



MONARCH WINGS ACROSS OHIO

Guide to *Monarch Habitat* in **GARDENS**



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The Kelvin and Eleanor Smith Foundation

The J.M. Smucker Company

American Beauties Native Plants

Bee Culture Magazine

Bikes, Bees and Butterflies

Brooks Bolyard

Canal Corners Farm and Market

City of Wooster

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Monarch Joint Venture

New Vista Enterprises

Ohio Pollinator Habitat Initiative

Pheasants Forever, Inc. and Quail Forever

The Meyer Foundation, Inc.

The Ohio State University

The Robert Rotella Foundation

The Wilderness Center

U.S. Fish and Wildlife Service

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Introduction

Monarchs used to number in the billions, but over the course of the last 20 years, their populations have decreased by nearly 90%. This is largely due to habitat loss, and a loss of milkweed, the host plant for their larva. To help monarchs recover, millions of native plants, especially milkweed, will need to be planted. With generous support from The Kelvin and Eleanor Smith Foundation and The J.M. Smucker Company, the Pollinator Partnership (P2) joined with a number of Northeast Ohio institutions to form Monarch Wings Across Ohio (MWAO). The goal of this exciting project was to find out how best to create new habitat for this iconic but imperiled butterfly.

Through the leadership of MWAO's partner organizations, monarch habitat research plots were installed on 18 sites in four different types of land: farm, gardens, rights-of-way, and corporate land. Over the course of three years, P2 scientists observed and analyzed how monarchs used these sites to gain an understanding of how best to create much needed new habitat on these land types. The guide you are reading is the culmination of these efforts. In it you will find a detailed road map to creating a successful monarch habitat project in your home or community garden.

Unlike many of the environmental issues we are faced with on a daily basis, you can have a direct, positive impact on monarchs by incorporating monarch habitat into your garden. From the smallest container gardens, to large landscaping projects, all create vital habitat for monarchs and other pollinators, and are a great way to beautify an area while providing critical resources for supporting wildlife. You will know you are successful once you start to see the caterpillars eating the milkweed leaves and the adult butterflies feeding on nectar from wildflowers.

Benefits of Planting for Monarchs

Creating new monarch habitat, or enhancing your current landscaping to support monarchs, shows your commitment to environmental stewardship, and can help inspire others in your community. While ornamental plants and lawn grass can give a crisp, manicured look, they also create virtual food deserts for much of our wildlife, including monarchs. High quality monarch habitat requires the addition of native plants, which have a long history of interaction with native wildlife, and in many cases, like milkweeds that monarchs rely upon, are necessary for a butterfly or bee's reproductive success. Luckily, many of our regionally appropriate plants don't get "too wild"; in fact, many provide beautiful floral displays that work well in a landscape or garden setting. Native wildflowers and grasses also have the benefit of thousands of years of adaptation and evolution with the surrounding ecology, soils, and climate patterns, allowing them to thrive in local conditions, and generally requiring much less care than ornamental plants. Many native plants and grasses are able to develop much deeper root systems than most ornamental landscaping plants, meaning they need less watering. Also, they are adapted to the local soil conditions and require little to no supplementary fertilizer. This can translate to cost efficient, low maintenance, high benefit plantings that reduce water use, and can reduce or eliminate pesticide and fertilizer applications. Native plants' long roots and their ability to help with soil stabilization and water infiltration also make them a wonderful addition to rain gardens. They can add further value by keeping our streams and other waterways healthier and helping to keep our Great Lakes great!

As you can see, there are many benefits to creating monarch habitat. In addition, you will be helping to support our many native pollinators, which provide an essential ecosystem service – pollination – while also enhancing water quality, soil health, and biodiversity. By creating



Photo: Amber Barnes

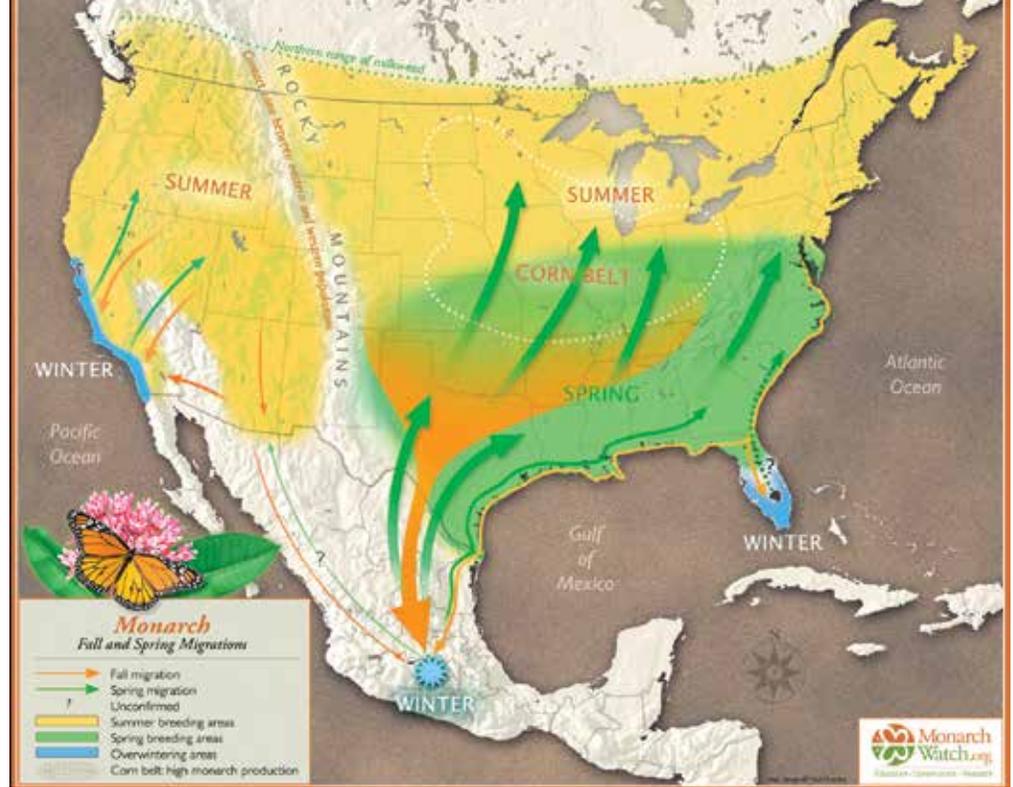
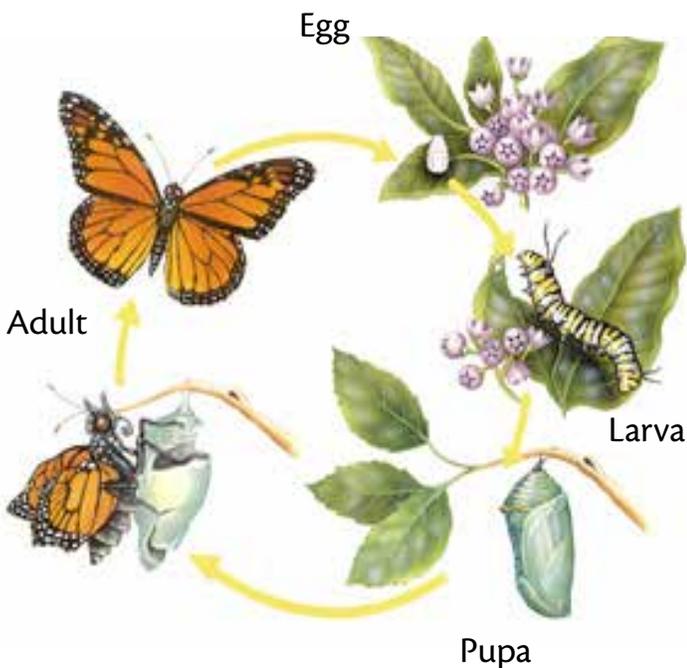
habitat that supports monarchs, you are also providing habitat and food for bees, birds, and other Ohio wildlife.

Monarch Habitat

Monarchs have a few simple, but essential habitat requirements; milkweed leaves for caterpillars to eat and grow (remember ‘The Very Hungry Caterpillar!’), native nectar plants, and water for some butterflies. Whether you are creating a formal garden, meadow, or an educational demonstration garden, providing milkweed is essential, because it is the only plant monarch caterpillars can eat. Once caterpillars become butterflies, they need the nectar of many different wildflowers, blooming during the spring, summer, and fall, to fuel their spectacular migration across the North American continent.

Monarch Life Cycle

A monarch egg is laid on a milkweed leaf. The egg hatches into a caterpillar within 3 to 6 days. The caterpillar feeds and grows, eating only milkweed leaves, over a 2-week period. Once fully grown, the caterpillar forms a chrysalis and, after about 10 days, emerges as an adult and begins feeding on nectar.



Monarch Migration

The monarch is probably the most recognizable butterfly in the United States, yet this beautiful creature is experiencing massive declines. The number of monarchs making the annual migration has plummeted; in the 1990s, close to 700 million monarchs made the journey each fall, now this population has experienced a decline of nearly 90%. This alarming decline is due in large part to the loss of milkweed, on which monarchs lay their eggs, and other native plants that provide nectar to fuel their migration. According to Monarch Watch (<https://www.monarchwatch.org/>), approximately 2.2 million acres of milkweed habitat is lost each year in the United States due to land conversion and agricultural pesticide use.

There are two populations of monarchs, one that migrates east of the Rocky Mountains, and the other that migrates west of the Rockies. This guide will focus on the eastern monarch population, which includes the monarchs we see in Ohio. The eastern monarch migration starts in March as the butterflies overwintering in Mexico start traveling north. Two, three and sometimes even four generations are produced as they move from Texas into southern Canada. It is the great grandchildren, or great-great grandchildren of the overwintering monarchs that we see in Ohio.

In mid-August, the last generation of the year begins migrating south on an epic journey of over 3,000 miles to central Mexico, thus beginning the migratory generation. Summer generations typically live for two to six weeks as adults; however, adults in the migratory generation can live for up to nine months! As monarchs from the eastern U.S. and southern Canada migrate toward Mexico, they need areas of refuge (high quality nectar sources and shelter from harsh weather) along the way, making Ohio an essential part of the monarch migration.

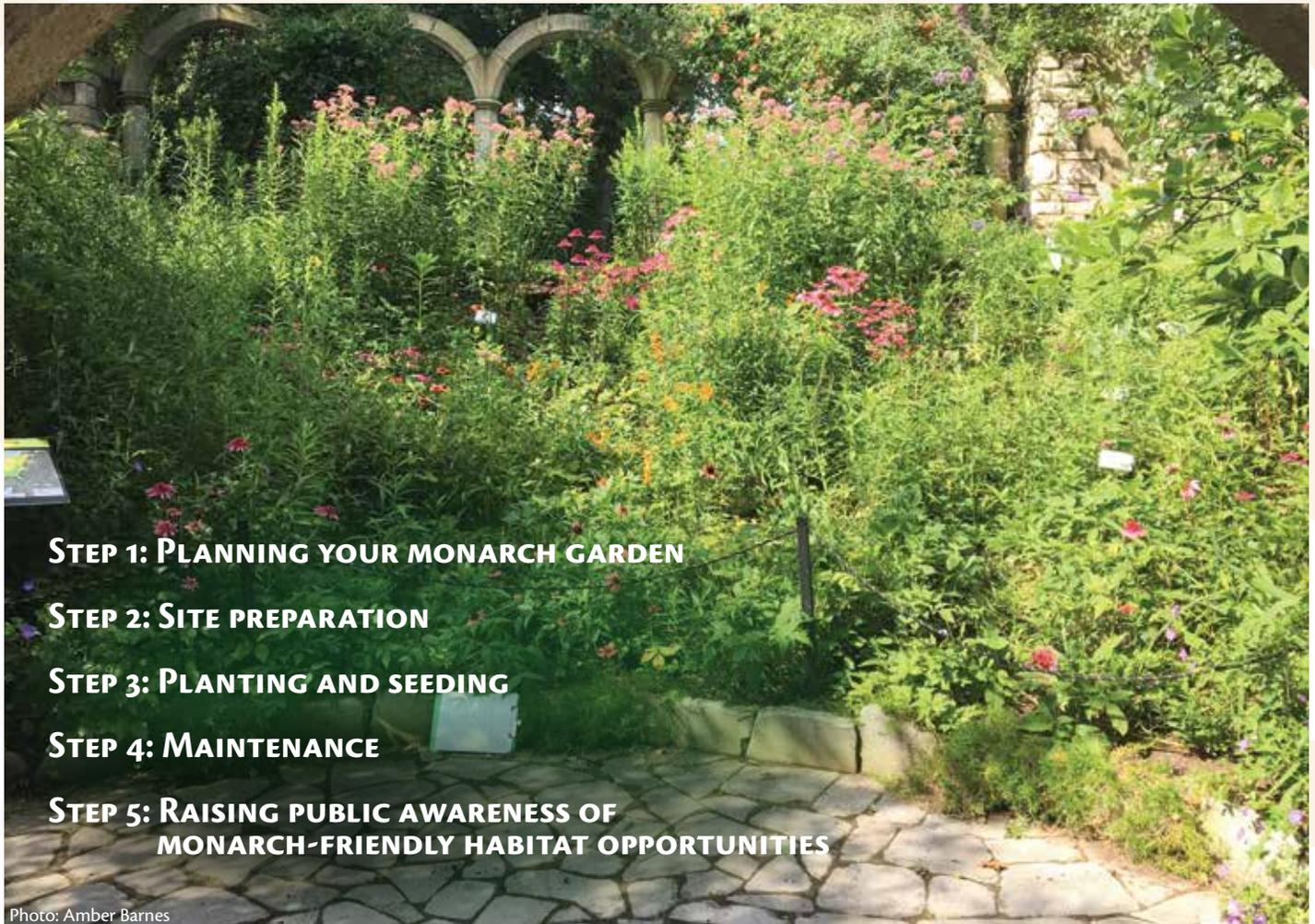
Creating Monarch Habitat in Gardens

Whether you're working with the community or at home, as a gardener, you have the opportunity to make a tangible difference for monarchs. Your garden does not need to be big – even small patches of nectar-rich flowers and milkweed host plants will attract and sustain monarchs and other pollinators.

Depending on your preference and desired outcome, monarch habitat can take the form of a designed garden with native perennials, a naturalized meadow that includes native grasses and wildflowers (in an area with more space), or an educational demonstration garden. It is not essential to start your monarch habitat from scratch, or to include only native plants; you can replace selected ornamental plants with native wildflowers and/or grasses throughout your existing landscape to suit your aesthetic preferences.

A carefully designed garden which incorporates a mixture of textures, flower types, and heights can sustain more wildlife than less diverse areas, while also providing an enhanced visual aesthetic. By incorporating the design elements below into your garden, you will create a thriving ecosystem that your family, neighbors, and community can enjoy for its beauty as well as for its contribution to monarchs and broader stewardship efforts.

Fortunately, five relatively simple steps can result in substantial positive impacts for monarchs and other pollinators. This guide will outline these five steps and equip you with the tools and knowledge needed to help monarchs in your garden. These five steps are:



STEP 1: PLANNING YOUR MONARCH GARDEN

STEP 2: SITE PREPARATION

STEP 3: PLANTING AND SEEDING

STEP 4: MAINTENANCE

**STEP 5: RAISING PUBLIC AWARENESS OF
MONARCH-FRIENDLY HABITAT OPPORTUNITIES**

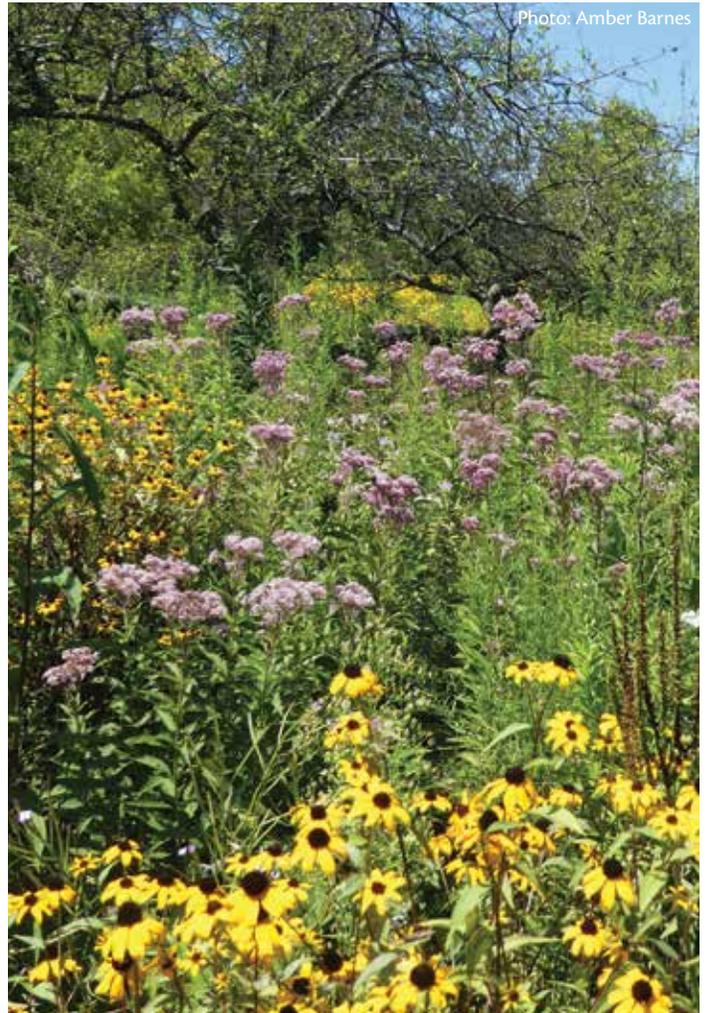
Photo: Amber Barnes

Components of Monarch Habitat

- Milkweed
- Nectar plants
- Sun
- Shelter
- Water

Basic Considerations for Monarch Habitat Creation

- ✓ Provide bloom from April to October:
 - Include at least three flowering species per season (spring, summer, and fall).
 - Include clumping native grasses in the flower mix (if you have the space).
 - Choose a variety of flower shapes, sizes, and colors to attract a diversity of pollinators to your monarch habitat.
- ✓ Include perching, nesting, overwintering, roosting, and chrysalis sites:
 - Leave patches of bare soil and minimize soil disturbance to provide nesting sites and protection for ground nesting bees.
 - Include hollow twigs and stems; tall and bunching grasses; and fallen logs.
 - Allow or plant other native plants near milkweeds to provide protection and cover for caterpillars that are molting or forming their chrysalis.
 - Incorporate trees into your landscape where possible to provide protected roosting sites for migrating monarchs and tolerate dead trees where they are not a safety hazard.
- ✓ Protect habitat from pesticide exposure:
 - To support the butterfly lifecycle, caterpillars will need to feed on the leaves of your vegetation. This is a natural part of the lifecycle and does not harm the plants. Do not apply pesticides on or near your monarch habitat.
 - To protect butterflies and avoid any accidental drift or contamination from pesticides, be sure to locate your new monarch garden at least 165 yards from where pesticides (particularly insecticides) are used.
 - Do not buy plants for your monarch habitat that have been treated with systemic pesticides. These pesticides are present in the plant tissues and in low levels, in the nectar, potentially poisoning caterpillars and butterflies.



Lawns and mowing:

Less lawn maintenance can be a boon for pollinators! Turf grass that is mowed frequently provides little value for butterflies, and other pollinators and wildlife. By mowing less frequently, no shorter than 3 inches, and allowing some low-growing non-invasive flowers to bloom in your lawn (such as violets, white clover, and dandelions), will make a significant difference to monarchs and other pollinators. For example, dandelions are often the first source of food for many pollinators in the spring, and keeping this resource in your lawn during a time when other pollen and nectar sources may be limited can benefit pollinators. Other native or non-invasive non-native wildflowers can be left to bloom in your lawn as well, for a more beautiful and pollinator-friendly lawn.



Photo: Amber Barnes

1 STEP 1: PLANNING YOUR MONARCH GARDEN

Your goal may be to add monarch-friendly flowers to your existing garden, create an educational demonstration area, or turn a grassy yard into a butterfly oasis. Whatever garden-type you are envisioning, taking the time to plan the details of the project will guarantee the best results. It is important to consider the specific needs of your site. For example, soil type, sun exposure, and the level of maintenance and upkeep you are willing to put into the project after it has been planted. Site-specific conditions will determine which plants will best suit your site; additional considerations include the timing of planting and available resources.

Important Layout Considerations:

1. Space milkweeds to limit competition with other plants (you can include a combination of clustered and isolated milkweeds too).
2. Create open lines of sight to allow butterflies to more easily locate and approach your garden. Each landscape is unique, so do the best that you can to avoid planting milkweed in a way that monarchs could only find your garden from a birds-eye view.
3. Experiment with including multiple species of milkweeds that are appropriate to your conservation and gardening goals (e.g. swamp milkweed and butterfly milkweed can be beautifully paired in a more formally designed garden to help support monarchs and native bees!).
4. Some species of milkweeds are more prone to rhizomatous spread than others. Make sure to install the right plant in the right place to get the fantastic wildlife benefits they bring while avoiding management challenges.

Design Features of Monarch Habitat in Gardens

Layout: Group flowers of the same species together into patches. This not only makes the design more visually appealing, but also makes foraging more efficient for monarchs and other pollinators. Plant layout is a really important factor in how monarchs use the habitat. In fact, there has been research conducted (Adam Baker and Dan Potter, University of Kentucky) which found that the placement of milkweeds within the garden design is important; planting milkweeds along the periphery can increase monarch egg-laying, as well as the general usage of the milkweeds.

Height: Trees, shrubs, vines and bunching grasses add a vertical dimension to your garden. Divide your garden into tiers, with the taller elements at the back, mid-height in the middle, and shorter plants at the front for a stunning visual effect. Having a diversity of vegetation heights creates more ‘micro-habitats’ and attracts more species of butterflies, bees, other beneficial insects, and birds.

Ground cover: Mulching flower beds with composted leaf-mulch is the most affordable and most effective type of mulch. Many butterflies, including Coral Hairstreak (*Satyrium titus*) and Purplish Copper (*Lycaena belloides*) lay their eggs in dead leaf litter, which then provide a source of food for the caterpillars. Leaf mulch also increases soil fertility and plant health. Most native bee species in Ohio are solitary and non-aggressive, and about 70% of them nest in the ground. Although mulch is an important component of the home garden in terms of weed suppression, retaining moisture, and providing habitat, it is important to leave some patches of bare soil in your garden for ground-nesting bees.

Water: Some butterflies and other pollinators benefit from having a fresh source of water available. This can take the form of mineral rich moist soil from which they can extract water (known as “puddling”) or a pond, birdbath, or shallow bowl of water with stones, pebbles and/or sand in it which rise above the water surface to provide them with a perch from which to drink. While much of the water that a butterfly needs comes from the flower nectar they consume, additional water and the minerals that it can contain can provide key hydration and nutrients. Remember to change the water frequently to reduce mosquito larvae or other contaminants.

Native plants

Gardeners have a wide array of plants to use in their gardens; however, it is best to use native plants which can support the needs of both generalist and specialist native pollinators. While some butterflies can lay their eggs on a variety of plants and their young will do fine, other butterflies are specialists and need particular host plants. Monarchs, for example, require plants in the milkweed family on which to lay their eggs; these are the only plants their caterpillars will eat. Monarchs have adapted to a variety of native plant species in other ways too. In fact, the timing of their migration is in sync with the bloom of native flower species across the continent and the phenology of the blooms can help signal to monarchs when it's time to move on from a location. See the Ohio Monarch Habitat Planting list on page 19 for regionally appropriate native species that will provide the resources needed for monarchs to thrive, from caterpillar to adult, in addition to benefiting bees, birds, and other Ohio wildlife in your neighborhood. Although native plants are the gold standard when it comes to habitat creation, that's not to say you cannot successfully incorporate some fun or favorite ornamental (non-native) plants into your habitat! However, you should be sure that any non-native plants you choose to use are not invasive.

Clearing the Confusion on Native, Non-Native, and Invasive Plants

Choosing plants for pollinators does not have to be complicated, but it helps to know commonly used terms, the different types of plants available to you, which plants to prioritize, and which to avoid. It is important to consult your local municipality, conservation authority, or Invasive Species Council to make sure the plants you are using are not designated invasive or noxious in your region.

Photo: Amber Barnes

NATIVE PLANTS

Plants that are a part of the natural environment of a region. Native plants, and their pollinators, have coevolved over thousands of years in a particular location. Selecting plants native to your region will provide the most benefit to pollinators and the environment. If you are creating a naturalized meadow, use only native species. In a garden, either use all native species or use them as the 'backbone'; that is, most of the plant cover (more than 75%) should be native. This will provide the most benefit to pollinators and the environment.

Non-Native Plants

Plants that are not historically part of a region. They arrived in the region either intentionally or accidentally by humans or some other means. Other terms used for non-native plants include ornamental, exotic, introduced, alien, and non-indigenous. Some non-natives are beautiful ornamentals and some provide resources for pollinators. There are a number of different types of non-native plants and some should never be intentionally planted.

Non-Invasive

Non-native plants that are not historically part of the natural environment of a region. These plants do not reproduce on their own and do not spread or outcompete native plants. It is okay to plant these plants in your habitat project.

Invasive Plants

Non-native plants that should never be planted. An invasive plant is a plant that is not native to the region and reproduces freely on its own. They invade natural or disturbed areas, out-compete native plants, and disrupt the ecosystem. Many seed mixes (including 'pollinator mixes') and plants sold at garden centers include species that are invasive in regions where they are marketed. Check species lists with local authorities and invasive species lists, and do not use if they are invasive.

Noxious Weeds

Non-native plants that are particularly troublesome for agriculture, the environment, or public health. Noxious weeds should never be planted and some are illegal to plant in certain areas. Check noxious weed lists to find out what species are prohibited in your area (e.g. <https://www.oipc.info/invasive-plants-of-ohio.html>).

Benefits of Incorporating Native Plants

Remember that specialized cultivars sometimes are not used by pollinators. Flowers that have been drastically altered, such as those that are double-flowered, or a completely different color than the wild species, often prevent pollinators from finding and feeding on the flowers. In addition, some altered plants do not contain the same nectar and pollen resources that attract pollinators to the wild types.

Proper Plant Selection and Identification:

Take time to evaluate the source of your plant material. You want to ensure you get plants that are healthy and correctly identified. Be sure to inquire at your garden center about whether the plants were grown using pesticide treated seeds and/or if the plants have been treated with systemic pesticides. It is not mandatory for garden centers to provide this information on the labels, so seek out nurseries that voluntarily label their plants according to the pesticide treatment used to grow them. Most nurseries and garden centers will be able to point you in the right direction. For more information on finding native plant nurseries, visit LEAP's website <https://www.leapbio.org/resources/native-plants>.

Though using native plants sometimes involves higher up-front costs, in the long-term there are savings when compared to using ornamental plants and seed mixes, mostly due to reduced maintenance costs. There are many other benefits to native plants as well, and their use in home landscapes and public gardens can serve multiple goals: financial, environmental, educational, agricultural, and aesthetic. Research has shown that native plants generally provide the most nutrition to the largest number of pollinators, including monarchs. Native plants also are the best adapted plants for your local conditions, usually requiring less watering and soil amendments than non-native plants.

Benefits Include:

- Native plants are more drought-tolerant than non-native plants
- Deep root systems of native plants increase water infiltration, and reduce run-off, erosion, and water pollution
- Native plant communities foster local identity and beautify landscapes
- Native plants support more wildlife than non-native plant species
- Native plants sustain populations of native pollinators and honey bees which can increase crop pollination in nearby agricultural lands, as well as in your own home or community garden, whether it is vegetables that need pollination or wild-flowering plants



Photo: Amber Barnes



Photo: Amber Barnes

Selecting Native Plants

Diversity is a key element of successful monarch habitat. Choosing plants with a variety of bloom times, colors, and shapes will ensure that there is a constant source of food from early spring to late fall in order to fuel their migration (e.g. coneflower, beebalm, goldenrod, and asters, just to name a few). Again, milkweed is an essential part of monarch habitat, as it is the host plant for this butterfly. There are several milkweed species to choose from in Ohio; be sure to select a milkweed species that will thrive in your garden's conditions. For more plant suggestions, consult the Ohio Monarch Habitat Planting List on page 19.

While blooming plants with showy flowers are an obvious choice when planning a butterfly garden, native grasses and sedges are also important to consider, as they form the backbone of meadow and prairie habitats. Their long roots sequester carbon, allow water infiltration, reduce erosion, provide shelter for bumble bees and other wildlife, and are larval hosts for various butterfly species. When considering planting or seeding a garden, native grasses tend to be less expensive than native flowers, so a strategy for keeping costs down while keeping diversity high can be to increase the proportion of grasses in the seed mix while maintaining a large number of diverse flower species (which are then included in smaller proportions). A mix ratio of 75% native forb (flower) seed to 25% native grass seed is preferable; however, if cost is a defining factor, one could employ a 70/30% or even a 65/35% forb to grass mix, but never use less than a 60/40% forb to grass ratio.

Planning Considerations

Timing: Plan to plant plugs, potted plants, and/or transplants in spring. However, if you are planning to create a natural meadow, the best time to sow a native seed mix in Ohio is in late fall. See Step 3: Planting and seeding for more information on when to plant or sow seeds for your monarch garden or meadow.

Location: Butterflies prefer sun, so plan to put your monarch butterfly garden in a sunny location.

Soil Type: There are many methods to test your soil's quality and composition, from simple DIY glass jar tests to sending samples to a laboratory. Knowing whether your soil is sand, loam, or clay, and whether it tends to be dry or moist, will allow you to choose the best native plants for your garden's conditions. Simple texture tests by feel can be used to determine the composition of your soil, following a flow chart such as the one provided here: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054311

Dimensions: If you are planting an entire garden from scratch, you should begin by measuring the dimensions (width and length) of your prospective flowerbed in order to determine how many plants or how much seed you need in order to provide an adequate number of plants per square foot for the area. Generally, one pot or plug every one to two feet is more than sufficient. Drawing your garden plan onto graph paper will also help you visualize the end result.

Plugs versus seeds: You can use seeds, plants, or a combination of both when creating a monarch garden. Plugs (or mature plants or transplants) are more expensive than seeds, but provide more immediate results, and allow for intentional design. You can also combine both by planting a few plugs and sowing seeds around them.



Photo: Amber Barnes

2 STEP 2: SITE PREPARATION

Proper site and seedbed preparation is a crucial step that is often overlooked, but is necessary to create successful pollinator habitat. Before any site preparation, it is essential to recognize the specific needs of your site.

Proper and thorough weed removal is one of the most important steps to successful habitat creation. Whether there is heavy weed pressure in your garden or you are removing turf grass to create a monarch meadow or expand your garden area, removing non-native and invasive vegetation is vital in preparing your site for planting. Choose the method below that best suits your needs.

When preparing your garden bed, keep in mind that if you are planting plugs, you should disturb the soil as little as possible to avoid stimulating weed growth. However, if your project involves using seeds, you should loosen the soil with a spade and use a rake to level the soil surface and enhance seed-soil contact; this allows for successful seed germination.

If you are turning a relatively small weedy or turf area into a monarch meadow or flower bed, the best two methods to eliminate the vegetation and prepare the soil are: solarization or occultation (tarping using a black tarp, see below), followed by sheet mulching. Either method should be done the season before planting. See the below section for more information regarding the various site preparation methods, and choose the one most suitable for your site and available resources.



Photo: Amber Barnes

Solarization

Solarization is a great method for sites one acre in size or smaller. However, solarization reduces beneficial microbes in soil, so consider using a mycorrhizal inoculant before planting to reintroduce these beneficial microorganisms. Begin by mowing and tilling the site. Then wait for rainfall or irrigate the area to saturation so that the moisture causes the dormant weed seeds to germinate. Dig a canal around the site, then place a clear, UV-stabilized plastic sheet over the site, and bury the edges of the plastic in the canal to ensure the heat is sealed in. The heat generated from the sun will become trapped under the plastic sheet, and the high temperatures and steam will kill the vegetation and dormant weed seeds. This should be done in the spring or early summer and left until the fall, just before seeding or planting. If the soil dries out, add moisture; the steam produced will help eradicate unwanted vegetation. Do not till between solarizing and planting as this can cause any remaining dormant weed seeds to germinate.

Occultation (or Tarping) Followed by Sheet-Mulching

Similarly, a site can be prepared using the occultation technique, which involves using a black tarp to smother the unwanted vegetation (opposed to solarization which uses clear plastic). As in solarization, prepare the site by mowing and/or tilling to remove the vegetation. Occultation does not produce temperatures quite as high as solarization; however, there are trade-offs: since occultation functions at slightly lower temperatures, there is less damage to the microbial layers of the soil (which is a good thing!). This process is usually followed by a technique called sheet-mulching, which is a very simple smothering technique used to suppress weeds. For sheet-mulching, add up to 3 layers of cardboard prior to spreading mulch. After the cardboard has been placed, add a thick layer (sheet) of mulch, 2-6 inches deep. The cardboard and mulch smothers the grass and weeds below. The cardboard will break down slowly into the soil, creating a weed-free barrier.



Photo: Kristen Miskelly

Hand Weeding and Clearing

In small garden areas, a combination of mowing and hand weeding can be very effective, but usually requires more working hours. On such areas in your garden, the careful and selective application of herbicide to individual weed plants can also be appropriate, especially if there are shrubby plants, such as the invasive Japanese knotweed, Autumn-olive, and buckthorn. This method is effective for preparing relatively small sites in spring and early summer when transplants (plugs and potted plants) are used.

Tilling

Tilling the site is a good option when weed pressure is low or multiple tills are possible to eliminate the seedbank. Conduct a survey of existing plant material and consider past weed problems before tilling. Often times, tilling will work well in the short term but can bring weed seeds to the surface from the historic seedbank, creating a long-term weed problem. If you want to till, consider combining it with herbicide application. When tilling to exhaust the seedbank, first till, then irrigate to germinate weed seeds, till to eliminate the plants, and repeat until the seedbank is exhausted.



Photo: Kristen Miskelly

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STEP 3: PLANTING AND SEEDING

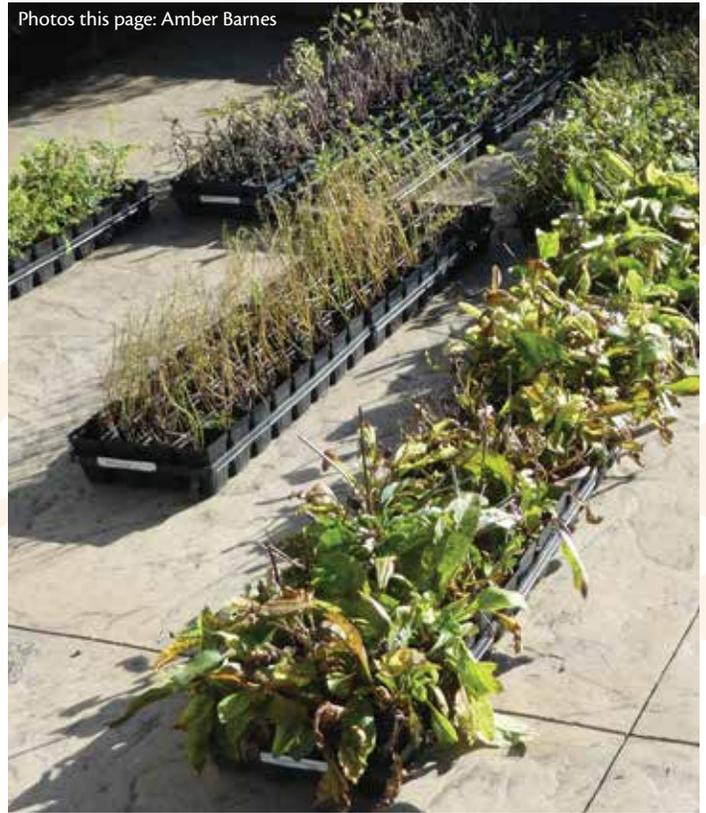
If seeding, a fall planting is considered the best time to establish a diverse native plant community that is attractive to monarch butterflies, bees, and other pollinating species in Ohio. This is due to the fact that seeds of many of Ohio native plant species need to go through a period of cold (stratification) before they will germinate (a process which can be mimicked artificially, details of which can be found with a quick Internet search).

When creating or enhancing your garden or landscaping project using plugs or transplants, it's best to plant in the spring after the last frost, but before the summer heat has set in. This allows time for the plants' roots to establish before going through a harsh winter. Alternatively, you can plant in the fall, providing that you get the plants in the ground at least a month before the first frost so that they can establish their root system before the cold. You should avoid planting or seeding in summer, as the heat and sun add to the stress of transplanting and germination can diminish, negatively impacting the survival rate of your new plants.

Whatever time of year you plant, do so early in the morning, late in the afternoon or on an overcast day, in order to avoid the midday heat. For plugs or plants, dig holes that are deeper and wider than the root ball, and loosen the soil. Make sure to thoroughly water your plants both before and after planting.



Photos this page: Amber Barnes



Planting, Spacing, and Layout:

Prior to planting, it can be helpful to lay out your potted plants (while still keeping them in the pot) in order to determine proper plant spacing and design. A good rule of thumb is to place one plant per square foot if you want a dense planting that will reduce weed pressure during early establishment. When you are ready to plant, start by digging a hole at least equal to the size of the pot. Next, gently remove the plant from its pot by squeezing the bottom of the pot to loosen the plant from its container. Ensure that the roots are not tightly condensed by gently rubbing the root ball and breaking apart/loosening the roots when necessary. This allows for the plants' roots to freely spread out once planted so they can search for water and nutrients. Lastly, place your plant in the hole, level with the surrounding soil, and be sure to press the soil tightly back in around the plant, followed by a generous watering. Transplanted plants need a large amount of water in the beginning to overcome the stress of being introduced into a new environment.

Broadcast Seeding

Broadcast seeding is when seed is scattered either by hand or machine. For sites under an acre in size, broadcast seeding by hand is very cost effective. Scatter the seed across the site by walking the length of it, and then scatter the seed again by walking the width of the site. Sawdust, sand, kitty litter, no-nitrogen fertilizer, or pelletized lime may be mixed with seed in a bucket to ensure a more even distribution. Special machines such as fertilizer buggies can also be used to make sowing light, fluffy seeds easier.

Broadcasting the seed over the area followed by lightly raking works well to achieve desired seed-to-soil contact. Many of the native plant species produce very small seeds and it is imperative they are not planted too deep (no greater than 1/8" deep), or they will not grow. Additionally, a broadcast seeding on top of existing snow works well, because the freeze-thaw action in the following spring naturally works the seed into the soil. Broadcasting over snow also allows the applicator the ability to see where the seed has been applied and achieve an adequate coverage of the area. If broadcasting onto bare soil, the technique of mixing sand or other carrier with the seed can be used to the same effect.

Photo: Amber Barnes



Plugs and Mature Plants

Plants are better than seeds for more formally designed gardens, hedgerows, landscapes, and wildflower strips. If you are planting something more formal, design the layout so that taller plants are at the back, and shorter ones are at the front. Plant flowers of the same species in groups for a more beautiful visual effect and to make foraging by pollinators easier.

Depending on the size, function, and location of your garden, you may be organizing family members or community volunteers to help out with the garden planting. On the planting day, develop a planting strategy and communicate it to all of the folks that are helping with the planting. Holes for plug plants can often be dug with a basic trowel, though if you're installing many plants at one time, an auger can be a great help! To save time, you can also dig the holes in advance.

When planning to use plugs or mature plants in your new garden, don't forget to make sure it is located near a water source. Installation can be stressful for plants and to assist with establishment, they'll need a good soak after being planted.

4

STEP 4: MAINTENANCE

Proper care and maintenance is a vital part of any pollinator habitat project. While native plants require less maintenance over time, some ‘TLC’ will help them establish and thrive.

Post-Seeding

In most cases, seeds are sown in the fall, which allows the seeds to overwinter and start the germination process in the spring. In these cases, nature is left to take its course and one hopes that the right amount of rain falls at the right time. However, if water is easily accessible, you can water your seeded area to help the seedlings survive. In this case, water the seeds once a week, until the seedlings are about 4-6 inches tall. After that, the seedlings will survive on rain water, unless there is a particularly dry period. Though many native plants are adapted to drought, watering during dry periods will increase plant survival, the attractiveness of the habitat, and the amount of pollen and nectar available for butterflies and other pollinators. Be mindful to only water when there are unusually dry periods, as excessive watering can favor weed growth.

In the fall, after plants have browned from frost, we recommend an annual mowing of the seeded area with the blades 6 inches from the ground. This will distribute the flower seeds throughout the site, keeps any woody plants from growing up in the planting area, and is particularly beneficial in the first couple of years. In seeded areas, always keep one section un-mowed to serve as a refuge to wildlife and stem-nesting native bees; rotate this section from year to year.

Post-plug/Potted Plant Garden Planting

Water the plants thoroughly the day of planting and at least once a week for 4-6 weeks post-planting. If conditions are particularly dry, water more often.

Spend time weeding your garden weekly or monthly, depending on the severity of weed pressures. Again, thorough site preparation before the plants go in the ground can greatly reduce the need for weeding, but will never completely eliminate it.

Leave the old stems in place over the winter. These can be trimmed back in late spring or left in place. The seed heads provide a winter food source for birds while the stems can provide cover for birds and nesting habitat for bees.



Long-term Garden Maintenance

Leaving your garden in a ‘natural’ state provides many benefits to wildlife.

- ✓ Keep dead leaves, stems, and twigs over winter to provide shelter and nesting habitat for bees and other pollinators.
- ✓ Keep dead flower heads over winter to provide seeds for birds.
- ✓ Keep leaf and grass litter on the ground to provide cover for butterflies, lightning bugs, and other wildlife.

Once the seeds on your plants have matured, you can spread them directly onto the flower bed to grow new seedlings. Alternatively, you can collect them and share with your friends, neighbors, volunteers, or other community members to help them start, expand, or diversify their own monarch garden.

Perennial plants are long-lived and may need to be divided if they get too large for their space. If plants are getting too close together after two or three years, consider dividing and transplanting plants and expanding your garden, or gift some extra plants to friends, neighbors, or volunteers! Some species may need division every 3-5 years, while others may not need it at all.

Signs that your plants need to be divided include: both flower size and quantity are reduced; the growth in the center of the plant has died out; or the plant has simply outgrown its boundary. For many species in Ohio, spring is the preferred time for division.

5 STEP 5: RAISING PUBLIC AWARENESS OF MONARCH-FRIENDLY HABITAT OPPORTUNITIES

Education and Outreach

You can use your newly created monarch habitat as a learning opportunity for other community members, from school children to local garden clubs. Consider hosting an educational tour of your garden to raise awareness about creating habitat for monarchs, and how easy it can be to provide quality habitat in a home or community garden!

Whether your habitat is part of a public park or a private residence, signage can be key for helping people to understand what they're looking at and its importance. This can be especially useful if you chose a less conventional and more naturalized look or wildscaping. Neighbors, passersby, and city or homeowner association staff will have a greater appreciation for your habitat if they can understand its purpose and vital need.

Pollinator Partnership (P2) has a wide variety of outreach materials available at www.pollinator.org. Many of the materials can be customized with your organization's logo (if you have one!).

Research and Monitoring

Information about the success of pollinator habitats and local pollinator populations is essential for conservation and land management. Adding data to new and ongoing monitoring efforts is valuable, and can give concrete evidence to the community or stakeholders of the difference you are making. Spending time watching what's interacting with your plants is a great way for parents, teachers, parks staff, and others to open people's eyes to the wonder and diversity of nature!

Consider partnering with a local citizen science program or a regional monitoring program such as eButterfly (www.e-butterfly.org), Journey North (journeynorth.org), Mission Monarch (mission-monarch.org) (available in English, French and Spanish), Monarch Watch (<https://www.monarchwatch.org/>), Bumblebee Watch (bumblebeewatch.org), Monarch Larva Monitoring Project (www.mlmp.org), or the Insight Citizen Science App (<https://insightcitizenscience.com/>). Partnerships with local conservation groups or universities are also great ways to support pollinators. Contact Pollinator Partnership if you are interested in including your pollinator habitat in a scientific study that can aid in pollinator conservation.



Photo: Amber Barnes

Insight Citizen Science App

The Insight Citizen Science App is a tool that empowers citizens to learn about North America's essential pollinators and participate in observation-based research. This user-friendly app provides a guide to walk you through the observation process and help you learn how to identify pollinators within the 7 featured pollinator categories. It also provides a platform where you can follow the observations of other citizen scientists across the United States, Canada, and Mexico. The free iOS app was launched in North America in 2019. Visit <https://insightcitizenscience.com/> to download this app for free!

Certification and Recognition

Pollinator Partnership Pollinator Steward Certification

This unique certification program is offered only by P2. P2 has been at the forefront of pollinator research, education and habitat improvement for over 20 years. Certification as a Pollinator Steward demonstrates that you have a science-based understanding of pollinators and gives you the practical know-how to help them. Certification also shows that you have used your knowledge to create habitat and educate others. Visit <https://pollinator.org/pollinator-steward-certification> for more information on this unique certification opportunity for your organization.

Million Pollinator Garden Challenge (MPGC)

The MPGC is a campaign to register a million public and private gardens and landscapes to support pollinators. Register your pollinator garden today. It is free and easy! You can also explore other pollinator friendly S.H.A.R.E. (Simply Have Areas Reserved for the Environment) landscapes all over the globe by clicking the MPGC map here <https://pollinator.org/mpgcmmap>. Registering your site as a S.H.A.R.E. site will ensure that others outside of your community will learn about the work you are doing to promote pollinators and specifically, monarchs.

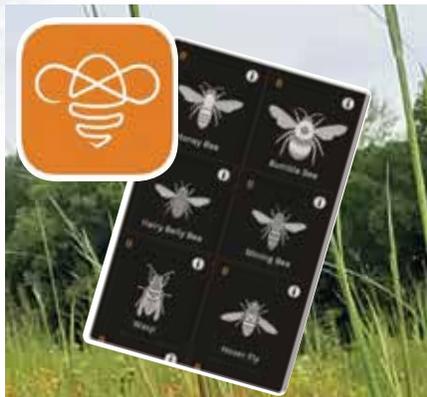


Photo: Amber Barnes



Photo: Elizabeth Kaufman

If we take a step back and look at our surrounding landscape, what we will notice is a mosaic of gardens, agricultural land, and natural areas. However, this landscape has become increasingly fragmented due to urbanization, industrial agriculture, and resource extraction. Pollinators and other wildlife need connectivity throughout the landscape in order to find food and shelter. Therefore, habitats of all shapes and sizes are needed to help reconnect this fragmented landscape! In order to implement the level of change that is necessary to sustain and support the monarch butterfly and other endangered pollinators, we need to integrate an 'all hands on deck' philosophy, and home, community, and educational gardens across Ohio and the country are key to the success of pollinator conservation initiatives. The efficacy and importance of gardens to pollinator conservation has been highlighted through the success of our Million Pollinator Garden Challenge, as well as at the Chicago Field Museum. The take home?

It is absolutely true that small changes can make a massive impact - are you ready to become part of the solution?

Ohio Monarch Habitat Planting List

From 2015 through 2017 P2 monitored adult monarch butterfly use of candidate nectar plants in Ohio to develop practical monarch habitat plant lists supported by data. Three years of data collection have been analyzed and provide insight into adult monarch feeding and preference patterns. The monarch recommendations below are based on data collected from 18 native Ohio plant species planted at 18 sites throughout Ohio. The early blooming pollinator species will help maintain floral resources through most of the growing season.

Nectar Recommendations

Botanical Name	Common Name	Light	Water	Height	Bloom Time	Flower Color
MONARCH NECTAR ALL-STARS						
<i>Asclepias incarnata</i>	Swamp Milkweed	Full Sun	Medium Wet to Medium	4 feet	June-August	Pink/Rose
<i>Eutrochium purpureum</i>	Joe Pye Weed	Partial Shade	Medium Wet to Medium Dry	Up to 7 feet	July-September	Pink
<i>Symphotrichum novae-angliae</i>	New England Aster	Full Sun	Moist to Medium Dry	5 feet	August-October	Purple
GOOD MONARCH NECTAR PLANTS						
<i>Asclepias tuberosa</i>	Butterfly Weed	Full Sun to Partial Shade	Medium to Medium Dry	2 feet	June-August	Orange
<i>Echinacea purpurea</i>	Purple Coneflower	Full Sun to Partial Shade	Medium	Up to 4 feet	July-September	Pink/Purple
<i>Liatris aspera</i>	Rough Blazing Star	Full Sun	Medium	3 feet	July-October	Pink/Purple
<i>Lythrum alatum</i>	Winged Loosestrife	Full Sun	Moist to Medium Wet	3 feet	June-September	Pink/Purple
<i>Parthenium integrifolium</i>	Wild Quinine	Full Sun	Medium to Medium Dry	4 feet	June-September	White
<i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountain Mint	Full to Partial Sun	Moist to Medium Dry	2 feet	June-September	White
<i>Solidago rigida</i>	Stiff Goldenrod	Full to Partial Sun	Moist to Medium Dry	4 feet	August-October	Yellow
<i>Symphotrichum laeve</i>	Smooth Aster	Full Sun	Dry to Medium	Up to 4 feet	September-October	Purple
EARLY BLOOMING POLLINATOR FRIENDLY PLANTS						
<i>Penstemon digitalis</i>	Foxglove Beardtongue	Full to Partial Sun	Medium to Medium Dry	5 feet	May-July	White
<i>Tradescantia ohiensis</i>	Ohio Spiderwort	Full to Partial Sun	Medium	3 feet	April-July	Purple
<i>Zizia aurea</i>	Golden Alexanders	Full to Partial Sun	Medium	3 feet	April-June	Yellow

Milkweed Recommendations

Ohio has 13 native milkweed species (*Asclepias* spp.). P2 tested these four milkweed species for their nectar attractiveness, but not for larval preference: *Asclepias incarnata*, *A. syriaca*, *A. tuberosa*, and *A. exaltata*. *Asclepias incarnata* (swamp milkweed) proved to be the most attractive of the four milkweeds to adults seeking nectar. However proved, it is highly encouraged that you plant the right milkweed species for your site, all are beneficial to monarchs. Below are the most commonly available milkweed species and their growing conditions. *Asclepias incarnata* can tolerate regular watering, making it easy to incorporate into display gardens that are watered frequently.

Botanical Name	Common Name	Light	Water	Height	Bloom Period	Flower Color
<i>Asclepias exaltata</i>	Poke Milkweed	Partial Shade, Shade	Medium to Medium Dry	5 feet	June-July	White
<i>Asclepias incarnata</i>	Swamp Milkweed	Full Sun	Medium Wet to Medium	4 feet	June-August	Pink/Rose
<i>Asclepias syriaca</i>	Common Milkweed	Full Sun	Medium to Medium Dry	3 feet	June-August	Pink/Rose
<i>Asclepias tuberosa</i>	Butterfly Weed	Full Sun	Medium to Medium Dry	2 feet	June-August	Orange

Monarch Habitat Actions

The monarch migration is in peril but you can help! Here are key actions you can take on your land to support the iconic butterfly and keep the migration a natural wonder for generations to come.

Key actions:

-  Increase nectar species
-  Increase milkweed
-  Ensure bloom during key migratory periods
-  Reduce pesticides
-  Reduce impact of mowing
-  Communicate with neighboring landowners about pesticide application

Plant or seed nectar strips around milkweed and



Plant milkweed and nectar plant flowering strips around crops



Reduce wind speed by planting windbreaks



Plant or seed utility rights-of-way with milkweed and nectar species



Minimize mowing roadsides, margins and lawns to maintain bloom and ensure of caterpillars and



Adjust mow utility right-of-way to minimize impact on eggs and caterpillars

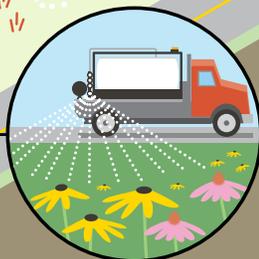


Roadsides with nectar species

Plant milkweed and nectar species on marginal lands



of marginal lands to maintain safety eggs



Minimize pesticide use near pollinator habitat



Planting schedule in roadside-of-way to impact to monarch caterpillars

Plant a monarch garden at home or school



Basic Monarch Habitat Checklist

Monarchs have a few basic requirements which are needed for good health and reproductive success. Below is a checklist for you to use to make sure these needs are being met by your monarch habitat project.

Food

- ✓ Milkweed: Female monarchs lay eggs on milkweed plants because the caterpillars (that hatch from the eggs) only eat milkweed leaves.
- ✓ Nectar Plants: Incorporate a variety of native flowers that provide nectar like goldenrod, bee balm, and asters. Adults need fuel (nectar) throughout the spring, summer and into fall, especially during peak migratory periods. Strive to maintain a continuous bloom from late April into mid-October. Use the [Planting List](#) on page 19.

Sun

- ✓ Adult monarchs need warm, sunny areas to regulate their temperatures or bask. Add a few rocks to your planting project to provide a warm resting area where adult monarchs can bask.

Shelter

- ✓ Windbreaks help slow wind speed and can create desirable areas for adult monarchs to feed. A windbreak can be a fence, hedge, or just a shrub.

Water

- ✓ Some butterflies and other pollinators benefit from having a fresh source of water available. This can take the form of mineral rich moist soil from which they can extract water (known as “puddling”) or a pond, birdbath, or shallow bowl of water with stones, pebbles and/or sand in it which rise above the water surface to provide them with a perch from which to drink. While much of the water that a butterfly needs comes from the flower nectar they consume, additional water and the minerals that it can contain can provide key hydration and nutrients. Remember to change the water frequently to reduce mosquito larvae or other contaminants.



Photo: Amber Barnes

Additional Monarch Resources

The following list of resources will help you dig deeper into topics such as plants and seeds for your new habitat site or additional information on protecting pollinators and how you can get involved.

Plants

When searching for where to purchase your plants and seeds for your monarch habitat project, wherever possible, look for local suppliers. Native plant nurseries are common in many areas of Ohio and surrounding area, while in other areas there needs to be a push from consumers to show there is a demand to expand the native plant industry.

Nurseries

Indigenous Landscapes (Pioneer Landscapes), Loveland, Ohio
Keystone Native Flora, Cincinnati, Ohio
Natives in Harmony, Marengo, Ohio
Ohio Prairie Nursery, Hiram, Ohio
Scioto Gardens, Delaware, Ohio
The Wilderness Center, Wilmot, Ohio
Natural Communities, Native Plants, Illinois

Nodding Onion Gardens, Columbia Station, Ohio
Cardo Native Plant Nursery, Walkerton, Indiana
Spence Restoration Nursery, Muncie, Indiana
Milkweed Market, Kansas
North Creek Nursery, Pennsylvania
Applied Ecological Services, Wisconsin

Plant Sales

Cleveland Museum of Natural History, Cleveland, Ohio
Holden Arboretum, Kirtland, Ohio

Shaker Lakes, Shaker Heights, Ohio
The Wilderness Center, Wilmot, Ohio

Migration Information

Journey North

Organizations with Additional Resources

Many books, websites, and people were consulted to gather information for this guide. Use this list as a starting point to learn more about pollinators and plants in your area. Some organizations you can explore include:

David Suzuki Foundation
Lady Bird Johnson Wildflower Center
Lake Erie Allegheny Partnership (LEAP)
Monarch Joint Venture
Monarch Watch
Wild Ones

Pollinator Partnership
North American Pollinator Protection Campaign (NAPPC)
The National Pollinator Garden Network
The Xerces Society

Ohio Monarch Initiatives

Monarch Wings Across Ohio
Ohio Pollinator Habitat Initiative

Regional and National Initiatives

Integrated Monarch Monitoring Program (IMMP)
Mid-America Monarch Conservation Strategy
Monarch Wings Across the Eastern Broadleaf Forest
Project Wingspan
S.H.A.R.E.



Additional Pollinator and Monarch Initiatives and Resources

BeeSmart™ Gardener APP for iPhone and Android, available at iTunes and the Google Play Marketplace.
Insight Citizen Science App for pollinator conservation and research. For iPhone at iTunes and <https://insightcitizenscience.com/>
Monarch Waystation Program: <http://www.monarchwatch.org/waystations/>
Ohio State University - Partners for Pollinators: <https://u.osu.edu/certif/>
Pollinator Partnership's Ecoregional guides for Ohio (there are two ecoregions for Ohio: Eastern Broadleaf Forest Continental and Eastern Broadleaf Forest Oceanic). Find the guides here: <https://www.pollinator.org/guides>
Pollinator Week: http://www.pollinator.org/pollinator_week



GARDENS

