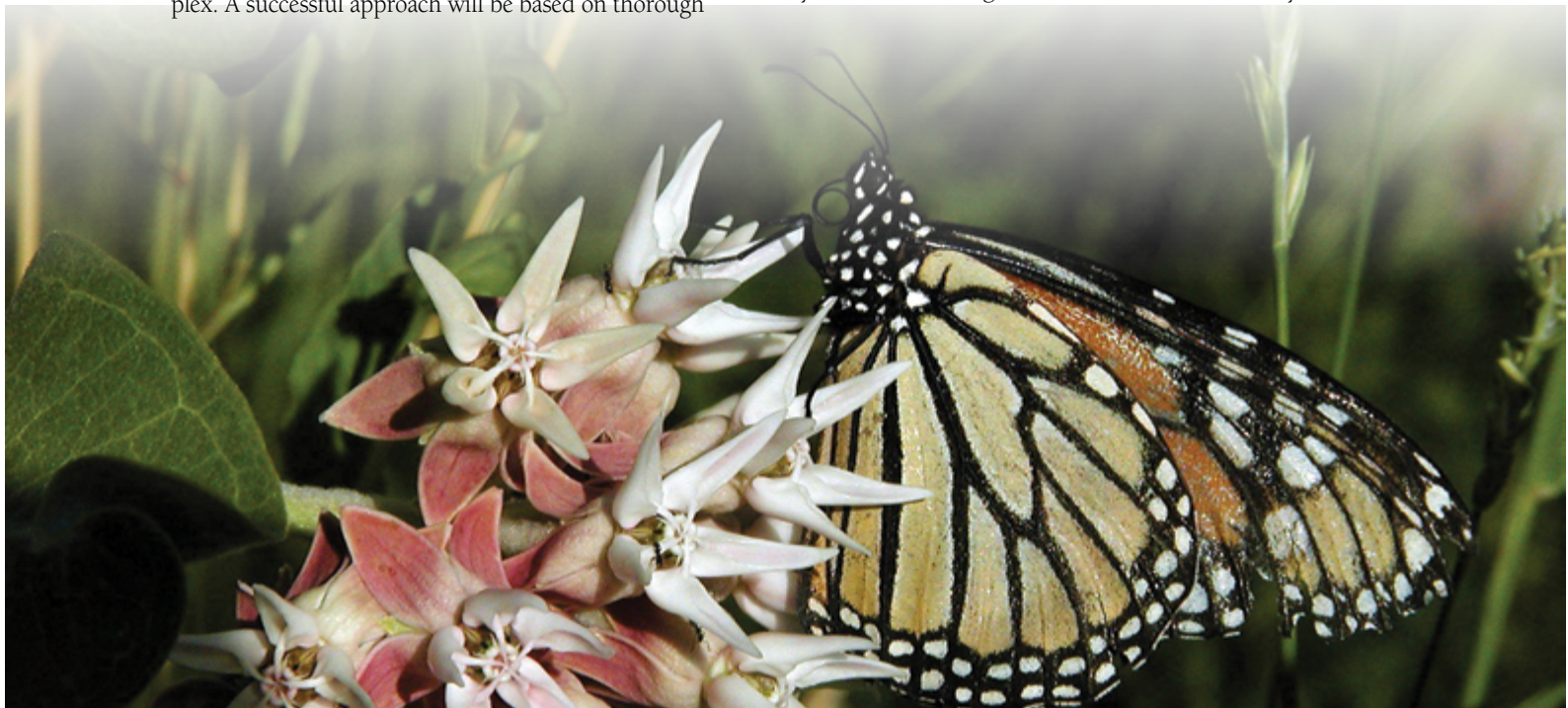


THE WAY FORWARD

Monarch butterflies and their annual long-distance migrations to overwintering sites in Mexico and California are among the most unique and spectacular biological phenomena in the world. The conservation and management of monarch butterflies is at a critical juncture. Overwintering numbers of monarch butterflies are at all-time lows in the Oyamel fir forests in Mexico and in the forests of coastal California. In February 2014, U.S. President Barack Obama, Canadian Prime Minister Stephen Harper, and Mexican President Enrique Peña Nieto committed their nations to ensuring the conservation of monarch butterflies. The implications for conserving and managing monarch butterflies for future generations are and will be profound and complex. A successful approach will be based on thorough

assessments, well-tailored policies, and land management actions, engaging a full range of partners and stakeholders across Canada, Mexico, and the United States in activities designed to adapt, mitigate, and educate for the conservation of monarch butterflies.

America's response to the conservation and management of monarch butterflies is inherently fraught with risk and uncertainty. The Forest Service will need to adapt its conservation and land management actions quickly and incorporate lessons learned into future agency direction. The agency is ready to collaborate with others, sharing its knowledge, skills, and experience to ensure that present and future generations will continue to experience and enjoy the wondrous lifecycle and annual migrations of the monarch butterfly.





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