



# Monarch Mania!

*Illinois Department of Natural Resources*

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# Life Cycle



The monarch's (*Danaus plexippus*) life cycle has four stages: egg; larva; pupa; adult. This type of life cycle is known as complete metamorphosis.

Metamorphosis means "change of form," and this insect undergoes some major changes of form in its life. The female monarch lays eggs on milkweed plants. Often the eggs are placed on the bottom of a milkweed leaf, but they can be placed anywhere on the plant. Each egg is white, ridged and has a point at the top. Eggs hatch within a few days into the larval, or caterpillar, stage. The air temperature helps to determine how quickly the eggs hatch.

Generally, it takes three to five days, but colder temperatures will slow development. The newly hatched larva eats the egg shell first, then "hairs" on the milkweed leaf and then the leaves of the plant.

The larva is cylindrical and soft-bodied. This stage lasts 10-14 days during which the larva eats nearly continually and grows tremendously. It has a hardened head with chewing mouthparts and well-developed maxillary palpi to aid in handling food. The larva also has spinnerets for releasing silk. The larva undergoes several molts before it pupates. "Molting" means to shed the skin. The caterpillar's body grows, but its cuticle (outside covering) does not. It must shed the old cuticle to be able to continue to increase in size. Stages between molts are called instars. Monarch larvae go through five instars before pupating.

In the pupal stage, the internal tissues are restructuring to form the adult. It takes about nine to 14 days for this transformation to occur. When the adult is preparing to emerge, the pupa turns dark, and the wings can be seen. At the end of this stage, the pupal skin splits apart, and the soft, newly formed adult pulls out. Emergence usually occurs in the morning. It takes several hours before the adult is capable of flying.

Monarchs in Illinois often produce three broods in summer. The last one is the migratory form of this insect. It is structurally different than the monarchs produced in the earlier spring and summer broods. During September and October these monarchs from the last brood of summer start their migration from Illinois to the overwintering grounds of specific, high-altitude forests in Mexico. In spring, these monarchs start the return trip to Illinois. They mate and deposit eggs, traveling as milkweed plants develop along the route, then die after two to six weeks. Their offspring usually start reaching Illinois in April. The generations produced in spring and early summer are not migratory.

# Monarchs and Milkweeds



A close relationship exists between monarchs (*Danaus plexippus*) and milkweed plants. Monarch larvae only eat milkweed plants of the genera *Asclepias* and *Ampelamus*. If there is no milkweed, there will be no monarchs. Female monarchs usually lay their eggs only on milkweed plants. They find milkweeds by using visual and chemical cues.

What are milkweeds? They are perennial, herbaceous plants. Most have leaves that are paired on the stem or in whorls of four on the stem. Their sap is white and milky. Milkweed plants contain cardiac glycosides. These chemicals are poisonous and affect birds and mammals. Many grazing mammals will not eat milkweeds. The toxicity of milkweeds varies by species, though, and tends to be greater in milkweeds in the southern United States. A few animal species have adapted to milkweeds and thrive on them. Monarch larvae can eat nothing else. The poisons accumulate in the body of the larval monarchs and are retained by the monarch in its transformation to the adult. They make monarchs unpalatable to many predators.

Flowers develop in an umbel at the stem tip. An umbel has a central point from which a group of flowers all develop. Color varies with the species, but milkweeds can be found with white, pink, red, orange, green and purple-pink flowers. The flowers are sometimes described as having an hourglass shape. Each flower has five petals and five sepals that bend downward. A five-parted cup supports five small horns and hoods. The hoods contain nectar and are arranged around the central flower column. The flower column has slits in it. Inside each slit is an opening where pollen must be delivered to fertilize the egg. Also, in each slit is the pollinarium that contains the pollen in packets.

# Monarchs and Milkweeds - continued




When an insect lands on the flower to drink nectar, its leg, antennae or bristles can slip into the slit where the pollen is stored. The pollen-containing structure clips onto the insect part. When the insect pulls away from the flower, this pollen packet goes, too. At another flower, the same insect body part may slip inside another slit in the flower column where the pollen needs to be delivered. If so, that flower is pollinated. Milkweed flowers are unique in this method of pollen transfer. The fruit that develops from the flower is a pod that contains seeds attached to floss. These seeds are easily dispersed by wind.


Twenty-four species of milkweeds grow naturally in Illinois. One of those species is not native to the state. Five species are listed as endangered in Illinois, and one of the five is listed as threatened on the federal endangered and threatened species list.


Milkweeds grow in a variety of habitats. Some of them prefer wet soil. Some of them prefer dry soil. Some of them flourish along roads or in fields. Others grow in open woods or thickets.


# Monarch Facts





 The monarch (*Danaus plexippus*) was chosen in 1975 to be Illinois' State Insect. Six other states named the monarch as their State Insect, too.


 Monarchs are found in North America but also in Australia, New Zealand, Hawaii and other Pacific islands.


 Monarchs can be found statewide in weedy areas, prairies, roadsides, pastures and marshes.


 The adult feeds on flower nectar, and the larva eats milkweed (*Asclepias spp.* and *Ampelamus spp.*) plants. There are four stages in the life cycle: egg; larva; pupa; adult.


 The monarch larva eats a lot and grows rapidly. When it is ready to pupate, it weighs about 3,000 times more than when it hatched from the egg.

 The first pair of legs on adult monarchs is very small and held next to the body. These legs are used for tasting.

 A group of monarchs is called a congregation.


 Experiments have shown that monarch adults prefer orange flowers to those of other colors when searching for nectar.


 Monarchs can fly at speeds reaching about 20 miles per hour.


 They travel from 40 to 100 miles per day when migrating, gliding on favorable winds to help speed them along.


# Monarch Facts - continued



 Monarchs ingest poisons from milkweeds that they eat during their larval stage. The poisons stay in this insect's body through the larval, pupal and adult stages. Cardiac glycosides induce vomiting in predators, and cardenolides are bitter tasting.

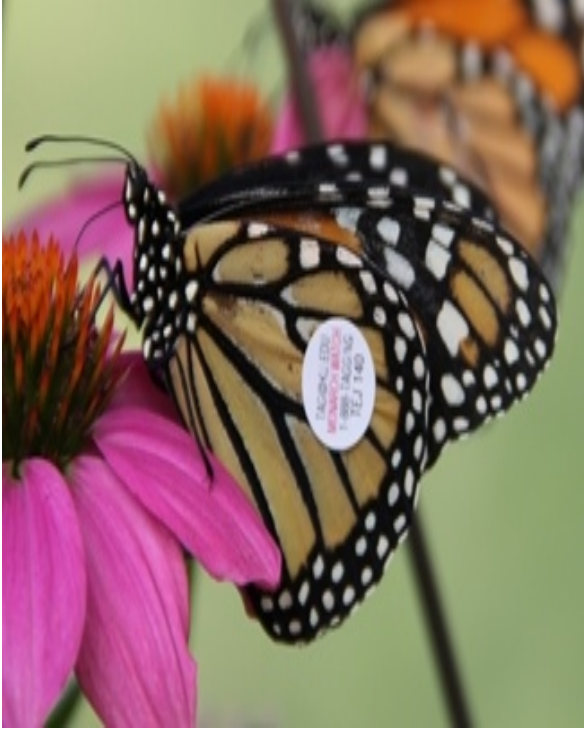
 Even though they are toxic, monarchs do have predators. Two species of birds and a species of mouse prey on monarchs at their overwintering site in Mexico. A parasitic protozoan is transferred from generation to generation in monarchs, too.

 Monarchs produce several generations each year with each living only a few weeks except for the generation produced in late summer or early fall. That generation migrates to Mexico and can live for about six months.

 Monarchs in North America are the only butterflies with a predictable, annual migration. They migrate about 2,500 miles to a special type of high-altitude forest in Mexico.



# An International Migrant



Monarchs (*Danaus plexippus*) from east of the Rocky Mountains in the United States and southern Canada travel as much as 2,500 miles in an annual migration from their summer habitat to their overwintering grounds in Mexico. Many other butterfly species migrate, but monarchs are the only butterfly species with a regular, predictable, round-trip migration. The monarchs from the eastern North American population spend the winter in oyamel fir (*Abies religiosa*) forests at high altitudes in the mountains of central Mexico where they form dense clusters on the trees. Upon reaching the overwintering sites, the monarchs' metabolism slows down, suspending their activities until environmental conditions improve. On

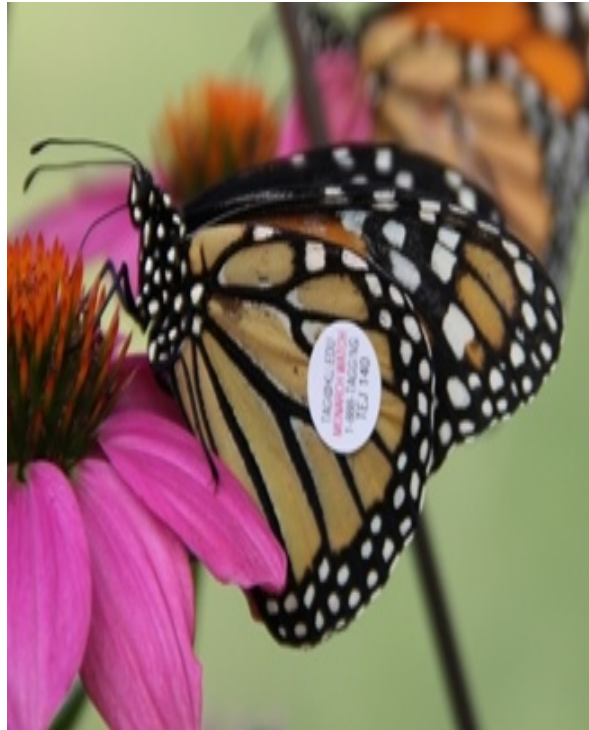
sunny days, they may leave the trees to collect nectar and obtain minerals from moist soil.

The spring migration from the mountains to eastern North America is completed over the course of two generations of monarchs. They move northward as milkweeds start growing on the migratory route. These monarchs live a few (two to six) weeks with the females laying eggs along the way. The return trip to Mexico is composed of monarchs from the last generation of the year. They fly the entire route to Mexico. They are biologically and behaviorally different from the other monarchs that developed in spring and summer. They live for about eight to nine months. Unlike the monarchs that develop in spring and summer and can reproduce about four to six days after emerging, the last generation of adult monarchs each year does not have fully developed reproductive organs, an energy-saving feature. This generation of monarchs feeds voraciously on nectar and builds up fat reserves. They benefit by feeding on nectar, if available, along the migratory route, to save the fat reserves for winter survival. It has been shown that decreasing day length, cooler night temperatures and decreasing milkweed plant quality lead them to start migration in the fall.

They have never been on this journey before. How do they navigate? Experiments have shown that ultraviolet light, an internal time-compensated sun compass and possibly other factors, like mountain ranges or bodies of water, may all play a role in navigation.

The trip to Mexico takes two to three months. Monarchs will not fly when weather conditions are unfavorable.

# An International Migrant - continued



There are also monarchs in western North America, mainly south and west of the Rocky Mountains and into southwestern Canada. Most of these western monarchs migrate to eucalyptus (*Eucalyptus spp.*), Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*) and other trees growing in groves along the Pacific Ocean from southern California to Baja, Mexico, to overwinter. A few go to the locations in central Mexico where the majority of the eastern North American monarchs overwinter.

Some monarchs overwinter in southern Florida and along the Gulf Coast, generally living on tropical milkweeds that are not native to these regions.

Why do monarchs migrate? Some scientists believe that monarchs may have originated in the tropics and moved north each spring to find more milkweed plants. They have not evolved ways to survive the harsh winters in eastern North America, so they return to more favorable areas to wait until milkweed is available again.

Monarchs that live on tropical islands and other places where it is warm year-round do not migrate and seem to be able to reproduce all year.

Tagging programs help scientists study migrating monarchs. Such programs led to the discovery of the overwintering sites in Mexico in 1975.



# Monarchs at Risk



Monarch (*Danaus plexippus*) populations have been rapidly declining in North America since 1997. From 1999 through 2012 in the Midwestern United States, there was a 64 percent decrease in the amount of milkweed available and an 88 percent decline in the number of monarchs present. While there have been some years of increases, overall the number of monarchs is decreasing. For the 2013-2014 overwintering season in Mexico, monarchs covered just

0.67 hectares (1.66 acres) of forest, the smallest amount of overwintering monarchs seen in these locations since they were discovered. The largest area in the past 20 years was 20.97 hectares (51.82 acres) in the winter of 1996-97. The number of monarchs overwintering in Mexico in 2016 was up, but a winter storm in March killed many monarchs and blew down many trees in the overwintering area. For the 2016-2017 period, there were an estimated 109 million monarchs occupying 2.91 hectares (7.2 acres). For more recent information, visit the following Web address.

<https://www.fws.gov/midwest/monarch/overwinteringmonarchs.html>

There are several natural and human-caused factors occurring at the same time to create a "perfect storm" of problems for monarch survival.

Monarchs are being killed unintentionally by herbicides and insecticides used to control weeds and other insects.

Illegal logging and forest degradation in the Mexican overwintering sites has reduced available suitable habitat.

Loss of milkweed plants due to habitat conversion to other uses and changes in land management practices has been devastating. It is estimated that since 1996, more than 167 million acres of milkweed habitat has been lost.

## Monarchs at Risk - continued



Drought conditions in the western United States have resulted in fewer milkweed plants.

Overwintering habitat loss and degradation in California due to development in and around the groves as well as loss of trees in the overwintering groves due to age has hurt these monarch populations.

Intensive agricultural planting reduces field margins where milkweed plants once thrived. Mowing along roadways also removes milkweed plants.

Temperatures the past few years have been unfavorable for the development of the immature stages of the first returning monarchs in the spring and the ability of the adult monarchs to move northward. Monarchs arriving later in the summer breeding grounds are not able to produce as many offspring as previously. Monarchs leaving later in the fall are not surviving as well along the migratory route.

Black swallow-wort (*Vincetoxicum nigrum*) and pale swallow-wort (*Vincetoxicum rossicum*) are members of the milkweed family that are native to Europe. They were accidentally introduced to the United States in the 1800s. Female monarchs will lay eggs on these plants, but the monarch larvae cannot eat them. These larvae die. These are called "dead-end" host plants. These two swallow-wort species also crowd out native milkweed plants. Black swallow-wort can be found in Illinois. Pale swallow-wort grows in Indiana, Wisconsin and Missouri and may also be present in Illinois.

# Helping Monarchs



You can help monarchs (*Danaus plexippus*) by taking the following actions.

1. Plant native milkweed plants.

Twenty-three milkweed species are native to Illinois, but some of them are endangered and threatened. The following five species are usually easily obtained from plant nurseries or native plant sales and would make good additions to your garden or a nice start to a butterfly or pollinator garden.

common milkweed (*Asclepias syriaca*) It grows best in well-drained soil.

swamp milkweed (*Asclepias incarnata*) This species prefers soil that is damp most of the time.

butterfly-weed (*Asclepias tuberosa*) Butterfly-weed grows best in well-drained soil.

horsetail milkweed (*Asclepias verticillata*) This species is suited for open areas with sunshine all day.

poke milkweed (*Asclepias exaltata*) Poke milkweed grows in woodlands and shady spaces.

## Helping Monarchs - continued



2. Plant other native plants that provide nectar for butterflies and other pollinators.

Monarch adults feed on milkweed nectar as do about 130 other insect species. However, they also take nectar from many other native wildflowers. You can attract a variety of butterflies and other pollinators by providing more species of native wildflowers. If you include the host plants for larval species and nectar plants for the adults, you will attract butterflies that will stay near your garden for a longer period of time.

Good choices include purple coneflower (*Echinacea purpurea*), blazing-star (*Liatris spp.*), goldenrods (*Solidago spp.*), asters (*Symphyotrichum spp.*), black-eyed Susan (*Rudbeckia hirta*), ironweeds (*Vernonia spp.*) and wild bergamot (*Monarda fistulosa*).

The Illinois Department of Natural Resources' *Butterfly Gardens* brochure provides more information. The *Butterfly Gardens* brochure may be accessed at the following Web page. <https://www.dnr.illinois.gov/publications/Documents/00000130.pdf>

3. Don't kill milkweed plants.
4. Encourage public land managers to create monarch habitat.

Let public land managers know that you are concerned about the status of monarchs and that planting monarch habitat is important to you. Your voice can make a difference. Encourage the planting of milkweeds and other native wildflowers and grasses along roadways, on the edges of farm fields, along railroad tracks and in the rights-of-way for electric transmission lines and pipelines. Talk to local park managers and express your concerns to them as well.

## Helping Monarchs - continued



5. Join citizen-science efforts to monitor monarch populations.

Monarch Watch, Journey North, the North American Butterfly Association, the Illinois Monitoring Network and the Monarch Larva Monitoring Project are examples of programs that citizens can participate in to help collect monarch data for use in scientific research.

6. Support conservation efforts for monarchs and other pollinators.

The North American Monarch Conservation Plan was prepared by the Secretariat of the Commission for Environmental Cooperation and may be accessed at the following Web page.

[https://www.fs.fed.us/wildflowers/pollinators/Monarch\\_Butterfly/news/documents/Monarch-Monarca-Monarque.pdf](https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/news/documents/Monarch-Monarca-Monarque.pdf)

The Monarch Joint Venture is a partnership of federal and state agencies, nongovernmental organizations and academic programs that are working together to protect monarch migration across the lower 48 states. Partners include the U.S. Forest Service, U.S. Fish and Wildlife Service, Iowa Department of Natural Resources, Natural Resources Conservation Service, Pollinator Partnership, Xerces Society for Invertebrate Conservation and many other organizations. The U.S. Fish and Wildlife Service has initiated a campaign to Save the Monarch Butterfly. Campaign activities may be accessed at the following Web page.

<https://www.fws.gov/savethemonarch/>

7. Avoid using pesticides, if possible.

8. Educate people about this issue. Everyone can help!



# Schools and Monarchs



Monarchs (*Danaus plexippus*) can provide great educational value in many subject areas and are an accessible resource. They are found statewide. They are easily recognized by students of all ages. They can be attracted to your schoolyard by planting native milkweeds. They are abundant when school starts in the fall but can also be found in late spring. All stages of the life cycle can be observed, and the transformation is mesmerizing to children and adults. Students can be involved with tagging and then tracking monarchs online through Monarch Watch.

Monarchs can be used to support educational goals from early childhood through high school. For early childhood students, studying monarchs can help them to develop skills in observing, asking questions, solving problems and drawing conclusions. They can also demonstrate concepts in relation to understanding that living things grow and change and that living things rely on the environment and/or others to live and grow. Tools and technology, such as magnifying glasses, computers and digital cameras, can be used to study monarchs.

Teachers of grades from kindergarten to high school can use monarchs to help study such topics as: describing patterns of survival; finding a solution to a problem caused when the environment changes and the types of plants and animals that live there may change; defining a solution for reducing the impacts of human activities on the environment and biodiversity; and many others too numerous to name here. Other subject areas can be incorporated into teaching about this topic as well.

# Schools and Monarchs - continued



Monarchs can be used to show a connection between the people and cultures of the United States and Mexico. Geography can be used in tracing the migratory route and discovering the locations of and reasons for selecting the specific overwintering sites. Stories, poems, plays, artwork and songs can be developed with monarchs as the theme. Mathematics can be used to estimate daily migration rates, number of monarchs per hectare in the overwintering range, percent loss of monarchs in the last decade and other calculations.

Students can go outdoors to study this species in their neighborhood. They can use technological tools to inform their community about their monarch studies and ask for community involvement in helping monarchs. Students can also add or enhance a schoolyard butterfly garden to support learning and assist monarchs and other pollinators. The Illinois Department of Natural Resources (IDNR) sponsors the *Schoolyard Habitat Action Grant* program that makes funds available to teachers for the purpose of developing or enhancing wildlife habitat on the school grounds or other public place. The IDNR also sponsors the *Illinois Biodiversity Field Trip Grant* to provide funds for teachers to take their students on a natural resources-related field trip in the state. For example, students could go to a prairie to look for monarchs. There are many other ways that teachers could use monarchs as educational tools, too.

*Schoolyard Habitat Action Grant* and *Illinois Biodiversity Field Trip Grant* information may be accessed at the following Web page.

<https://www.dnr.illinois.gov/education/Pages/grants.aspx>

# Invasive Species and Monarchs



black swallow-wort  
(*Vincetoxicum nigrum*)

pale swallow-wort  
(*Vincetoxicum rossicum*)



Monarch larvae must eat milkweed plants to survive. They are adapted to the milkweed plants of the scientific genera *Asclepias* and *Ampelamus*. Female monarchs lay eggs on milkweed plants so that the larvae will have an immediate food source when they hatch from the egg.

A problem has developed, though, that has led to female monarchs laying eggs on the wrong types of plants in the eastern United States. Black swallow-wort (*Vincetoxicum nigrum*) and pale swallow-wort (*Vincetoxicum rossicum*) are members of the milkweed family that are native to Europe. They were accidentally introduced to the United States in the 1800s. They are known as "dead-end" hosts. Female monarchs will lay eggs on these plants, but the monarch larvae cannot eat them. These larvae die. Experiments have shown that female monarchs will lay eggs on these nonnative plants even when native milkweeds are present in the same area. These two swallow-wort species also crowd out native milkweed plants, reducing native plant biodiversity and biodiversity of the animals that depend upon the native milkweeds. Black swallow-wort grows in Illinois. Pale swallow-wort is currently found in three of Illinois' border states so the chance of it advancing into Illinois is good.

## Invasive Species and Monarchs - continued



Both of these swallow-wort species are herbaceous vines that can grow to a length of 6.5 feet. They have clear sap. Their leaves are opposite each other on the stem, oval, with smooth margins and a pointed tip. Black swallow-wort flowers are dark purple and are similar in appearance to native milkweed flowers. Their petals are about as wide as they are long. Pale swallow-wort flowers range from pink to burgundy. Their petals are longer than wide. The seed pods of both species are longer than those of common milkweed (*Asclepias syriaca*), but they contain seeds that are similar in appearance to those of common milkweed and are wind-dispersed.

There is another milkweed in Illinois that should not be confused with these two invaders. Sandvine (*Ampelamus albidus*) grows in Illinois, and monarch larvae can eat it. It is a vine that has heart-shaped leaves and white flowers.

What can be done to stop the invasive swallow-worts? The first step is to successfully identify the plants. They are easiest to identify when they are blooming. Plants in full sun produce fruits sooner than those in shaded areas and should be eradicated first to reduce seed dispersal. When swallow-wort has been removed, it is important to plant the area with native plants quickly so that more invasive species do not move in. Digging, cutting, mowing and seed pod removal can help control these plants. Cutting should be used in combination with other techniques, since cutting alone can lead to resprouting.

Prescribed burns can help to keep these plants out of an area after they have been removed by other methods. Appropriate disposal of all roots, root parts and seeds is required to ensure that they do not grow. Bag them and either burn them or dispose of them in a landfill. Do not put them in a compost pile.

# Value of Monarchs and Other Pollinators



Monarchs (*Danaus plexippus*) are pollinators, as are many other insects and some bats. Hummingbirds, some monkeys, some rodents and other animals are pollinators, too. Humans can be pollinators as well! Not all plants need pollinators, but about 85 percent of them do. These plants would not be able to produce seeds and fruits without pollinators.

Pollinators help plants by transferring pollen. Pollen contains the male reproductive cells. For fertilization to occur, pollen must reach the female reproductive cells of the plant. Some pollen is carried by wind. Other pollen must be transferred by animals. The animals that move pollen are called pollinators. They are important to both native plants and agricultural crops.

In the United States, more than 150 crop plants require pollinators. Pollinators help insure that we have food to eat. It is estimated that one of every three bites of food that we eat is related to the actions of pollinators. Pollinators provide more than \$10 billion in economic value annually in the United States, but they are also vital to the existence of native plants and all of the animals that feed on them.

Pollinators are in decline worldwide. Habitat loss, pesticide use, competition from nonnative species and diseases are killing pollinators.

What can you do to help pollinators? Plant native wildflowers. Use a variety of species so that you will provide flowers (nectar sources) from spring through fall. Provide shelter and overwintering areas for pollinators. Use chemicals only when necessary and use the least toxic chemicals. Include host plants for larval butterflies. Save a few dead limbs for bees to nest in or build a bee nesting box. We can each take small actions that will combine to make a huge positive difference.