

# Western Monarch Mystery Challenge

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Learn about western monarch butterflies and help fill the knowledge gap for conservationists.



The Western Monarch Mystery Challenge is a project led by Washington State University and Tufts University in collaboration with University of California, Santa Cruz and The Xerces Society for Invertebrate Conservation.

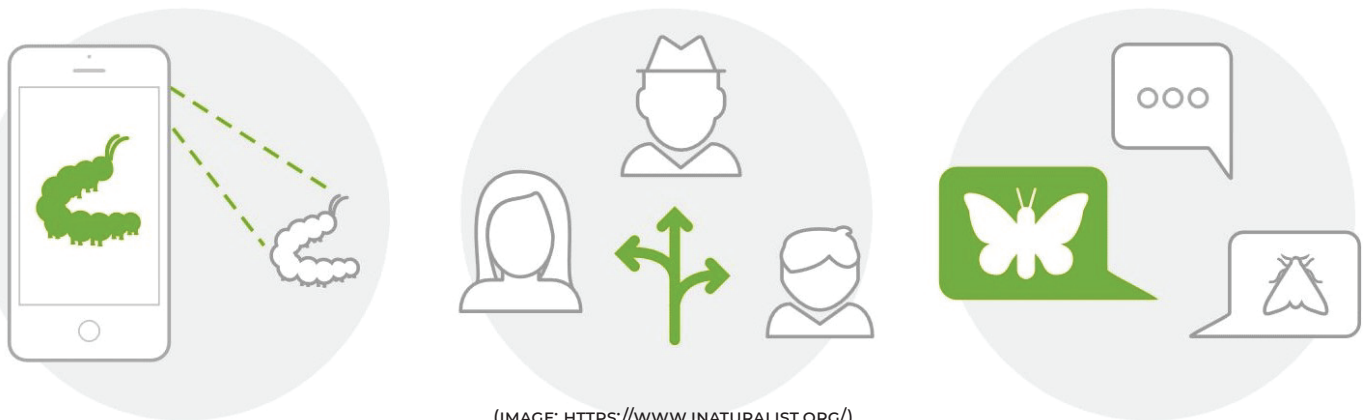
# The Western Monarch Mystery Challenge

## Become a Community Scientist and Help Save the Monarch Butterfly



There is a big mystery in California right now that has scientists stumped. California is home to a wide variety of wildlife, but few are more recognizable than the monarch butterfly. Unfortunately, the migratory population of western monarch is struggling and is now at risk of extinction having lost more than 99% of their population since the 1980s. Two scientists raising the alarm are Cheryl Schultz and Elizabeth Crone. “Scientists are a bit like detectives,” Schultz explains, “when we are confronted with a problem we need to be detectives to figure out what the underlying causes of the problem are.”

One of the problems, according to Schultz and Crone, is that there isn't enough information about western monarchs' environments between coastal overwintering sites and spring breeding grounds. To help gather this missing information Schultz and Crone's team have designed the Western Monarch Mystery Challenge project. This project asks the public to join in solving the mystery by collecting data about adult monarch butterflies. When the public helps professional scientists gather data it is called Community Science. Becoming a community scientist for the Western Monarch Mystery Challenge is easy. Just take a photo of an adult monarch butterfly (close up, long distance, blurry, it doesn't matter) and either upload it to [iNaturalist](https://www.inaturalist.org/) or email it to [monarchmystery@wsu.edu](mailto:monarchmystery@wsu.edu) along with the date and location. You can even win great prizes for participating!



Participating in the Western Monarch Mystery Challenge with [iNaturalist](https://www.inaturalist.org/) helps scientists around the world crowd source the vital data they need to solve critical scientific problems. To contribute, follow these simple steps:

- 1) Take a photo of any living organism, such as an adult monarch butterfly.**
- 2) Upload the photos to iNaturalist allowing users to create data from your observations.**
- 3) Add comments about your photo and talk to other users about their uploads or research.**

You can even join specialty projects, like the Western Monarch Milkweed Mapper Project, to help scientists with specific research needs.

The Milkweed Mapper Project gathers data about the western monarch and its habitat. Data is crowd sourced from the community and shared with researchers like Schultz and Crone. By becoming a community scientist, you can turn a curiosity about monarch butterflies into a fun and meaningful hobby. Every photo you email to [monarchmystery@wsu.edu](mailto:monarchmystery@wsu.edu) or upload to iNaturalist helps scientists find a solution to save monarchs.



# Know Your Butterflies:

## Identifying Western Monarch Butterflies

Before you head out to participate in the Western Monarch Mystery Challenge you should first learn more about monarch characteristics. Monarchs are highly iconic with their distinct large orange and black wings; but it is still easy to get them mixed up with other types of butterflies. The monarch's wings are lined in black with white and orange dots along the border of the wings. The inner part of the wing is veined, also in black, with bright shades of orange between the veins. But this description is not too far off from other butterflies who sometimes share the same habitat as the western migratory monarch.

At the right you will see five photos of butterflies whose pictures are regularly sent into the Western Monarch Mystery Challenge as a monarch spotting. One of the photos is indeed of a monarch butterfly, but four are not. **Can you tell the difference between these butterflies?**

The monarch butterfly is the fifth (bottom) photo. The other four (from top to bottom) are a Western Tiger Swallowtail, Gulf Fritillary, California Tortoiseshell, and a Painted Lady. Seeing all these butterflies together, it is easy to understand how they could be mistaken for one another. Don't let this stop you from submitting your photos through iNaturalist or directly to the Western Monarch Mystery Challenge team. All photos are valuable, and if you are not sure you captured an image of a monarch, it is always better to send the photo rather than miss out on contributing good data. **Plus, all photos of adult monarchs, submitted in April, within the Challenge area are eligible for a weekly prize.**

As you become more familiar with monarchs, take the time to recognize differences between the males and females. A male has a pair of black spots on its hindwings, while a female monarch butterfly has none. Another trait to look for is the behavior of a monarch when it lands on a milkweed plant. If the monarch curves its abdomen towards the milkweed, then this is a female trying to lay eggs.



WESTERN TIGER SWALLOWTAIL



GULF FRITILLARY



CALIFORNIA TORTOISESHELL



PAINTED LADY



MONARCH



Male



Female

Knowing how to identify monarch butterflies, and how to get your observations into the hands of scientists is very important. It means you have the power to become a community scientist and help solve the mystery of where monarchs go in the early spring.





## Butterflies: More Than Beautiful Wings

While monarch butterflies stand out because of their bright colors and distinct wing patterns, their anatomy is similar to other butterflies. The monarch has two sets of paired wings, like other butterflies. Look closely at the diagram below and you will notice the monarch has an upper wing called the forewing and a lower wing called the hindwing. Also, like other butterflies the monarch uses its proboscis to drink nectar from flowers. Butterflies can taste nectar with their proboscis, like we do with our tongue, but they also taste with their feet. Can you imagine if your tongue was on your feet? You might be more careful about where you stepped. Like all other butterflies, the monarch undergoes metamorphosis where it changes from a caterpillar to a chrysalis or a pupa, then to an adult butterfly.

## Fun Facts About Monarch Butterflies on the Fly

Migratory monarch butterflies are incredibly unique at their cellular level. Every year, thousands of migratory monarch butterflies leave the places they were caterpillars to migrate, sometimes thousands of miles away, to places they have never been before. Scientists are still unsure exactly how monarchs know to perform certain functions, like migrating, when their biology has made it clear that this behavior is not a learned trait. Here are other fun facts about monarchs on the fly during the migration season:

- Monarchs rely upon their compound eyes, antennae, proboscis, and legs for sensory information.
- When a monarch leaves the overwintering groves, it will be their great, great grandchild (up to six generations) that comes back the following fall.
- Every fall western monarchs fly up to 1,000 miles to the overwintering groves on the coast of California, from as far east as the Rocky Mountains, and as far north as British Colombia, Canada.
- Between March and November every year there will be between four to six generations of monarch butterflies.
- Monarchs overwintering on the California coast experience diapause, in which their biology is “paused” allowing them to survive for much longer.
- On average an adult monarch will live for one month after emerging from the chrysalis. However, migratory monarchs entering diapause can live up to 6 – 9 months.
- A female monarch can lay up to 500 eggs in her lifetime.
- On average a monarch will travel between 50-100 miles per day when migrating. However, the longest recorded migratory distance in a single day was 265 miles.
- Like bees, monarchs and other butterflies pollinate wildflowers and contribute to healthy ecosystems.

### Know Your Butterfly Lingo

**Biodiversity:** a mix or variety of plant and animal species.

**Habitat:** natural environment of an organism.

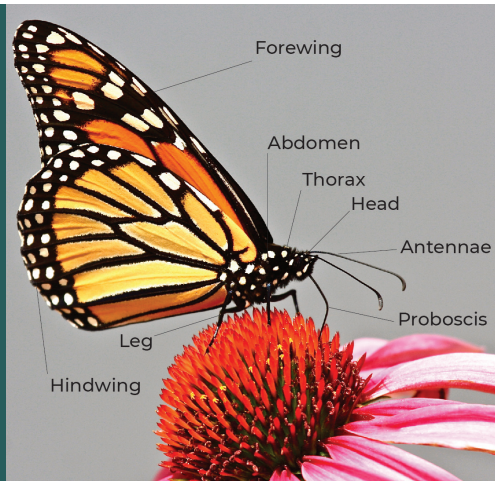
**Migration:** the act of going from one region to another.

**Migratory population:** the portion of an organism group (population) which moves from one region to another (migration).

**Overwintering site:** the location where an organism spends the winter.

**Pesticide:** a chemical used to kill plants, fungus, or animals considered pests.

**Diapause:** a hormonally controlled “pause” characterized by reduced activity; often occurring seasonally.



## Field Notes and Observations

Did you know that while doing research, scientists take pages and pages of notes? In the space below you can begin your own notes about the butterflies you see, their behaviors, and their habitats.

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

## Helping Western Migratory Monarch Butterflies From Your Own Backyard

There are many ways you can help monarchs:

1. Help other people learn about monarch butterflies. Use social media to share about your experiences helping save the monarch population. You can even contact your favorite public figures and ask them to lend their voice to protecting monarch butterflies.

2. Plant native milkweed and wildflowers in your yard or on your patio. If you are purchasing plants from a nursery, make sure the plants have not been treated with pesticides or chemicals.

3. Submit adult monarch butterfly photos through iNaturalist to help collect vital data for scientists and the Western Monarch Mystery Challenge.

### When helping monarchs you should avoid:

1. Don't use pesticides, or other harmful chemicals in your yard or on patio plants. These chemicals can also be found on nursery plants, so always ask before you buy.

2. Make sure the host and nectar plants you plant are local varieties. Tropical milkweed will not help the western monarch. Check your local nursery for native plant species and high nectar producing flowers.

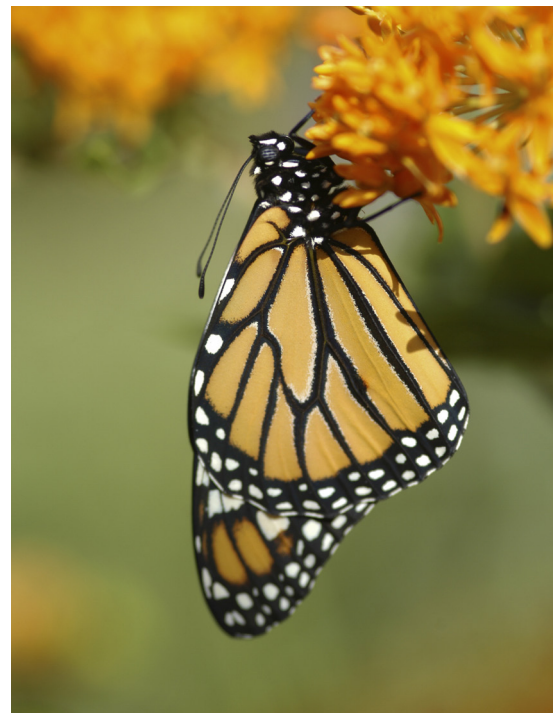
3. Captive rearing is not the solution for western monarch butterflies. It often leads to disease concerns, specifically a monarch-specific protozoan parasite known to monarch folks simply as “OE”.

# Western Monarch Butterflies:

## A Vulnerable Migratory Population in Decline

Two scientists raising the alarm about the rapidly declining western monarch population are Cheryl Schultz, a professor with the School of Biological Sciences at Washington State University and Elizabeth Crone, a professor of Biology at Tufts University. Schultz and Crone head a team of scientists working to solve the mystery around the migratory monarch population crash. To do this, they are calling on the public for help fill important knowledge gaps through crowd sourced data. The project headed up by Schultz and Crone's team, the Western Monarch Mystery Challenge, asks the public to become Community Scientists and assist in data gathering by taking pictures of monarch butterflies as they migrate to the summer breeding grounds. Participants can either upload images to [iNaturalist](https://www.inaturalist.org) or email photos (along with date and location) to [monarchmystery@wsu.edu](mailto:monarchmystery@wsu.edu).

The decline that scientists are raising the alarm about can be seen clearly in the numerical data. During the mid-1980s the migratory population of western monarch was 8-10 million butterflies. Scientists and the public noticed that monarchs were disappearing from coastal overwintering sites and started counting them in the late 1990s. These yearly counts are known as the Western Monarch Thanksgiving Count. Based on these counts, scientists voiced great concern as the population steadily dropped – to far less than 300,000 butterflies by 2017. Then at the Thanksgiving 2018 Count, the numbers came in at less than 30,000 butterflies – a number that indicates the migratory population has tipped below the threshold towards extinction. But the precise cause of this population crash is unknown to scientists. There is a lack of data for scientists to draw from in early spring, a time of year when monarchs are sparse in the landscape. This is why scientists, like Schultz and Crone, are calling on the public to help crowd source data to fill the current knowledge gap.



## Causes for Long-Term Population Decline vs. Rapid Crash



Schultz, Crone, and other scientists studying the decline of western monarchs have identified 4 main causes for the steady population decline over the last 50 years: loss of overwintering habitat, loss of breeding habitat, increased use of pesticides (particularly glyphosate and neonicotinoid insecticides), and climate change. Their research shows that populations are most sensitive to environmental conditions during early spring. This is the time after monarch butterflies have left overwintering sites on the California coast and before they are seen breeding in the Central Valley and Sierra Mountains. But scientists don't know where monarch butterflies are during this critical time of year, or what resources they need in spring

to help populations grow. It's a real mystery. To help address gaps in knowledge, Schultz and Crone are looking to the public, especially the California community, for help.

"Scientists simply need more information about western monarchs' environments between coastal overwintering sites and spring breeding grounds," Schultz explains, "especially in sparsely populated regions in early spring." Schultz and Crone's team think crowd sourced data could be key to solving the mystery of western monarch population crash. They hope, through the Western Monarch Mystery Challenge, that thousands of people will send in photos that will be used to construct the needed data.



### Challenge Map

A gap of knowledge exists during migratory western monarch's journey from coastal wintering sites to breeding sites



Early Spring  
Monarch Mystery Challenge

Summer  
Breeding Habitat

Overwintering Groves

Direction of Spring Migration

Not part of the challenge

## Community Scientists, the Key to Recovery?

With crowd sourced data being used for everything from mapping apps to your favorite streaming service, it is not surprising that scientists are looking to crowd sourced data. Often, scientists run into a problem collecting data from sparsely populated areas, or difficult to reach locations; not to mention the time they need to spend in their labs or teaching at universities. The problem is that when field research needs to be done, like necessary field observations along the migration route of the western monarch, data can be difficult to obtain. This creates knowledge gaps that require scientists to get creative in finding solutions. For this reason, scientists like Schultz and Crone are calling on the public to help crowd source the field data required to solve the mystery behind the monarch population crash.

Recognizing that “breeding and migrating habitats are only a few of the gaps in our knowledge of western monarchs,” Schultz explains that her team “especially

needs observations of monarch biology in places where human populations are low, like the Great Basin Desert, and at times of year when monarch butterflies are sparse, such as early spring in western California, just as they leave the overwintering grounds.” Many in the science community believe the best way to obtain these critical observations is by crowd sourcing the data.

Scientists know the butterflies spend winter months (November to February) in groves along the California coast, and start breeding in central California in May. However, observations of the western monarch population in March and April have been lacking in recent years. Schultz and Crone’s team, through their project the Western Monarch Mystery Challenge, are calling on the public to act as Community Scientists by participating in research then pooling their collected data. The team urges “volunteers across the West to collect monarch observations, especially in the early spring (February–April), the period in which monarchs typically leave the overwintering sites.” By taking photos of monarchs and submitting them to the Challenge with date and location, individuals can become community scientists and play a very active role ongoing scientific research.

With the public acting as field researchers, those studying monarch biology hope to solve the mystery of where western monarchs are in early spring. This information will help the development of conservation actions for the western monarch population during a time of year when their numbers are lowest, and the butterflies are most vulnerable.

Participation in the Western Monarch Mystery Challenge is simple. 1) If you see a monarch outside the overwintering groves along the coast of California, take a picture. It’s okay if the photo is blurry or far away. Scientists suspect monarchs spend the spring somewhere between the coast and the Central Valley, but your data can help confirm this or develop a new hypothesis. The Challenge focuses on the region with a migratory population of western monarch; this does not include the resident monarch population found in Southern California. 2) Report your observations. To make sure your data are received upload it to the free [iNaturalist](#) app/website or email the photos to [monarchmystery@wsu.edu](mailto:monarchmystery@wsu.edu) along with the species, date, and location of your photo. It is that simple. The Western Monarch Mystery Challenge is even awarding a weekly prize through Earth Day, April 22nd, and all it takes is submission of your observations to be eligible.



(PHOTO: CHERYL SCHULTZ)

# Migration: It's All About Biology

Monarch biology is extraordinary. Once a monarch emerges from the chrysalis, a monarch in the spring and summer will have a life span of only about a month but during the fall and winter might live up to 9 months. The map below illustrates the migratory patterns for both western and eastern migratory monarch populations; but we are only going to discuss the western migratory monarch (the left side of the map).

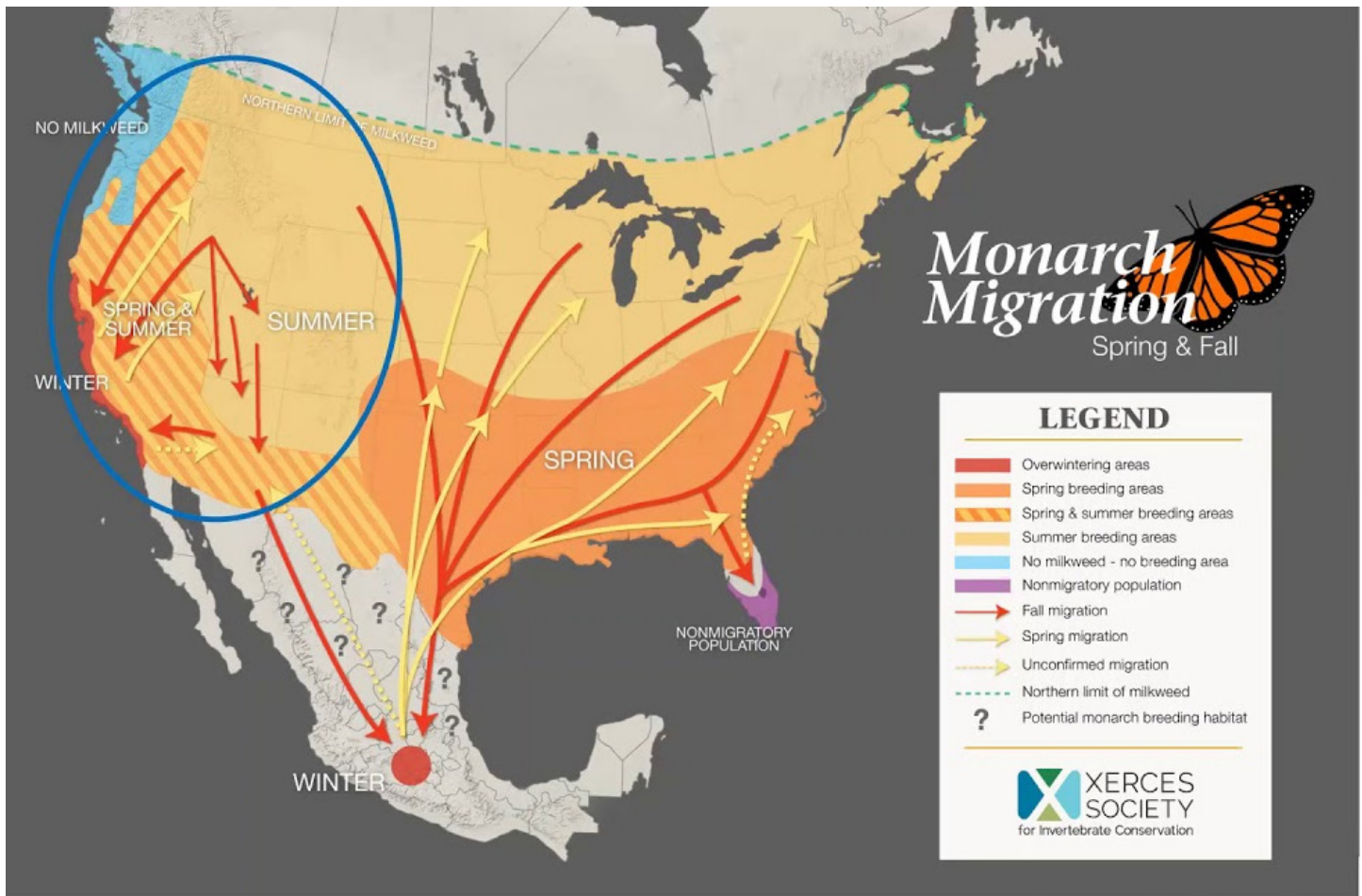
In March the western monarch population begins the migration east toward the spring and summer breeding grounds, returning to the overwintering groves along California's central coast in the fall. But it will not be the same butterflies making the return migration.

When a monarch leaves the overwintering grounds they head east, mating and laying eggs along the way. Some female monarchs may have mated in the overwintering groves but will not lay eggs until they find a milkweed plant along the migratory route. These eggs will hatch within 3-5 days of being laid and spend the next 10-14 days as caterpillars eating nothing but milkweed plants.

Once ready, like all other butterflies, monarch caterpillars shed their skin [exoskeleton], become

a chrysalis, undergo metamorphosis and emerge a few weeks later as an adult monarch. This new generation of monarchs now continues the migratory cycle heading east to the summer breeding grounds. However, some of them will stay where they are and continue breeding, until it is time to migrate back to the California coast for overwintering. Monarchs will continue to breed for multiple generations along the migratory route to the summer breeding grounds (as far north as British Columbia, Canada and as far east as the Rocky Mountains).

By the time a migrating monarch population reaches the summer breeding grounds, its members are the grandchildren, or great grandchildren, of those butterflies who left the overwintering groves in March. In the fall, the migration reverses, and the population returns to the central coast, but these butterflies are migrating for the first time. No monarch makes the migration more than once; it is part of their biology, a combination of genetic and environmental factors, that makes them continue the journey started by ancestors potentially six generations back. Thus, a 1000+ mile journey requires many generations to complete.





# Monarch Habitat: A Vital Balance

One of the leading causes of western monarch population crash is habitat loss in breeding, migratory and overwintering habitats. This loss is critical in understanding the population crash because monarchs require a mix of host and nectar plants within their breeding and migratory habitats and coastal groves in the winter.

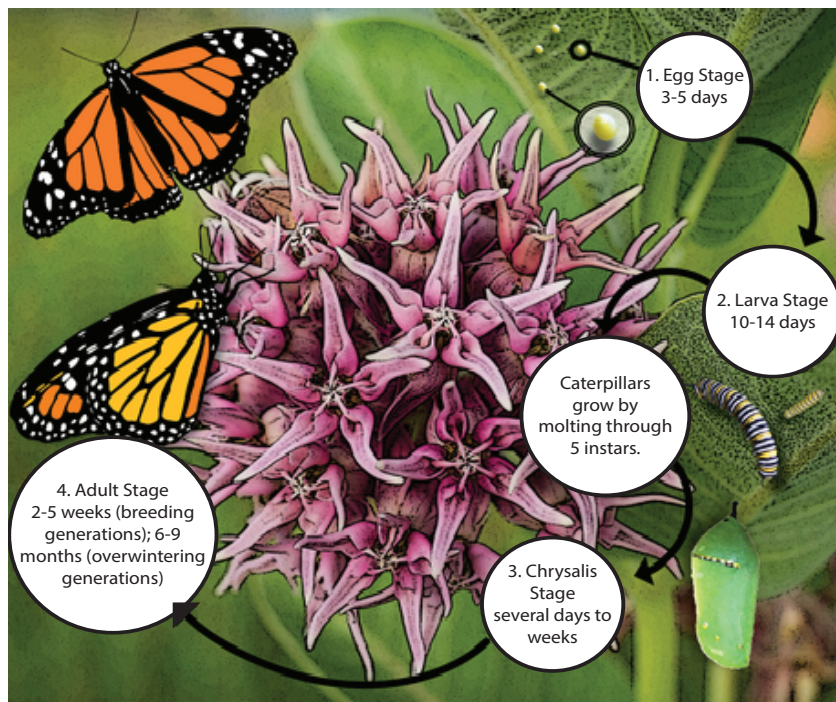
A host plant is a plant which caterpillars eat while a nectar plant provides the sugar-rich liquid diet required by the adult. Monarch caterpillars will only eat milkweed. For this reason, milkweed is the only host plant a monarch will use in the spring and summer when laying eggs. But without nectar plants such as wildflowers (the key sustenance for egg laying, flying, and winter survival), adult monarchs are unable to thrive.

Monarchs are also particular about their overwintering environments. During the winter, biologists have observed that the monarch shelters in coastal groves. These groves include eucalyptus trees as well as trees native to California like Monterey Cypress and Monterey Pine. Here monarchs regularly gather in the hundreds; decades ago, they gathered by the thousands. These groves also require a nectar-rich supply of wildflowers to support monarchs during the diapause.

For these reasons it is important for conservation and recovery efforts to focus on monarch habitats. Without immediate efforts to increase vital elements in monarch habitats, along migratory routes, and to stop the loss of breeding and overwintering sites, recovery for the western migratory monarch is uncertain.



## Monarch Life Cycle Sheds Light on Importance of Habitat



(IMAGE: MICHELE BLACKBURN, XERCES SOCIETY)

During the life of a western monarch, breeding butterflies need access to a variety of plants throughout the year. During the spring and summer host (milkweed) and nectar (wildflowers) plants are key for breeding. Nectar plants are important in early spring and late summer while migrating across the western US; and sheltering groves along the California coast are vital in the winter.

Each year, these unique butterflies have four to six breeding generations; meaning that a monarch at a wintering site this year might be the great, great grandmother of a monarch in the wintering site next year. If monarchs are unable to find suitable plants at each key stage of their life cycle, the population will decline.

Monarch butterflies have been declining since the 1980's. However, an abrupt crash in 2018 led scientists to suspect that the monarch is running into trouble during

the spring migration from coastal wintering groves to milkweed habitats west of the Rocky Mountains. Unfortunately, this period in the monarch life cycle is the least documented stage. Thus, scientists are not sure what factors most contributed to the population crash.

Because the migratory region is sparsely populated, scientists are hoping, through the Western Monarch Mystery Challenge, to crowd source the needed data. The more people who respond, the more observations will be gathered, and the more likely it will be that scientists discover the cause of the population crash in spring 2018.



# The Long Road to Recovery:

## Protect, Manage, and Restore Monarch Habitats

Despite the western monarch teetering near the quasi-extinction level, the population has the potential to rebound. Scientists studying the mystery of population crash suggest five courses of action: 1) protect, enhance, and manage overwintering habitat, 2) Restore breeding and migratory habitat in California, 3) protect monarchs and their habitat from pesticides; 4) identify, protect, and enhance summer breeding habitats throughout the West, and 5) prioritize research efforts to develop an effective and efficient recovery. Additionally, scientists have identified two crucial steps at the state and federal levels that would help conservation and recovery efforts. First, monarch habitat must be “designated as Environmentally Sensitive Habitat Areas (ESHAs) by the California Coastal Commission.” Second monarchs need to be “listed under the federal Endangered Species Act” so they can be formally protected by California Department of Fish and Wildlife.



The good news is that elected officials at both the state and federal levels are starting to listen. California is already taking steps to help protect the monarch population, by passing CA AS 2421, the Monarch Butterfly and Pollinator Rescue Program which allocated \$3 million for a recovery program. In Washington D.C., H.R. 5920, the bipartisan Monarch Action, Recovery, and Conservation of Habitat (MONARCH) Act was introduced during a late February 2020 session: simultaneously with a companion Senate bill.

Representative Jimmy Panetta of California's 20th District introduced the bill in the House and the bill is co-sponsored by representatives from across the country. “As the western monarch butterfly comes closer and closer to extinction, we don't just risk losing these beautiful creatures—we also face an increasing threat to American agriculture and our food supply,” said Senator Jeff Merkley of Oregon who introduced the companion bill in the Senate. While these efforts move recovery in the right direction, scientists stress that only immediate action will save the monarch.

## Helping Western Migratory Monarch Butterflies In Your Own Community

**There are many things people can do to help; here are just a few suggestions:**

1. Become an advocate. Contact your state and federal elected representatives and ask them to support conservation and recovery efforts like the MONARCH Act. Encourage others to do the same by sharing your experiences on social media.

2. Plant native milkweed and wildflowers to provide new resources for migrating and breeding butterflies. Beware - some nurseries use pesticides, so make sure to ask before you purchase plants.

3. Join iNaturalist and participate in the Monarch Mystery Challenge as a community scientist and help collect vital data.

**When supporting conservation, there are also a few things to avoid:**

1. Don't use pesticides, especially glyphosate and neonicotinoids. These chemicals can also be found on nursery plants, so always ask before you buy plants.

2. Make sure the host and nectar plants you plant in your garden are local varieties. Tropical milkweed, while beautiful, will not help the western monarch. Check with your local nursery about native varieties.

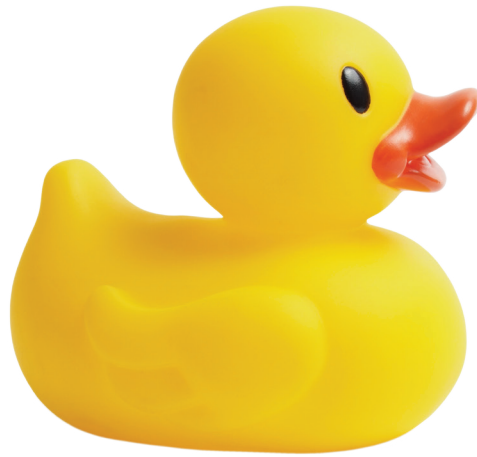
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# Rubber Duck Lab




**a nonprofit education-innovation organization**

This PDF was written and designed by Rubber Duck Lab, a nonprofit organization promoting equitable access to project-based learning, 21st century skill development, and new technologies through active exploration, collaboration, and creativity; online, in the classroom, and within the community.

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For more information on the Western Monarch Mystery Challenge, visit:

 [@MonarchMystery](https://www.facebook.com/MonarchMystery)  
 [@WesternMonarchMystery](https://www.instagram.com/WesternMonarchMystery)  
 [@WMonarchMystery](https://twitter.com/WMonarchMystery)

<https://labs.wsu.edu/conservation-biology/western-monarch-mystery-challenge/>

For more information on the western monarch, visit:

<https://xerces.org/western-monarch-call-to-action>

<https://www.westernmonarchcount.org>

<https://www.monarchmilkweedmapper.org>

For more information on monarch conservation across North America, visit:

<https://monarchjointventure.org>