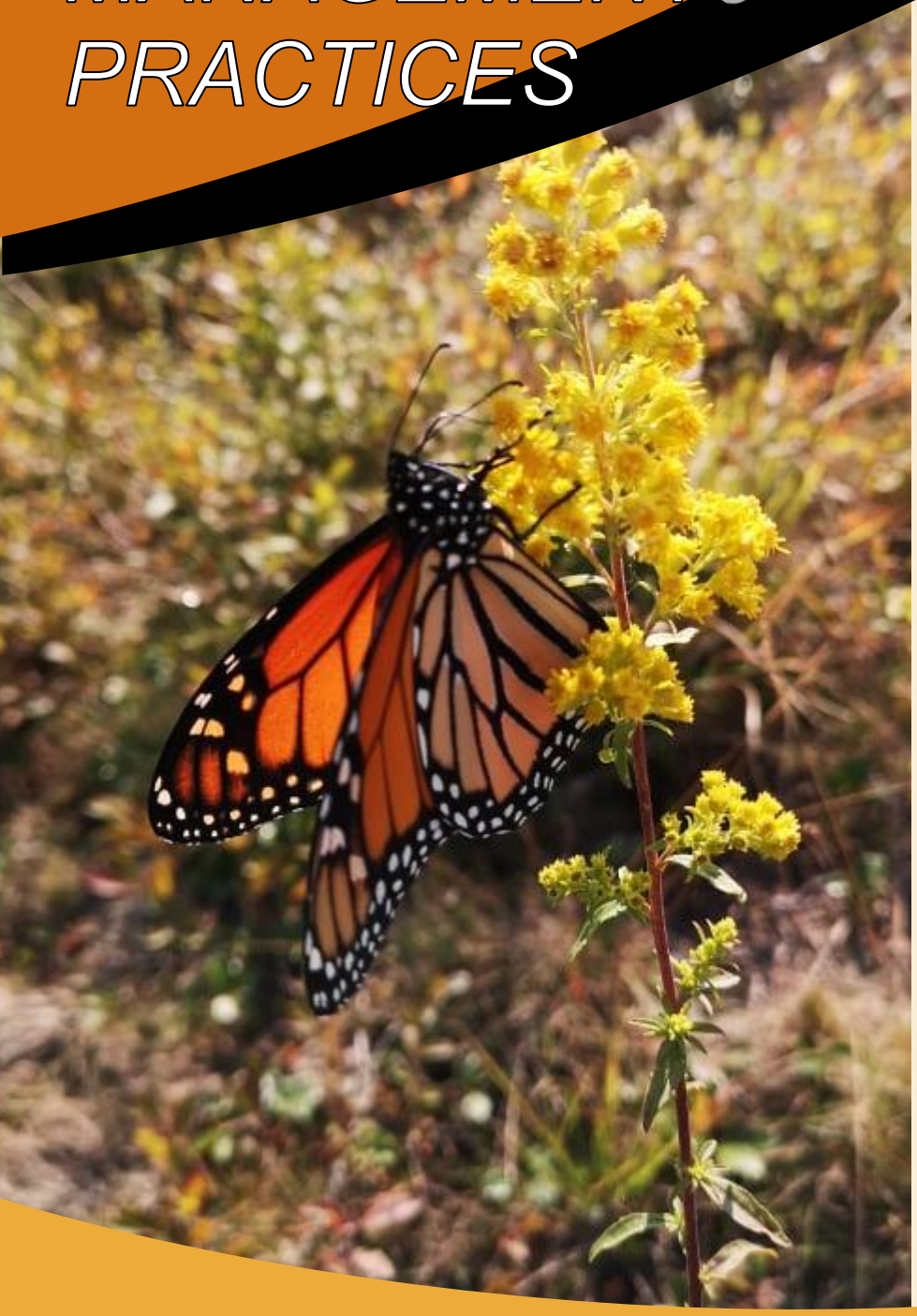
MONARCH BENEFICIAL MANAGEMENT PRACTICES



It is a hard to find a more charismatic species than the mighty Monarch butterfly (*Danaus plexippus*). Every year this species migrates 5000 km+ from its wintering grounds in Mexico to the United States and Canada. Sadly, this world traveler is Endangered in Nova Scotia, and their population is declining. Many factors are behind the range wide decline, but the most significant are the widespread use of pesticides and the loss of their habitat. Reclaiming and revitalizing lost habitat will be needed if we ever have hope to refill the sky, with the majestic Monarch butterfly.

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Introduction

Monarch

Monarchs are protected under the *Nova Scotia Endangered Species Act* (Nova Scotia Department of Natural Resources and Renewables 2021) and the *Species at Risk Act* (Environment and Climate Change Canada 2016), under which they are currently listed as Endangered. Monarchs undergo several life stages and have one of the largest migrations in the animal kingdom. This offers a challenge to conservation efforts, as not only must the resources be available to complete the life cycle, but this must happen at an extremely large scale, spanning three countries.

Monarchs annually migrate 5000 km to Mexico from the northern edge of their migration route, where they overwinter until the following spring. The spring migration typically takes three to four generations of butterflies to complete the journey from Mexico back to the northern parts of their range, with each generation living a few weeks. In their summering grounds, the final “super generation” of butterflies that emerge in the fall will complete the journey south to the overwinter site, living up to eight months, and begin the cycle again in spring.

Monarch Fact

Male Monarchs possess scent glands on their hind wings to attract females. This feature can be used to identify males from females.

Photo credit: Delaine Carlson

Photo credit: Carter Feltham

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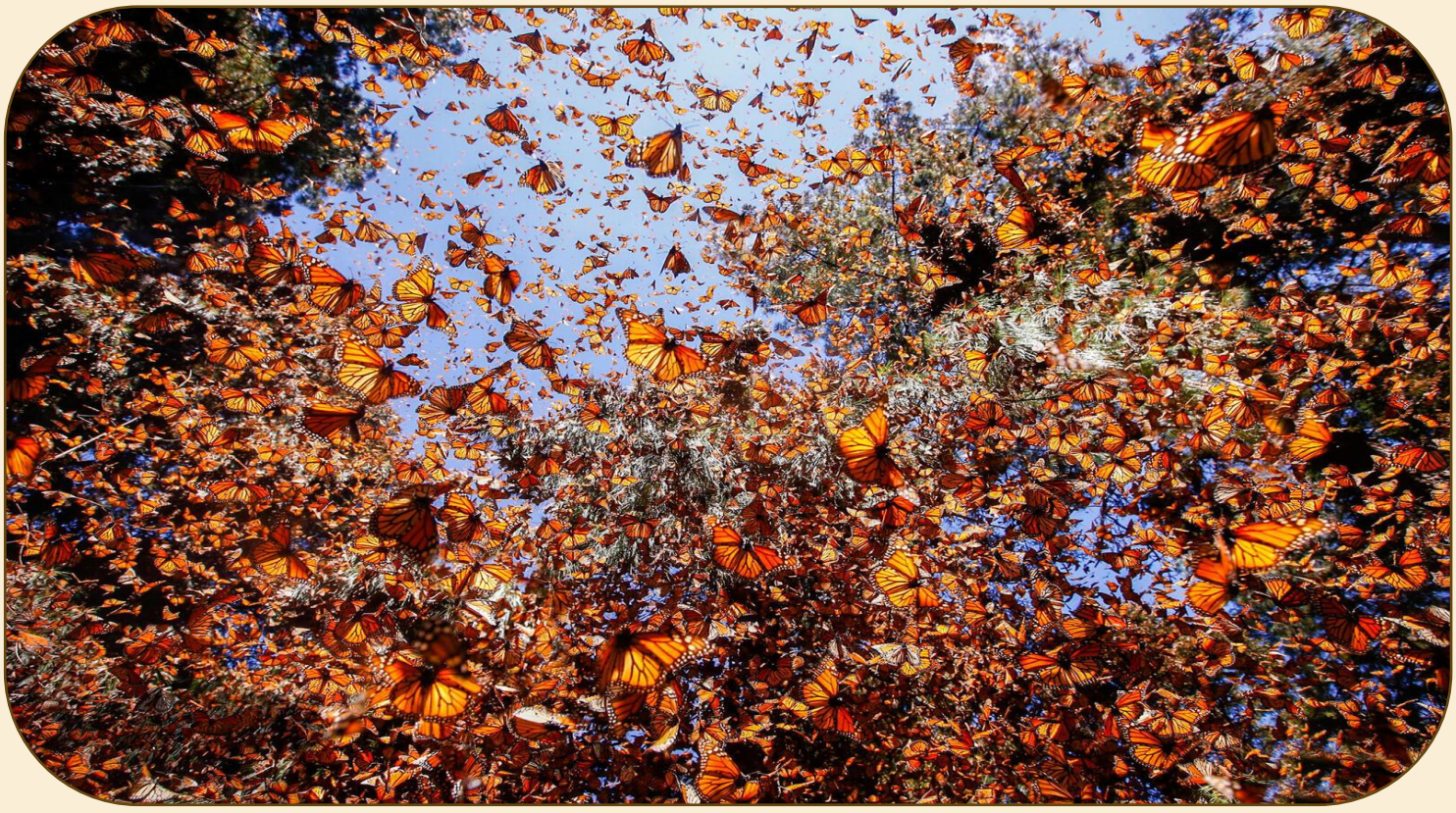
Goehring and Oberhauser (2002) demonstrates that shorter daylight hours and cooler, fluctuating temperatures are key signals for Monarchs to enter reproductive diapause and prepare for migration. As part of the northern edge of the range, Nova Scotia plays a critical role in providing the resources needed for these butterflies to make the journey to the overwintering site. To achieve this, we must focus on maintaining and improving safe food sources along the migration route and at staging areas. This generation will complete the journey south to the overwinter site, living up to eight months, and begin the cycle again in spring.



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Monarch Mimic

The Viceroy (*Limenitis archippus*) mimics the Monarch butterfly, with the key difference being a lateral vein on each hind wing.

Photo credit: Lori Phinney

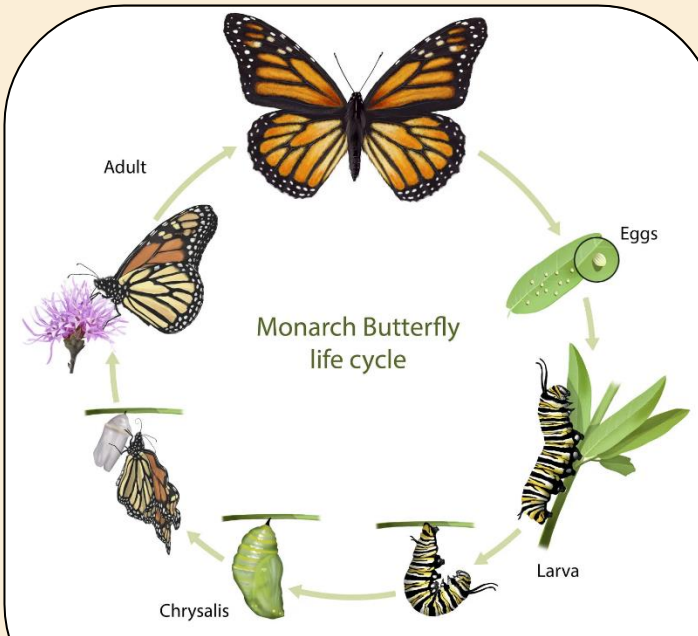

Diagram credit: Nicolas Primola/Shutterstock.com

Monarch Biology

The key to a successful Monarch habitat comes from addressing the needs of each life stage. Adult female Monarchs can only successfully lay eggs on *Asclepias* species, commonly known as milkweed. Female monarchs can lay up 300-400 eggs in their lifetime, typically only laying one egg on each milkweed plant (Monarch Joint Venture 2024). The caterpillars will consume leaves of the milkweed, ingesting the toxin produced by the plant and storing it for their own defense system. This toxin makes both caterpillars and adult butterflies unpalatable for most predators thus they are brightly colored as a warning. The caterpillars grow and molt through five stages, called instars. During these stages they will become 2000 times their original mass (Monarch Joint Venture 2024). They may strip several neighboring milkweed plants of their leaves during their growth, it's important to have plenty available so they can complete they full life cycle.

Once ready to pupate the caterpillars will find a safe area to attach themselves to a sink pad they create, shedding their skin once more to reveal a chrysalis. Once ready the butterfly will emerge from the chrysalis, hanging upside down to allow fluid from the abdomen to fill the wings.

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Monarch Biology Continued

The wings unfold and dry over time, allowing the butterfly to take flight in search of food. Once emerged the adult Monarchs will feed on nectar from flowering plants and serve an important role as pollinators. After their long metamorphic period, nearby flowers will provide that very important first meal as an adult. Once environmental cues indicate to these butterflies it is time to begin the migration, their bodies will contribute food resources to build flight muscles. Having sufficient food resources along the flight path south towards Mexico is a key to ensure amble energy for the journey. Along this route, butterflies congregate in areas that provide food and shelter during the night, these areas are called “staging areas”. Also known as roosting areas, large numbers of butterflies may spend time here when they are not active.

This document focuses on two of these key areas in Nova Scotia: breeding habitat for the larval stage and staging areas for migrating adults.

Common Milkweed

(Asclepias syriaca)

Key Areas

Breeding Habitat: areas with abundant native milkweed species and nectar producing plants.

Staging Areas: open areas where Monarch can rest, feed, and shelter during migration.

Photo Credit: Carmella Joy Newell

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Breeding Habitat

In Nova Scotia, we have two species of naturally growing milkweed, Common Milkweed (*Asclepias syriaca*) and Swamp Milkweed (*Asclepias incarnata*).

Swamp Milkweed can often be found growing in wet areas such as along riverbanks and lakeshores. The plant can grow up to 120 cm tall, alternating leaves, and delicate deep pink flowers clusters which transform into pods containing hundreds of seeds in the fall (Credit Valley Conservation 2022). Individual seeds have fluffy white floss that carry the seeds on the wind to disperse them.

Common Milkweed is more often found in agricultural landscapes and disturbed areas, easily spotted along the highways in summer with their large pink cluster of flowers. In addition to having wind dispersed seeds Common Milkweed can reproduce through underground root shoots, forming large clusters of clones (Plant database 2022).

There are many other species of milkweed throughout the Monarch's range, and some can be purchased in Nova Scotia. However, its best to encourage native species.

Swamp Milkweed *(Asclepias incarnata)*
Photo Credit: Carter Feltham

Common Milkweed *(Asclepias syriaca)*
Photo Credit: Lori Phinney

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Staging Habitat

When Monarchs begin migrating south for the winter, they may gather in groups in areas called “staging areas” or “roosts”. These sites are areas where they can feed on nectar-rich plants and find shelter to spend the night before moving on their way further south towards the overwintering sites in Mexico. These sites may naturally change over time; however, a few sites in Nova Scotia have been observed being used repeatedly. Reports of Monarch gatherings in Nova Scotia tend to occur in coastal areas with large areas of wildflowers (MTRI Resource Database). While the critical characteristics of staging areas in Nova Scotia are not fully understood, managing current staging areas can be as simple as allowing them to remain as wildflower fields. Some areas are at risk of succession into shrub lands and forest, which may require some manual removal, but for other sites this occurs naturally due to the landscape.

Monarch staging area identified in Nova Scotia. The habitat is dominated by nectar-producing wildflowers and grasses due to the shallow soil layer on rock and high winds preventing any tall trees from growing.
Photo Credit: Carter Feltham

Threats

Monarchs face several risks related to habitat loss and degradation, both within Nova Scotia and across their broader range. While the availability of milkweed in Nova Scotia, essential for Monarch breeding, is not well documented, the species faces greater threats outside the province.

In their overwintering habitats in Mexico and California, Monarchs are threatened by deforestation and habitat destruction. The loss of forest cover in Mexico, primarily due to illegal logging, reduces the availability of essential overwintering sites.

Throughout their migratory and breeding range, large-scale agriculture has drastically reduced milkweed, the only food source for Monarch larvae. Widespread herbicide use, especially in areas with genetically modified crops, has eliminated much of the milkweed in key regions like the Midwest, driving population declines.

Pesticide use poses an additional threat. Insecticide exposure can directly impact caterpillar survival, and research shows that Monarchs prefer to lay eggs on milkweed plants that haven't been exposed to insecticides (Prouty *et al.* 2021; Olaya-Arenas *et al*. 2020).

Threats Continued

In Nova Scotia, herbicide use, particularly in gardens and agricultural fields, can similarly remove milkweed from the landscape. Although Monarchs rely on milkweed, the plant can be problematic for farmers, as its latex-filled sap can interfere with equipment, and its consumption by livestock can cause health problems. Additionally, invasive species such as Dog-strangling Vine (*Cynanchum louiseae)*, further threaten Monarchs by tricking females into laying eggs on plants where larvae cannot survive (King's Printer for Ontario 2021).

Monarchs are also vulnerable to vehicle collisions. Roadsides often attract Monarchs due to abundant nectar producing plants, but these areas also put them at high risk of mortality. Planting important breeding and staging habitats away from roads can help reduce collisions and support population recovery.

The combination of habitat loss, agricultural practices, vehicle strike, and the use of pesticides presents a significant threat to Monarch populations, particularly across their migratory and breeding range in the United States and Canada.

Dog-strangling Vine *(Cynanchum louiseae)*
Photo Credit: Jennifer Forman

Common Milkweed leaf executing milky white latex sap

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Predatory stink bug *(Pentatomidae sp.)* feeding on Monarch caterpillar.
Photo Credit: Anurag Agrawal, Cornell University

Monarch caterpillar eating milkweed leaves.
Photo Credit: Carter Feltham

Predation

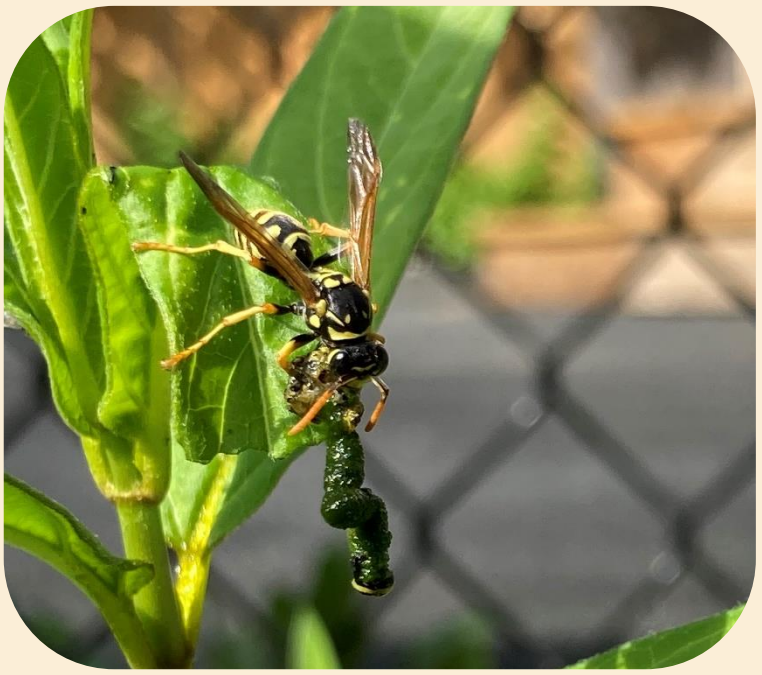
Predation is a natural and essential part of the Monarch's lifecycle, with many predators targeting Monarchs during their early life stages, including predatory insects and birds. While this is a normal ecological process, certain human-induced conditions can artificially increase predation risk. When planning or managing habitat for Monarchs, it's important to focus on minimizing factors that may lead to an unnatural rise in predation, such as structures that encourage predatory species like wasps to nest nearby. Wasps are known to prey on Monarch caterpillars and may be attracted to flowering milkweed. To reduce this risk, it may be beneficial to manage milkweed flowering and remove nearby structures that could serve as potential nesting sites for wasps. It is essential to recognize that Monarchs naturally produce hundreds of eggs, but only a few caterpillars survive to adulthood. This low survival rate is crucial for natural selection, ensuring that the fittest individuals maintain the species' migratory behavior. Monarch caterpillars serve an important ecological function, both as grazers and as prey, contributing to the overall health of the ecosystem

Predation Continued

While it may be tempting for people to remove caterpillars in an effort to 'protect' them from predation, such interventions disrupt natural processes and can have unintended consequences. Encouraging a diversity of native plants helps create a balanced habitat with a healthy mix of predators and prey, supporting the natural ecosystem that Monarchs rely on.

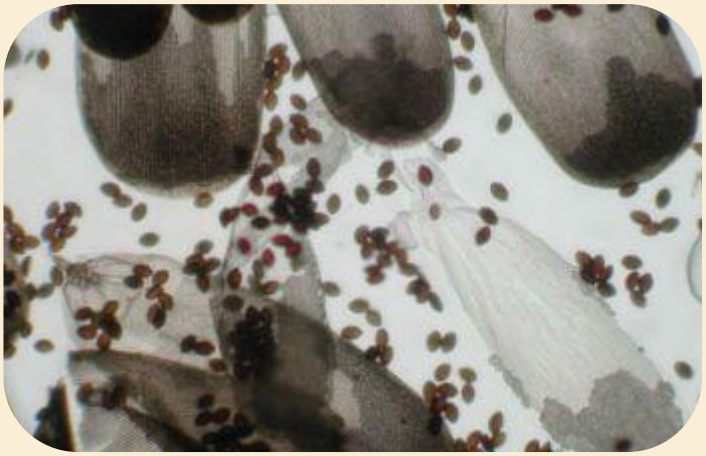
Disease

Ophryocystis elektroscirrha (OE) is a protozoan parasite that infects Monarch butterflies, often causing lethal effects. The parasite's spores are deposited on milkweed leaves and eggs by the female during the egg-laying process. When Monarch caterpillars eat the contaminated leaves, they ingest the spores and become infected. As the caterpillar pupates, the parasite reproduces inside it, and when the adult butterfly emerges, its body is often covered with OE spores. In heavily infected Monarchs, the infection can lead to deformities, and they may be unable to fly (Monarch Health 2019).



Wasp feeding on Monarch caterpillar.
Photo Credit: Julie McKnight

Monarch caterpillar eating milkweed leaves.
Photo Credit: Carter Feltham



***Ophryocystis elektroscirrha* (OE) spores between butterfly scales.**

Monarch feeding on A. *syriaca* flowers.
Photo Credit: Lori Phinney

Disease Continued

While research by Geest *et al.* (2019) found no significant difference in OE infection rates between natural and cultivated sites, captive rearing greatly increases the risk of OE infection, especially when done improperly. Healthy individuals can become infected if enclosures, tools, or surfaces are not thoroughly cleaned. Furthermore, studies have shown that captive rearing may reduce an individual Monarch's fitness, impacting its ability to migrate successfully (Tenger-Trolander and Kronforst 2020; Davis *et al*. 2020). Given the conflicting research on the overall impact of captive rearing, we advocate for a hands-off approach to Monarch conservation, as it better supports natural selection and the species' resilience in the wild.

Habitat Needs

More and more studies have explored the finer details of Monarchs and milkweed, giving clues to the best practices we can use. Pocius *et al.* (2017) examined survival of Monarch caterpillars on various milkweed species, which found that caterpillars on our two native species of milkweed have high survival rates (>60%). Several studies have compared cultivated wild milkweed for Monarch survival and found no significant difference (Cutting and Tallamy 2015; Geest *et al.* 2019). Geest *et al.* (2019) also examined the difference between wild milkweed and milkweed in gardens and found similar egg density, survival, parasitism, but Monarchs are three to five times more likely to lay eggs in gardens.

Another study looking into the impacts of pesticides on Monarch noted that the caterpillars grew faster on Swamp Milkweed (Prouty *et al.* 2021). Baker and Potter (2019) examined further into structure of cultivated milkweed patches and determined Monarchs were two and a half to four times more abundant in patches with milkweed planted at the edge of the habitat. They also detected a preference for Swamp Milkweed and Common Milkweed over Butterfly Weed (*A. tuberosa*) and for spacing between individual milkweed plants from other plants, including other milkweeds.

Take Aways

- Both wild and cultivated milkweed patches are beneficial (Cutting and Tallamy 2015; Nestle *et al.* 2020; Geest *et al.* 2019)
- Native milkweeds are the best choice (Baker and Potter, 2019; Prouty *et al.* 2021; Pocius et al. 2022)
- Strategic mowing of milkweed can increase value to Monarchs (Kings *et al.* 2019; see **Mowing** pg 20)
- Habitats with diverse native plants are best (Nestle

Photo Credit: Nicole Hubley

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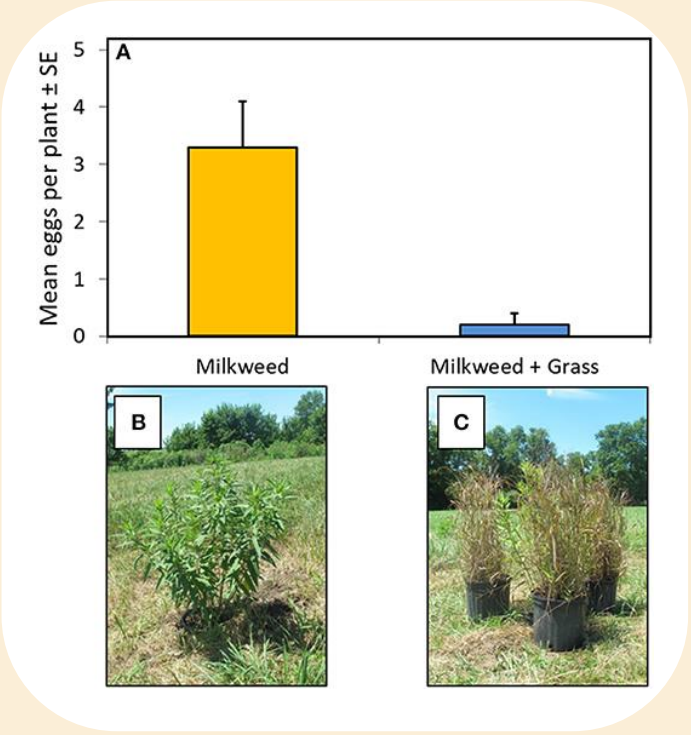
Habitat Targets

This table along with the provided score cards were adapted from the Guide to Managing for Optimal Habitat Attributes: Monarch Butterfly from the Saskatchewan Prairie Conservation Action Plan (2020).

Table 1. Table of habitat features and habitat types to consider when managing Monarch habitat. *In this case small refers to patches ≤5m^2, and medium is ≤16m^2.

Habitat Feature	Habitat Targets		
	Natural Habitat	**Agricultural Habitat**	**Restored Habitat**
Breading Habitat (Juveniles)			
Patch Configuration	Many small* patches of milkweed, including partially shaded areas	Many medium* patches of milkweed, including partially shaded areas	Many small* patches of milkweed, including partially shaded areas
Habitat Isolation	Distance to nearest patch <7 km		
Native Milkweed Density	>0.15 stem/m^2	0.5-2 stem/m^2	>0.15 stem/m^2
Native Milkweed Abundance	At least 10 stems per patch with any combination of *A. incarnata* or *A. syriaca*		
Nectar Producing Plant Abundance	Additional 8 or more nectar producing plants		
Vegetation Buffers	At least 200 m of herbaceous vegetation	At least 200 m of herbaceous vegetation	At least 200 m of herbaceous vegetation
Nectaring Habitat (Adults)			
Nectar Producing Plant Diversity	At least 6 species of summer and 6 species of fall flowering plants. Ideally 2 species with consecutive blooms. (For other pollinator species: an additional 2 species of early spring following plants)		
Vegetation Buffers	Nectar producing patches surrounded by at least 200 m of perennial herbaceous vegetation		
Staging Habitat (Adults)			
Nectar Producing Plant Diversity	≥6 stem/m^2 of late blooming nectar producing plants		
Roosting Locations	Occasional sheltered shrubs or trees within 1 km of staging habitat		

Score Card Background

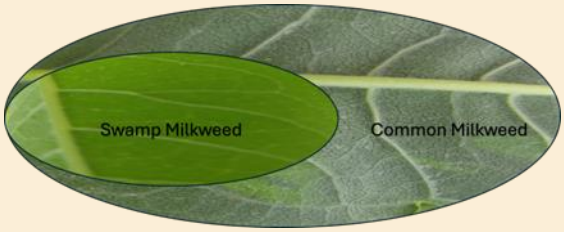


Comparison of mean number of eggs found on visually unobstructed and obstructed milkweed.
Figure Credit: Baker and Potter 2019

Patch Size and Configuration:

Blader (2018) found that Monarchs showed no preference for any patch size from observing roadside patches of milkweed growing in Iowa. The author suggested that finding an optimal patch size would be dependent on the predation and mortality rates in different patch sizes. Nail and Oberhauser (2015) determined ~29 milkweed plants may be needed to produce one migratory Monarch; however, they indicated this may only be relevant to the north-central region of the US. Grant *et al.* (2022) found that caterpillars would abandon their natal stem before consuming all its foliage, using three to four stems to feed from throughout its larval stages. They concluded that two to four stems of Common Milkweed equivalent to the biomass of a 10-35 cm stem would be sufficient for a single larva. Common Milkweed can grow taller and has larger leaves than Swamp milkweed, therefore one stem of Common Milkweed may be more equivalent to three to four Swamp milkweed stems of a similar size. A single stem of Swamp milkweed can reach up to one and a half meters, comparing from Grant *et al.* (2022) work we can estimate that one mature stem could sustain one caterpillar. Considering all that has been presented, having multiple mature and young plants would be best practice.

Baker and Potter (2019) examined various configurations of gardens and determined Monarchs were two and half to four times more likely to visit gardens where milkweed was planted along the border instead of within the interior. Interestingly they also found that milkweeds obstructed by grasses received little to no Monarch eggs, despite having some visible access.



Visual representation of leaf size differences of *A. incarnata versus A, syriaca.*

Guidelines established by Saskatchewan Prairie Conservation Action Plan (2020) suggest providing three small patches of milkweed of at least 10 stems of milkweed each.

Many Nova Scotians have reported running out of milkweed for their Monarch caterpillars. Monarchs may be attracted to the gardens for the high-quality milkweed but laying more eggs than the patch can support if not enough milkweed is available within the site and within the travel distance for the female butterfly to distribute her eggs more appropriately. While establishing enough milkweed patches across the province within 7 km radius suggested by Saskatchewan Prairie Conservation Action Plan (2020) may prove difficult, we can attempt to mitigate the issue of overpopulating sites.

From the previous studies stated, Monarchs are more likely to lay on milkweed that is unobstructed, and if all milkweed available is unobstructed they could potentially lay on every milkweed available in the patch likely leading to overpopulation, especially if predation is low. Intentionally obstructing some milkweed so females will not lay eggs on them may provide a buffer of food resources for caterpillars later. While the movement abilities of caterpillars are not currently known, Monarch Joint Venture (2024) states that caterpillars may walk up to 10 m to find an area to pupate. It can be assumed that plants within 10m may be utilized by caterpillars. For every milkweed stem on the exterior of the patch and thus readily available for laying females, at least one stem should be planted in the patch interior or obscured within 10 m as a food resource.

Habitat Isolation:

Breeding Monarchs can fly up to one and a half kilometers in a day for a total of approximately 10-15 km in net lifetime (Grant *et al.* 2022). If milkweed patches are scarce females' overall fecundity may be reduced (Zalucki and Lammers 2010). Providing milkweed patches that minimize gaps between natural patches would be the most ideal situation, however the abundance and distribution of wild milkweed in Nova Scotia is currently not well understood. Caution must be taken when introducing new patches of cultivated milkweed in areas without other known patches to prevent attracting Monarchs to areas with limited resources.

Native Milkweed Density and Abundance:

Blader (2018) compared oviposition on stems within three density patches, single stem, five stems and ten stems (or 0.5, 2.5, 5 stems/m^2 respectively). Monarchs laid eggs in all three patches, taking advantage of all the milkweed available to them regardless of low-density stem patches being only 10 m from the higher density patches. Blader (2018) also examined wild growing roadside milkweed patches and found instances of high juvenile densities (two per stem) in low density patches (<0.25stem/m^2), although the average was typically <0.5 juveniles per stem and average stem density was 0.14 stems/m^2. Other studies such as Knight *et al.* (2019) found no effect of milkweed density on presence of eggs, while a previous study found egg density decreased when milkweed increased beyond 2 stems/m^2 (Pitman *et al.* 2018). Cutting and Tallamy (2015) found that small, low-density patches of milkweed supported the highest survival of Monarchs in Australia.

Native Milkweed Diversity:

Nova Scotia has a limited availability of native milkweed species, the only two being Swamp Milkweed and Common Milkweed. A study found that when multiple species of milkweed were available female Monarchs laid most eggs on Swamp Milkweed and laid two and a half times more eggs overall (Victoria *et al.* 2018).

Nectar Producing Plant Abundance:

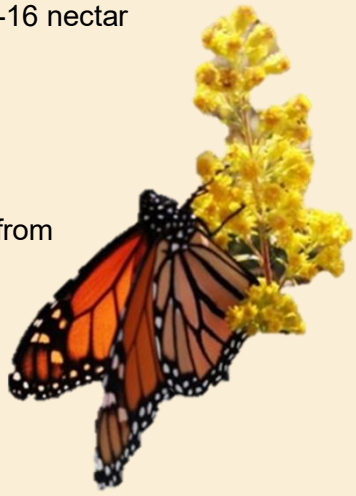
A study in Texas found the highest number of Monarchs in patches with 4-16 nectar plants in a plot (USDA 2019)

Buffers:

The butterfly club developed by Parks Canada and the Mersey Tobeatic Research Institute recommends creating pollinator gardens at least 50 m from roadways.

Nectar Producing Plant Diversity:

Plants that provide nectaring opportunities, also called forbs, are important for breeding Monarchs and those recently emerged, gathering resources to migrate south. Providing a variety of native forbs will benefit more species than just Monarchs and opportunities to



Monarch feeding on Goldenrod sp. an important late blooming forb.

feed throughout the season. Providing nectar sources that have staggered, or continuous blooms ensures a reliable food source for pollinators. Monarchs typically arrive in Nova Scotia mid-summer (July) and begin migrating south between September and October. Thus, having nectar available for this time span would be critical. Visit Pollinator Partnership Canada online for region specific native plant guides (Pollinator Partnership 2025).

Interactions with Other Species:

Supporting one species at risk can help to support other species. By providing nectar producing plants that flower in early spring, the habitat created can support early emerging pollinators. Adding other host plants and plants that provide food, and nesting materials can improve the area's diversity and create a more natural ecosystem.

Late Blooming Forbs

- Virgina Rose *(Rosa virginiana)*
- Yarrow (*Achillea millefolium spp.*)
- Pearly Everlasting (*Anaphalis margaritacea*)
- Fireweed (*Chamerion angustifolium*)
- Boneset (*Eupatorium perfoliatum*)
- Joe-pye Weed (*Eupatorium maculatum*)
- Black-eyed Susan (*Rudbeckia hirta*)

Roost Location:

Monarch butterflies need areas to roost from bad weather and through the night. Suitable roosts may be larger trees such as willows, maples, or conifers, although it seems any larger shrubs or trees would suffice (Saskatchewan Prairie Conservation Action Plan 2020).

Other Considerations:

Creating habitat for Monarchs has the potential benefit of creating food sources for other pollinator species. In Nova Scotia there are many bee and insect species at risk. Taking into consideration general needs of many species and providing safe resources can positively impact many species at risk.

Baker and Potter (2020) found that butterfly houses were used predominantly by predatory wasps and no evidence that butterflies used them.

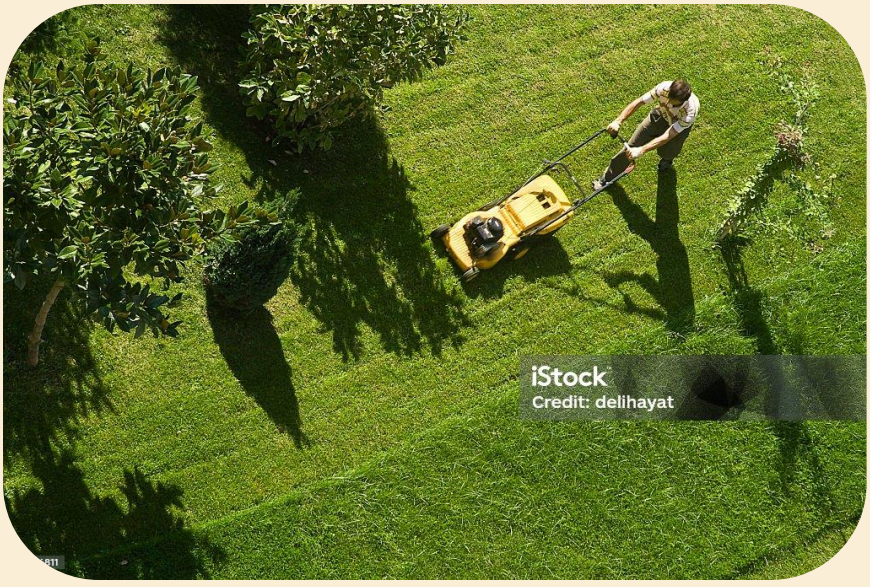
Planting native milkweed in groups or clumps can increase pollinator efficiency and protect pollinators from predators (Colangelo *et al.* 2024).

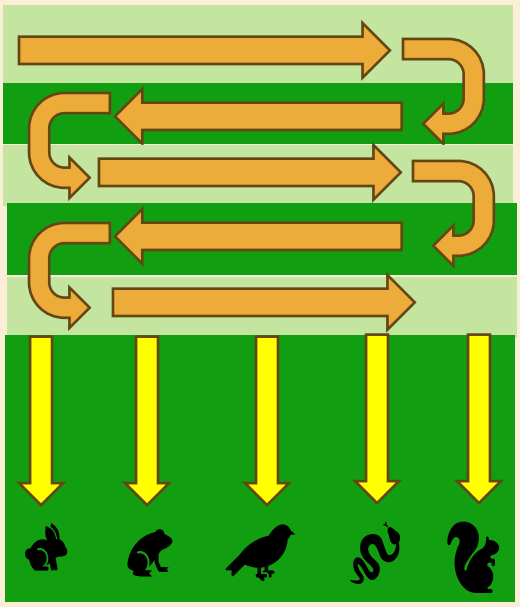
Mowing

Strategic mowing should be completed in early Summer before Monarchs arrive to avoid accidental mortality. Mowing sections of milkweed patches can improve their value if done two to three weeks prior to their arrival (generally mid-late June) as young milkweed shoots are prefered (Knight *et al.* 2019). Areas dominated by forbs should be mowed in sections, keeping areas uncut for continuous nectar supply for pollinators. Mowing flowering plants can help replenish nectar supplies by encouraging new growth in areas where nectar producing plants may be spent and no longer producing nectar.

Mowing Tip

When mowing an area, the traditional pattern of moving in a circle can trap animals in the center of the area. Its best to mow from one side to the other so animals can escape away from the mower.





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When mowing areas to benefit insects, mow no more than one third of the patch/area at a time (Michalsky *et al.* 2020). After new forbs have begun to bloom in the area that was cut, the next area can be trimmed. Mowing in wetland areas should be avoided completely, for both the animals and your lawn mower. Wetlands not only provide important habitat for wildlife, including Monarch and many other species at risk, they also serve as nature-based climate change solutions and mitigate impacts of severe weather (e.g., fooding, sea level rise, storm surge), they also act as “carbon sinks” and provide carbon storage.

Some species of bird will nest on the ground, take extra caution when mowing if a bird flushes and begin vocalizing alarm calls. The bird has likely nested in the area so it is best to mark off that area completely from any mowing activities until after the nesting season (May 1-August 31).

The Bobolink is at risk ground nesting species of migratory bird in Nova Scotia. They nest in open grassland habitats such as hayfields, pastures and farmland areas.

Take Aways

Provide **buffer** around patches

Plant at least **3 patches** of native milkweed

Ensure at least **10 stems** of native milkweed in each patch

Plant **native wildflowers** to provide resources for our native wildlife

Patch mowing can benefit pollinators

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Questions or sightings? Let us know!
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