PennState Extension

Milkweed Isn't Only for Monarchs

A glimpse into the bustling milkweed insect community.

Photo: Jack Meyer, Penn State

The milkweeds (*Asclepias* sp.) are an incredible resource for insects and other arthropods – their flowers are buzzing with pollinators lapping up nectar, their leaves covered with hungry herbivores, followed by roaming predators looking for nourishment. Even milkweed roots are food for insects feeding below the ground. Some of these visitors are exclusive milkweed lovers – what we call specialists. Not only is milkweed their favorite food but also the only food they will ever eat. There are over 100 different species of milkweeds that are considered native to North America, and even more found worldwide. Planting milkweed species native to the region in which you reside has been a major goal of conservation aimed at supporting both pollinators and other organisms that specialize in using this unique group of plants.

A well-known milkweed specialist is the monarch butterfly, *Danaus plexxipus*. As caterpillars, the monarch can only eat milkweed plants, while the adults will nectar on milkweeds and a variety of other flowering plants. Across the range where monarchs live, there may exist different species of milkweeds for a mother monarch to lay her eggs on, which will subsequently hatch out to these hungry caterpillars. In much of the United States, there are overlapping ranges of a few different species of milkweed, making regional differences in native species important to consider. In the Northeastern United States, the three native species of milkweeds recommended for planting by the Xerces Society of Insect Conservation are common milkweed (*A. syriaca*), swamp milkweed (*A. incarnate*), and butterfly milkweed (*A. tuberosa*) (Borders & Lee-Mader, 2014). All of which monarch caterpillars can feed and thrive on.

Each species of milkweed exhibits unique plant traits that might influence whether a conservationist or gardener might plant it. For example, common milkweed is often considered to be weedy since it can spread through rhizomes and grow in a wide variety of conditions. Common milkweed is among the tallest of the three species and has wide, fuzzy, large leaves. Swamp milkweed tends to grow bushier and can grow quite tall, yet has slender long leaves with no hairy trichomes. Butterfly milkweed is the smallest of the three species, with thin hairy leaves and bright orange flowers. The latter two species also do not tend to spread, making them a good choice for a garden setting.

Figure 1. (Left) An immature monarch butterfly (caterpillar) feeding on the flowers of butterfly milkweed, *A. tuberosa*. (Right) Foliage of *A. tuberosa* which consists of small leaves and is usually covered in dense hairs called trichomes. Photos: Lilly Germeroth, Penn State

Figure 2. (Left) A freshly emerged monarch caterpillar establishing a feeding site on *A. incarnata*, or swamp milkweed. (Right) A monarch caterpillar resting by its feeding site on *A. syriaca*, or common milkweed. Photos: Lilly Germeroth, Penn State

Most data and general information tend to focus on common milkweed, but in the last 5–10 years, there has been a large push to have other native milkweeds planted across the landscape. To get a better idea of what kinds of milkweeds gardeners within the Northeastern United States (with a bias toward Pennsylvania and surrounding states) were planting, we developed a survey that was distributed to gardening, native plants, insect enthusiast, and homestead social media pages, University listservs, Master Gardener chapters, and beyond. In total, we received over 300 responses, 194 of which referred to gardens in Pennsylvania. We found that the largest portion of respondents, 43%, had all three native milkweeds (common, swamp, and butterfly) present in their garden, as opposed to only common milkweed. Only 10% of respondents had only common milkweed in their gardens, and nearly 20% had both swamp and butterfly. This suggests that in this region, it is important to understand the challenges and/or benefits the monarch faces on each of these species of milkweed.

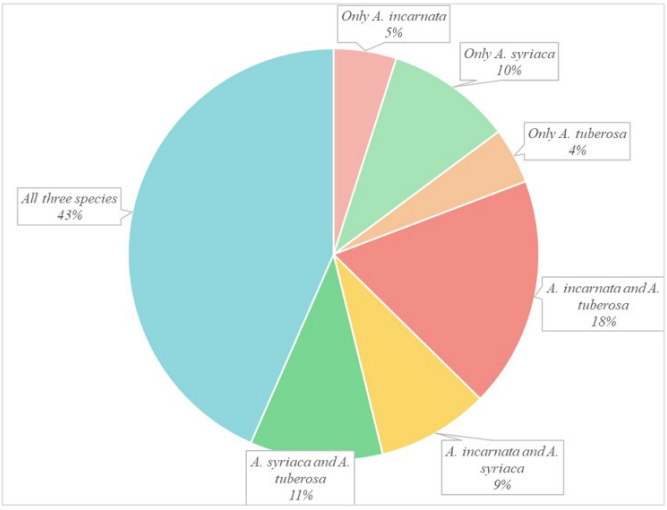

Diagram 1. Species of milkweed grown by Pennsylvania residents responding to a survey to determine the occurrence of milkweed in Pennsylvania gardens. Each response reflects the presence of at least one stem of the species in their garden. N=194

While monarchs will eat each of these milkweeds if given the chance, each of these plants offers a different microhabitat for this caterpillar, as mentioned above. Some of these physical traits are the most apparent to gardeners' eyes, but these plants also have different defensive chemicals in their tissues that defend the plant against being fed upon by these herbivores. Milkweed host plants are crucial to each of these specialist insects, making differences in how navigable the plant is for native insects and species of conservation concern, like the monarch, crucial. Importantly, we should consider how much nectar milkweeds have for pollinators, how plant defensive toxins play a role in insect visitation, and how planting different species of milkweeds might shape the community of insects feeding upon it.

A goal of gardeners and conservationists has been to understand which species of milkweed is best for the monarch. Additionally, when designing conservation plantings, one should consider which species is best for the monarch with attention to their interactions with the other native, beneficial insects with which they share the plant.

To take a close look at the milkweed insect community, researchers in the Hermann Lab of Arthropod Ecology and Trophic Interactions at Penn State University visited ten backyard gardens across the State College area that grew all three species of native milkweeds: swamp milkweed (*Asclepias incarnata*), butterfly milkweed (*Asclepias tuberosa*), and common milkweed (*Asclepias syriaca*). Each week, from May to September, we recorded all arthropods in each of the gardens on each of the milkweed species. This gave us a glimpse into an ever-bustling, growing, changing, reacting system, and with this data, we can see 1) what organisms use milkweed the most, and if this varies by milkweed species, and 2) if the presence of other members of the community, like competitors or predators, had a correlation with monarch egg and caterpillar abundances on the plants.

Figure 3. An example of a garden site. Photo: Sophia Mucciolo, Penn State

Who Uses Milkweed?

When you look at a milkweed plant, whether it's common, swamp, or butterfly milkweed, here are the top four organisms you are likely to see.

1. Aphids

Aphids are herbivores the size of a lentil, and most live their lives stuck with their straw-like mouthparts, feeding on the phloem (sugar-based substrate) within the plant. *Myzocallis asclepiadis* is an aphid specialist to common milkweed. They are pale green at the beginning of the summer season, and as the summer goes on, they turn pinkish-red. They can be found scattered across the bottom of common milkweed leaves and, through their feeding on the plant, spread sticky "honeydew" across the leaves. This honeydew, which most aphids produce, is a byproduct of drinking so much plant liquid and discarding extra sugars they get in their feeding.

Figure 4. *Myzocallis asclepiadis*. Image by permission, copyright Seth Ausubel, all rights reserved, from https://influentialpoints.com/Gallery/Myzocallis_asclepiadis_common_milkweed_aphid.htm

Aphis nerii is another species of aphid, but this species is a generalist, meaning they can feed on many types of plants. They are not native to Pennsylvania and migrate North from the Southern United States every year. Due to their prolonged migration, they arrive in the Northeastern United States in mid-summer. Of the milkweeds, their preferred host is swamp milkweed, *A. incarnata*, where it can be found crowding around the stems and veins of the plant.

Though *A. nerii* can often cause visible stress to swamp milkweed when heavily infested, it is unclear how removing the *A. nerii* would impact monarchs. The phenology of the organisms does not appear to overlap, leaving *A. nerii* a pest of milkweeds and not a problem for monarchs in this region.

Figure 5. (Left) *Aphis nerii* feeding in clusters on the stem of *A. incarnata*. (Right) An ant in the genus *Crematogaster* tending the aphid *Aphis asclepiadis*, a less common milkweed specialist aphid compared to *M. asclepiadis*. Photos: Lilly Germeroth, Penn State

2. Ants

Ants are also a frequent find on milkweed. Ants are often foraging for sustenance in the form of excreted honeydew or from arthropods they can bring back to their colony. Milkweed produces nectar which ants take advantage of, and the aphids that frequent milkweed offer honeydew as well. This relationship between these ants and aphids, often observed on milkweeds, can be considered a mutualism—the ant gets to drink this nutrient-rich by-product from aphids, and in return, the ants may protect the aphids from predatory arthropods.

3. Predators

Though monarch caterpillars can sequester toxins from milkweed, and they are not entirely defenseless, many generalist predators will eat monarchs as eggs and caterpillars (Hermann et al. 2019). These include things like spiders, ladybeetles, damselbugs, and stinkbugs. These predators are also some of our most valuable native predators, providing a service for common garden pests like aphids. While the general public is concerned about to loss of monarch butterflies, the benefit of native predators greatly outweighs the potential cost to monarch butterflies.

Figure 6. (Left) This is what a ladybeetle looks like early in its life. Here, it is roaming common milkweed looking for other insects to eat. (Right) An adult seven-spot ladybeetle foraging on swamp milkweed. Photos: Lilly Germeroth, Penn State

Figure 7. (Left) An adult lacewing on butterfly milkweed, *A. tuberosa*. Lacewings are predatory insects and feed on other insects throughout their lives. (Right) Predatory spiders are also commonly found on milkweed. This young spider has created an enclosure from a young common milkweed plant by folding the leaf over with its web. Photos: Lilly Germeroth, Penn State

4. Herbivores

Red milkweed beetles are another specialist to common milkweed, spending their whole lives with the plant. As adults, they roam the plant and feed on the leaves and flowers, and as young, they live underground and feed on the roots of the plant. They leave characteristic "U" shaped notches on the tips of leaves and make a defensive "peet!" sound when startled, which is the sound of forcing air out of small holes on their sides.

Figure 8. (Left))The red milkweed beetle is a type of Longhorn beetle (Family Cerambycidae). (Right) This is what milkweed seed bugs look like as young. Photos: Lilly Germeroth, Penn State

Milkweed seed bugs can be found quite easily on common milkweed, as they are bright red. When they are young, they feed in clusters, using straw-like mouth parts, similar to aphids. Once they are older, you can distinguish them as either the large milkweed seed bug, *Oncopeltus fasciatus*, or the smaller milkweed seed bug, *Lygaeus kalmii*. Though their feeding can reduce seed production by the plant, the average gardener need not worry about their impact.

Figure 9. These are large milkweed bug adults and nymphs feeding on milkweed seed pod. (Raymond Cloyd, KSU), from https://blogs.k-state.edu/kansasbugs/2020/10/02/large-milkweed-bug/

What Do Monarchs Like?

Monarchs do have a preference for where to lay eggs on different species of milkweeds (Pocius et al. 2018). Regardless of preference, after eggs are laid, the offspring are left with the mother's initial choice unless they leave the initial host plant for further feeding. Considering the species of milkweeds we plant can play a role in the survival of the caterpillars.

In our work, we found the most monarch eggs on swamp milkweed, *A. incarnata*, with about 20% fewer on common milkweed, *A. syriaca*, and the least on butterfly milkweed. However, we found the most mature caterpillars on common milkweed, *A. syriaca*.

Importantly, few eggs make it to hatching from egg to caterpillar, and even fewer caterpillars make it to adults (De Anda & Oberhauser, 2015)– the world is a tough place for these little monarchs, between predators wanting to eat you and a plant trying to keep you from eating it! So, mother monarchs lay hundreds of eggs across her lifetime in hopes that one will make it to adulthood. On *A. incarnata*, 23% of the eggs hatched out to larvae that we detected. On *A. syriaca*, the successful hatch rate to caterpillars was 45%. This comparison is interesting when considering *A. tuberosa*, where the larvae abundance was almost 90% of the egg abundance.

There are two major things that would cause a difference in monarch abundances on each of these species: rate of oviposition, or where the female lays her eggs, is different between these species due to chemical cues from the plant or because there are the habitat characteristics she likes (Cutting & Tallamy, 2015), (Pitman et al., 2018) and even the presence of insects she sees on the plant for be influential in this decision (Árnyas et al., 2009). The intensity of predation on eggs and caterpillars could be different between each of these species of milkweed, given the differences in predator community. Each species of milkweed could be delivering a different challenging dose of defenses in the sap of the leaves for baby caterpillars to have to cope with, and some are more toxic than others (Agrawal et al., 2009, Agrawal et al., 2012).

In short, we found the most monarch eggs on swamp milkweed, or *A. incarnata*, but the most caterpillars on *A. syriaca*. This is interesting, considering the higher abundance of predators and herbivores on *A. syriaca* as opposed to *A. incarnata*, and the differences in plant chemical defenses between these species of milkweed.

What Are Problems for Monarchs?

The most sweeping threats to the monarch butterfly are those of habitat destruction. This is largely in the overwintering range in Mexico, where the forest they return to annually has been largely, devastatingly, deforested (Brower et al., 2012). The monarch butterfly has evolved this annual dance of migration up the center of North America, following their milkweed host plant sprouting in the spring for food. As agricultural development has converted nearly all their natural habitat to cropland, the monarch's journey has become disjointed and seemingly more difficult (Thogmartin et al., 2017).

Backyard gardening efforts seek to scatter more stepping stones across the landscape for monarchs and our other native insects to use, like mirages in concrete deserts. You can learn more about what native plants you can plant in your backyard using the National Wildlife Foundation's Native Plant Finder, and consult the Xerces guides for further information on which milkweed to plant in your region.

Check out the video Up Close With Milkweed and Monarchs detailing the goals and conservation musings of the Hermann lab while conducting their research on native insect conservation.

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