REGIONAL POLLINATOR ACTION PLAN

for

FRANKLIN COUNTY

Identifying and Expanding Wild Pollinator Habitat Across Franklin County

Prepared by the Franklin Regional Council of Governments (FRCOG) in collaboration with the Towns of Heath, Shelburne, Conway, Montague, Greenfield, Wendell, Bernardston, and Orange.

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Franklin Regional Council of Governments

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INTRODUCTION

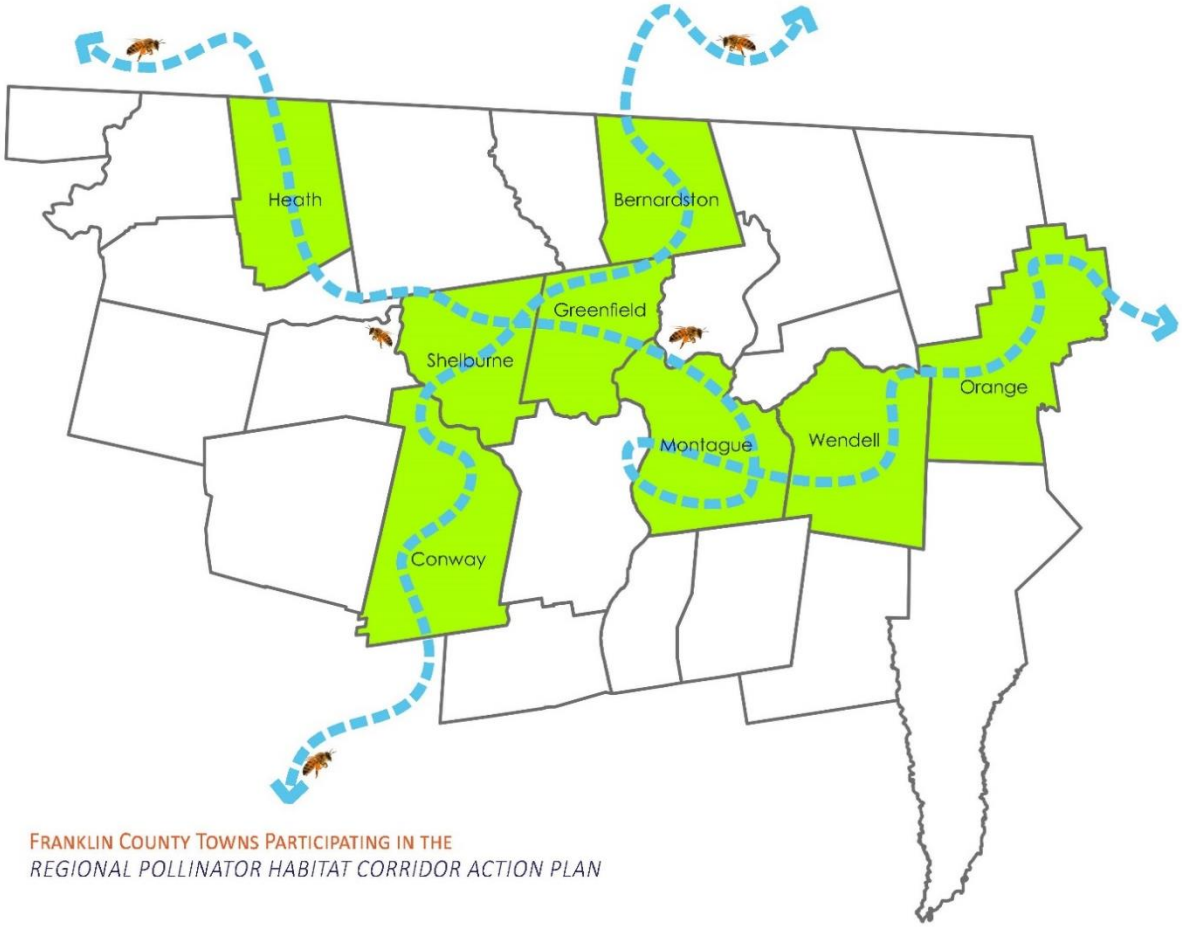
The Commonwealth of Massachusetts has a rich diversity of native wild pollinators, including an estimated 380 species of bees and 120 species of butterflies. In recent decades, however, both managed, agricultural pollinators and wild, native pollinators nationwide have experienced significant challenges to their ability to survive and flourish. In the 2017 *Massachusetts Pollinator Protection Plan*, the Massachusetts Department of Agricultural Resources (MDAR) identified the need to evaluate, sustain and enhance pollinator populations in the state.[1] This urgent task is not only important to protect biodiversity and fully functioning ecosystems, it is also linked to the climate resiliency and sustainability of our local farms and food systems. Agriculture, a key industry sector of Franklin County, is important to both the county's economy and character.

Eight Franklin County communities are working together to proactively identify, create and support pollinator habitat in and around areas of development to respond to declining populations of native pollinator species. The Franklin Regional Council of Governments (FRCOG) worked with Greenfield, Heath, Shelburne, Conway, Bernardston, Montague, Wendell, and Orange to map local pollinator resource areas and identify corridor linkages at both the municipal and regional scale. This plan addresses the overall decline of native wild pollinators in the county by identifying existing and potential pollinator habitat in participating towns and presenting both general and town-specific strategies to strategically create or expand habitat in order to create "corridors" and "stepping stones" that connect existing habitat areas. Taken together, the work of the eight participating towns creates the Regional Pollinator Action Plan for Franklin County, the first of its kind in Massachusetts. To view the *Regional Pollinator Action Plan,* the *Regional Pollinator Habitat Corridor Implementation Toolkit*, and the *Pollinator Action Plans* for each of the eight participating towns, go to https://frcog.org/franklin-county-regional-pollinator-plan/.

Green Infrastructure
The use of vegetation, soils and other elements and practices to restore some of the natural processes required to manage stormwater runoff and protect surface waters

The plan addresses a pressing climate problem facing Franklin County and the rural landscapes across the Commonwealth: the health, biodiversity and climate resiliency of plants in our diverse ecosystems. This includes "green infrastructure" in our developed town centers and the sustainability of our local farms and food system. FRCOG's approach includes updating land

[1] Apiary Program Working Group, Division of Crop & Pest Services, "Massachusetts Pollinator Action Plan" (2017): https://www.mass.gov/files/documents/2017/06/zw/pollinator-plan.pdf



FRANKLIN COUNTY TOWNS PARTICIPATING IN THE
REGIONAL POLLINATOR HABITAT CORRIDOR ACTION PLAN

use regulations to require planting of native plants that attract and sustain native pollinators, improving management techniques in existing or potential pollinator habitat, and identifying opportunities to integrate pollinator plantings into climate resiliency projects. Climate resiliency projects that manage stormwater and improve flood resiliency in village centers and downtowns, restore riparian buffers and river functions in watersheds, and retain soil and reduce erosion on farmlands, present opportunities to integrate beneficial plantings and landscape management practices. New development integrating low-impact development (LID) best management practices or nature-based solutions are also opportunities to integrate pollinator habitat. Implementing and stewarding pollinator habitat can also offset some of the environmental impacts of renewable energy projects, such as large-scale solar.

Low Impact Development

Preservation of the natural landscape and minimimal use of impervious surfaces to keep stormwater close to the source

Nature-Based Solutions

Projects that restore, protect and/or manage natural systems and/or mimic natural processes to address hazards like flooding, erosion, drought and heat islands in ways that are cost-effective, low maintenance, and multibeneficial for public health, safety, and well-being

Including pollinator habitat in these projects provides several co-benefits, making the projects more cost-effective, politically feasible, and sustainable.

Pollinator Work at Multiple Scales:
Regional and Town Pollinator Action Plans

To provide context for designing and expanding habitat for wild, native pollinators, the *Regional Pollinator Action Plan* provides a review of the importance of pollinators and the significance of their decline. The *Regional Pollinator Action Plan* includes a set of strategies for expanding pollinator habitat at a local scale and for coordinating pollinator work regionally. The pollinator strategies include different types of landscape stewardship, community engagement, outreach and education, and stakeholder partnerships.

The *Regional Pollinator Action Plan* serves as a preface for each *Town Pollinator Action Plan*. In this way, each participating community can continue working on local goals within the broader context of Franklin County. With the same pollinator landscape analysis and pollinator-friendly strategies underpinning local level planning, each town will have an awareness of inter-jurisdictional pollinator habitat areas and the potential for overlapping open space, and recreational or green infrastructure projects in which pollinator habitat could be an important and exciting co-benefit. Keeping in mind the mutual goals, shared challenges and interests of neighboring communities, towns can find common ground and work together on innovative projects. Partnerships will be key to working at the regional scale and to ensuring the physical continuity and ecological vitality of Franklin County's regional pollinator corridors.

The *Regional Pollinator Habitat Corridor Implementation Toolkit* provides a series of resources for pollinator work applicable to any town, including:

- a regional map showing pollinator corridors and stepping stones across the eight Franklin County communities that participated in this plan;
- model language for pollinator-friendly land use regulations;
- a set of landscape typologies to serve as replicable designs that guide pollinator habitat projects and plantings in five typical settings (Urban/Village Center, Residential, Riparian Buffer, Meadow, and Agriculture);
- a set of custom plant lists associated with each setting; and
- a "pollinator-friendly habitat" sign to help local landowners and land stewards communicate to the public about their pollinator-friendly landscapes.

Town Pollinator Action Plans provide each community with maps of their town that are customized for pollinator planning and for understanding local landscapes, natural resources, pollinator corridors and habitat stepping stones at the town scale. During the planning process, the maps provided the basis for inventorying exisiting and potential pollinator sites and for

brainstorming opportunities and strategies for expanding local pollinator habitat. Town plans document the local knowledge, aspirations, challenges and concerns shared by pollinator workshop participants, and included residents and municipal officials of each pollinator community, residents from neighboring towns, and regional stakeholders. In this way, each *Town Pollinator Action Plan* provides a current snapshot of the existing interest and knowledge within each community to pursue beneficial pollinator work and landscape change.

Each *Town Pollinator Action Plan* includes a Summary of Implementation Opportunities and Strategies table that outlines the pollinator work that the community intends to undertake moving forward, as well as a conceptual design for pollinator habitat implementation on a site of the Town's choosing.

Town Pollinator Action Plans include:

- Mapped landscape analysis
- Descriptions of existing habitats and natural resource areas in town
- Mapped existing and potential pollinator habitat in town identified by stakeholders
- Mapped pollinator corridors and habitat stepping-stones
- Recommended pollinator-friendly revisions to the Town's zoning & land use regulations
- Implementation strategies specific to the town
- A table of opportunities and strategies that identifies potential partners
- A concept design for one site selected by the town that links to a pollinator plant list and the pollinator landscape design typologies in the toolkit

Planning Process

FRCOG staff worked with the participating towns and conducted at least one pollinator workshop and attended at least one Planning Board meeting or spoke with planning staff from each of the eight participating Franklin County towns. Participants in the town pollinator workshops included members of Town departments, boards and committees, as well as volunteers, and community members active in pollinator gardening and ecological landscape stewardship. Each town's *Pollinator Action Plan* reflects the local knowledge and ideas of of residents, community-based organizations, businesses doing related work, Town committee volunteers and some municipal officials. Engagement of the community, education and outreach, and partnerships between different stakeholder groups will continue to be important to advancing the beneficial work for native pollinators.

The planning process relied on public meetings in a virtual format in which interested people could join a workshop for each town participating in the plan. At the town pollinator workshops, FRCOG staff presented the reasons for creating the plan and a series of landscape analysis maps for discussion with stakeholders. The maps provided a basis for capturing community-driven ideas for ways to establish pollinator habitats and corridors across each

town. Stakeholders were asked to identify existing and potential locations for pollinator habitat within the town boundaries, and to brainstorm strategies for implementing pollinator habitat and overcoming challenges. Participants also gave feedback on the content of maps, plan recommendations, and other key deliverables. At the Franklin County pollinator workshop, participants from a number of participating towns discussed pollinator protection and habitat expansion strategies that they believe will have traction in their towns and across the county.

This *Regional Pollinator Action Plan* encompasses planning work with eight Franklin County communities who, early on, expressed interest in collaborating to create pollinator action plans for their towns and the region. Over the course of this project, a number of other communities have expressed their interest in developing town pollinator action plans. The FRCOG looks forward to building out this *Regional Pollinator Action Plan* by working with more Franklin County towns as funding becomes available, and by demonstrating an innovative pollinator planning process for others to model elsewhere in Massachusetts and beyond.

Objectives of the Regional Pollinator Action Plan

- To connect, conserve, and foster habitat for native pollinators
- To demonstrate new pollinator protection strategies locally and regionally
- To recommend and implement stewardship practices on public and private land that foster pollinator habitat across the region
- To engage diverse stakeholders in collaborative strategies that address pollinator decline as a pressing climate resiliency problem facing Franklin County and other rural regions across the Commonwealth
- To involve residents and the greater community in education and implementation efforts
- To help communities identify mutual goals and opportunities for improving biodiversity, climate resiliency, and the sustainability of local farms and food systems

THE IMPORTANCE OF POLLINATORS

Native pollinators are integral to local and regional biodiversity, climate resilience and food system security. Native pollinators, including bees, butterflies, moths, flies, beetles, wasps, and hummingbirds, are considered "keystone species" that are critical to the healthy functioning of the ecosystems that surround us. Pollinators that have evolved with native plant species play an essential role in the plants' lifecycle, in particular, plant reproduction. Insect pollination is the process by which pollen is transferred from the male reproductive structures of one flower to the female reproductive structures of another. The work of native pollinators is critical to creating genetic diversity within the plant communities they pollinate because a diversity of responses to stress supports ecological resilience. Native plants are adapted to the local soil, sun, and climate conditions, and provide food and shelter for many other native species, including rare and endangered amphibians, mammals and birds. The more diverse the plants and ecosystems are, the higher the ecological and landscape resilience is to climate change. Healthy ecosystems provide important services such as flood resilience, clean drinking water, recreational assets, wildlife habitat, and carbon sequestration.

Keystone Species
A species on which other species in an ecosystem largely depend, such that if they were removed the ecosystem would change drastically

Ecological Resilience
The capacity of an ecosystem to continue ecosystem-specific functioning after a disturbance, such as a pest outbreak, drought, or wind event

There are approximately 1,000 regular flower-visitor species in the northeastern United States. They are members of an ecological network of pollinators, plants, and the habitats that support them. It is not always easy to determine which species are actually providing pollination services to particular plant species. It is therefore prudent to protect the entire community of flower-visiting insects and animals to ensure that the critical ecological service of pollination is achieved. Protecting intact native ecosystems from the myriad threats they face and providing for the entire pollinator community also serves the broader goal of protecting the Commonwealth's natural heritage of biological diversity.

In Massachusetts, over 45% of agricultural commodities rely on pollinators—mainly wild and managed bees—for pollination. Managed pollinators are deployed for agricultural pollination, and primarily include four bee species: the European honeybee (*Apis mellifera*), the common Eastern bumblebee (*Bombus impatiens*), the alfalfa leafcutting bee (*Megachile rotundata*), and

the orchard mason bee (*Osmia lignaria*).[2] The forest- and farm-based food system is a key industry sector for Franklin County and is recognized as an important economic cluster in regional economic development plans. According to the 2017 Census of Agriculture, there were 830 farms in Franklin County, a 6% increase in the last five years; and Franklin County also leads the state in agricultural sales and percentage of land in agriculture.[3] Given the importance of agriculture to the county, and the importance of pollinators to agriculture, maintaining a healthy population of wild and managed bees supports the county's agricultural industry.

The decline of native pollinators represents a pressing ecological threat to the biodiversity and climate resiliency of Franklin County's green infrastructure, the sustainability of local farms and food systems, and the character of rural landscapes across the Commonwealth. Pollinator habitat strategies presented in this action plan focus on addressing the decline of wild native and specialist pollinators through the protection, development and connection of native pollinator habitat and whole lifecycle resources on lands within each town.

Pollinator Decline

In the 2007 Massachusetts Pollinator Protection Plan, the Massachusetts Department of Agricultural Resources (MDAR) identified a critical need to evaluate, sustain, and enhance pollinator populations in the state. Both managed, agricultural pollinators and wild, native pollinators have declined in abundance, diversity, and geographical distribution in recent decades and are experiencing significant challenges to their survival.[4] Local level data is needed to inform effective conservation and restoration strategies for threatened pollinator species. Citizen scientists through projects like **Beecology** can help meet this need for current, local data by equipping people to digitally collect and submit ecological data on native pollinators.[5]

Rapid declines in bee abundance have been in the news in recent years with much of the attention focused on a phenomenon called Colony Collapse Disorder, a condition affecting managed bees that have been domesticated for agricultural use whose causes are still undetermined. However, many wild pollinators, including bumblebees, moths, butterflies and other less glamorous species of arthropods, are also experiencing dramatic population declines in their wild environments.

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[2] Apiary Program Working Group, Division of Crop & Pest Services, "Massachusetts Pollinator Action Plan" (2017): https://www.mass.gov/files/documents/2017/06/zw/pollinator-plan.pdf

[3] Massachusetts Department of Agricultural Resources: https://www.mass.gov/info-details/agricultural-resources-facts-and-statistics

[4] Apiary Program Working Group, Division of Crop & Pest Services, "Massachusetts Pollinator Plan," (2017): https://www.mass.gov/files/documents/2017/06/zw/pollinator-plan.pdf

[5] About the Beecology Project, https://beecology.wpi.edu/website/home

The beginning of 2017 brought an announcement by the U.S. Fish and Wildlife Service that the rusty patched bumblebee *(Bombus affinis*)[6] had become the first bumblebee in the United States listed as Endangered under the Endangered Species Act. The rusty patched bumblebee was once common in Massachusetts but is rarely seen today and is in danger of becoming extinct: it is now likely to be present in only 0.1 percent of its historical range. The species' 87 percent population decline over the past 20 years due is likely due to habitat loss, intensive farming, introduced disease, pesticide use and climate change. The International Union for the Conservation of Nature (IUCN) lists the rusty patched bumblebee as Critically Endangered.

Table 1 shows the IUCN's conservation assessment information for seven red-listed North American bumblebees whose range includes the northeastern United States. Four local species of bumblebee are listed in the table as Critically Endangered (*B. affinis)* or Vulnerable (*B. fervidus*, *B. pennsylvanicus*, and *B.terricola),* demonstrating that Massachusetts is very much a part of a national and global insect extinction crisis*. Bombus bohemicus* is also considered ultra-rare in Massachusetts, but there is insufficient data for listing the species.

Given that there is limited research on pollinator decline, especially at the local level, citizen scientists, conservation organizations, schools and other groups can play a vital role by collecting the data that is needed to inform effective pollinator planning initiatives.

Bombus affinis, a.k.a. rusty patched bumblebee (Creative Commons)

[6] U.S. Fish & Wildlife Service, "Rusty Patched Bumble Bee Guidance on ESA Implementation": https://www.fws.gov/midwest/Endangered/insects/rpbb

Table 1: Selected Species from the IUCN Red List of Threatened North American Bumble Bee Species

International Union for Conservation of Nature and Natural Resources

Common Name ***Latin Name***	**Conservation Status** ***Each Species' Population Trend is Decreasing**	**Geographic Range**	**Habitat & Ecology**	**THREATS**	**CONSERVATION ACTIONS NEEDED**
Suckley Cuckoo Bumble Bee *Bombus suckleyi*	Critically Endangered	Western North America and scattered localities in the Northeast US	Forest, Shrubland, Grassland	○ Urbanization, Commercial and Industrial areas ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Resource and habitat protection ○ Habitat and natural process restoration
Rusty Patched Bumble Bee *Bombus affinis*	Critically Endangered	Eastern US (Maine to Tennessee, Massachusetts to Minnesota) and Canada (Ontario)	Forest, Grassland, Artificial/ Terrestrial	○ Urbanization, Commercial and Industrial areas ○ Mining and quarrying ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Awareness and communications ○ Training ○ Legislation
American Bumblebee *Bombus pensylvanicus*	Vulnerable	Eastern and Central US and Southern Canada, Mexico	Temperate Forest, Grassland, Artificial/ Terrestrial	○ Urbanization, Commercial and Industrial areas ○ Mining and quarrying ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Invasive/problematic species control ○ Species recovery ○ Training, education, communications ○ Legislation ○ Conservation payments
Yellow-banded Bumblebee *Bombus terricola*	Vulnerable	Newfoundland and Eastern US through the Great Plains and Mountain West to British Columbia	Forest, Shrubland, Grassland, Wetlands (inland), Artificial/ Terrestrial	○ Urbanization, Commercial and Industrial areas ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Invasive/problematic species control ○ Species recovery ○ Training, education, communications ○ Legislation ○ Conservation payments
Yellow Bumblebee *Bombus fervidus*	Vulnerable	Eastern and Central US and Southeastern Canada, Mexico	Forest, Shrubland,	○ Urbanization, Commercial and Industrial areas ○ Mining and quarrying ○ Fire, fire suppression	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Invasive/problematic species control

Table 1: Selected Species from the IUCN Red List of Threatened North American Bumble Bee Species

International Union for Conservation of Nature and Natural Resources

Common Name ***Latin Name***	**Conservation Status** ***Each Species' Population Trend is Decreasing**	**Geographic Range**	**Habitat & Ecology**	**THREATS**	**CONSERVATION ACTIONS NEEDED**
			Grassland, Artificial/ Terrestrial	○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Species recovery ○ Training, education, communications ○ Legislation ○ Conservation payments
Southern Plains Bumblebee *Bombus fraternus*	Endangered	Eastern US Temperate Forest, coastal plain of the Southeastern US, west throughout the US Great Plains	Grassland, Artificial/ Terrestrial	○ Urbanization, Commercial and Industrial areas ○ Mining and quarrying ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Invasive/problematic species control ○ Species recovery ○ Training, education, communications ○ Legislation ○ Conservation payments
Variable Cuckoo Bumblebee *Bombus variabilis*	Critically Endangered	Eastern Temperate Forest and Great Plains region of the midwestern US, Guatemala; Mexico	Forest, Grassland, Artificial/ Terrestrial	○ Urbanization, Commercial and Industrial areas ○ Mining and quarrying ○ Fire, fire suppression ○ Annual and perennial agriculture, Livestock farming and ranching, Agriculture and forestry effluents ○ Invasive non-native/alien species/diseases ○ Drought, Extreme temperatures, Flooding, Habitat shift and alteration	○ Site/area protection and management ○ Resource and habitat protection ○ Habitat and natural process restoration ○ Invasive/problematic species control ○ Species recovery ○ Training, education, communications ○ Legislation ○ Conservation payments

Source: International Union for Conservation of Nature and Natural Resources, "Red List": https://www.iucnredlist.org/search?query=bumble%20bee&searchType=species

Pollinators[7]

Bees

Prominent among the flower-visiting community are bees, most of which collect pollen to feed their developing young. Adults feed on the nectar that flowers provide and collect pollen in the process. Some bee species are generalists that visit a variety of different plant species, while others are specialists that only visit plants in a particular family, genus, or even a single species. Some visit many different flowers for nectar but collect pollen from only a few. There are nearly 400 bee species in Massachusetts, and all of them deserve protection, but specialist species that have co-evolved with native plants are of particular concern because a local decline in either the bee or its plants can lead to the local extinction of both. A diverse community of plants that can provide nectar and/or pollen to a variety of bee species is a conservation imperative.

Pollen
A fine powder produced by the male part of a flower or cone for reproduction

Nectar
The sugary liquid produced by plants to attract insects for pollination

Some bees are social, like the familiar non-native honeybee (*Apis* spp.), with multiple individuals sharing a single nest (hive). Bumblebees (*Bombus* spp.) are the only bees native to North America that are truly social, with complex social hierarchies. Most bees are solitary and nest in burrows they excavate themselves or in natural cavities such as clay soils or hollow twigs. Providing suitable nesting opportunities is another conservation requirement.

Native bees also include carpenter bees (*Xylocopa* spp.), which sometimes tear a hole into the base of the flower to access the nectar and bypass the pollen. Despite this occasional short cut, however, they are valuable pollinators. Sweat bees (*Halictid* spp.) are small, fuzzy dark brown to black, and many are a metallic green. They are common, non-aggressive bees that nest in the ground. All species of sweat bees are pollinators. Before the honeybee replaced them, native miner bees (*Andrena* spp.) were the primary pollinators of blueberries, apples and other early blooming food crops. The docile, solitary, ground-nesting mining bee group is only active in spring. The Megachilidae family of bees, which includes mason bees and leafcutting bees, is a diverse family of solitary bees that predominantly build their nests in aboveground cavities. All species of megachilids feed on pollen and nectar, but some ("cuckoo bees"), feed on pollen collected by other megachilid bees.

[7] Information in this section relied on Lavengood, Joanne, "Massachusetts Pollinators: The Usual Suspects ... And a Few Others," *Western Massachusetts Master Gardener Association*: https://www.wmmga.org/content.aspx?page_id=22&club_id=101643&module_id=229398

While all pollinators are important, native bees are vital to successful pollination processes of native ecosystems in Massachusetts and Franklin County. According to Dr. Robert Gegear, a bee ecologist from UMass Dartmouth who conducts fieldwork in Franklin County, the historical record shows that Franklin and Hampshire Counties have greater bumblebee diversity than any other counties in the state.[8] Despite this good news, protecting native bumblebee habitat in Franklin County remains vitally important. Developing strategies that can be replicated may help bolster other habitat protection efforts in Massachusetts and beyond.

Butterflies

Mass Audubon lists over a hundred butterflies in Massachusetts.[9] This list includes swallowtails (family *Papilionidae*), whites and sulphurs (family *Pieredae*), gossamer wings, which include coppers, hairstreaks, blues, and elfins (family *Libytheidae*), brushfoots, which include fritilaries, checkerspots, tortoiseshells, browns, wood nymphs and satyrs (family *Nymphalidae*), milkweed butterflies, which includes the monarch and queen butterflies (subfamily *Danainae*), and finally, skippers (superfamily *Hesperioidea*). Adult butterflies visit flowers for nectar while the larvae feed on plants. Each species typically has only a few host plants where the larvae can develop successfully. Butterflies are the second best pollinators after bees and do their fair share of pollinating flowers despite lacking the special pollen carrying structures that bees have. Butterflies perch to eat, so they prefer flowers with a landing platform. As they move around to find nectar, their long legs collect pollen. Though they carry less pollen than bees, they cover more distance by flitting from flower to flower. Butterfly conservation is served by ensuring a supply of plants that provide nectar for adults and food and nesting area for larvae.

Moths

Moths are co-members with butterflies of the order Lepidoptera. Unlike butterflies however, who pollinate during the day, most moth species do their pollination work after dark. Moth bodies are also covered in hair, aiding in the transport of pollen. More abundant and diversified than butterflies, there are over 200 species of moths Massachusetts. Hawk moths (family Sphingidae), with close to forty species in New England, are among the most conspicuous pollinator species. These are relatively large moths with long tongues that hover like hummingbirds when they are feeding at flowers. Most species have no interest in flowers, but those who do prefer tubular blooms, finding it easier to drink nectar. Fragrant and white or pale colored blooms that reflect moonlight are also a draw for moths.

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[8] Gegear, Robert, "Conserving Heath's Bumbling Little Treasures." *Heath Herald* (February/March 2018): https://heathherald.org/uploads/3/4/6/3/34634026/vol_39-6_2018febmar.pdf

[9] Mass Audubon, "Butterfly Atlas": massaudubonbutterflyatlas.org

Wasps

There are several hundred species of stinging wasps in Massachusetts. Like bees and ants, the wasps that regularly visit flowers belong to a group (*Aculeata*) in the order Hymenoptera. Most species are solitary and nest in the ground, but some nest in natural cavities or build freestanding nests out of mud. Some are social and build their nests out of paper they make by masticating wood fibers, including paper wasps (*Polistes* spp.), yellowjackets and hornets (*Vespula* and *Dolichovespula* spp.). Many adult wasps visit flowers for nectar but most of them seek their prey elsewhere, so they spend less time at flowers than bees do and are less likely to be effective at pollination. Wasps also lack the plumose hairs characteristic of bees and their simple hairs are less likely to hold pollen. They are often conspicuous at flowers, and some of them are easily mistaken for bees.

***Clockwise from left to right**: Green sweat bee on New England aster* (Creative Commons); *monarch butterfly on joe-pye weed; sphinx moths on showy milkweed (Tom Koerner, USFWS); ruby-throated Hummingbird on globe thistle (Jacques Pelletier, Canadian Wildlife Federation); ants on unknown plant species* (Beatriz Moisset, USFS); *goldenrod soldier beetle on goldenrod sp.* (Kansas State University); *great black wasp on fennel (Wikimedia commons); Tachnid fly on catnip* (Beatriz Moisset, USFS).

Birds

The primary avian pollinator in the eastern United States is the ruby-throated hummingbird (*Archilocus colubris*). Hummingbirds transport pollen by accumulating pollen on their feathers and face while feeding on nectar as they move from bloom to bloom. Ruby-throated hummingbirds prefer tubular, nodding and brightly colored (especially red) flowers.

Flies

Flies differ from all other insects in having only two wings rather than the usual four. There are thousands of species, but only a few families are regular flower visitors in our area. Among

these are the flower flies (family *Syrphidae*) that are often convincing mimics of wasps or bees. Also frequently seen are the thick-headed flies (family *Conopidae*) that often resemble wasps; they are internal parasites of adult wasps or bees. The large family Tachinidae includes many regular flower visitors and many other flies belonging to several different families are occasional flower visitors. Although important pollinators in some places, flies appear to be relatively unimportant pollinators in our area.

Beetles

Beetles are thought to have been important pollinators of the earliest flowering plants during the Cretaceous Period millions of years ago. Their importance as pollinators in Massachusetts today is not well understood. Nonetheless, they are connected to ancient flowering plants such as magnolia and yellow water lilies. Paw-paw, sassafrass, and sweet shrub have also adapted to beetle pollination.

Some beetles are conspicuous flower visitors in our area, demonstrating a preference for bowl-shaped flowers. Among the most prominent are the long-horned beetles (family Cerambycidae), blister beetles (family Meloidae), and the soldier beetles (family Cantharidae). There are also a number of small and inconspicuous beetles that visit flowers, including the tumbling flower beetles (family Mordellidae) so called because of their jerky movements employed to escape predators.

Ants and Slugs

Slugs are among the less glamorous flower visitors, occasionally pollinating plants such as wild ginger. Ants are not important pollinators, per se, but many spring ephemerals in our rich woods rely on ants for seed dispersal. The seeds of spring ephemerals are covered in fatty external appendages called eliaosomes. Attracted to the lipid-rich eliaosomes as food for their young, the ants carry the seeds back to their nutrient-rich nest where the unharmed seed can germinate.

Other Arthropods

A number of other insects as well as spiders are regularly found in or on flowers and, while they provide little in the way of pollination services, are nonetheless important members of the community of animals that rely on flowers for their livelihoods. These include crab spiders, thrips, assassin bugs, and many others. This diverse cast of characters benefit from maintaining a diverse assemblage of native plants.

Native Plants

There is consensus that good pollinator habitat requires a high proportion of native plant species. While non-native plants can provide food for pollinators, native plants generally have more abundant pollen and nectar sources. Native plants are also perennial, making them a more reliable food source than annuals. Because native pollinator species have co-evolved with

native plants, native plants also best accommodate the anatomy and seasonal timing of native pollinators.

While some non-native invasive plants may partially meet the needs of native pollinators, non-native invasive plants do not support pollinator diversity and species survival. Some species of native bees that are generalist feeders are in fact increasing in abundance and geographic distribution (e.g., *B. impatiens* and *B. griseocollis*) while many more others are declining.[10] While generalist bees can forage on the same native plants that specialists bees can, the reverse is not true: specialist bees are not adapted to non-native plants. Therefore, planting natives for at-risk bees helps all pollinators, but planting non-natives does not.

> ***Local Ecotype***
> *A subset of a species that has adapted to a specific geographic environment and as a result has evolved to be genetically distinct from other members of the same species found in different environments*

Furthermore, local pollinator populations may have adapted to particular local ecotypes of native species. This can mean that native plant seeds or starts sourced from outside the region do not fully meet the needs of local pollinators. Shopping at local plant nurseries can help ensure that pollinator plants or seeds have local genetics (see Local Native Plant Nurseries in the *Regional Pollinator Habitat Implementation Toolkit).*

Practically speaking, native plants are better adapted to the local climate and soils. Though they may take some effort to establish, native plants typically require less watering and maintenance. Culturally speaking, native plants are part of the natural heritage and create a distinctive sense of place.

Pollinator decline is not the only thing threatening native plants: land conversion, wetlands destruction, and the introduction of invasive non-native plant species causes the loss of native plant diversity, abundance, and distribution. Not surprisingly, the decrease in native and increase in non-native plant populations is in turn a contributor to native insect decline.[11] These critical declines underscore the point that native plants are essential to a healthy, diverse pollinator population and to the food system benefits of a healthy wild pollinator population.

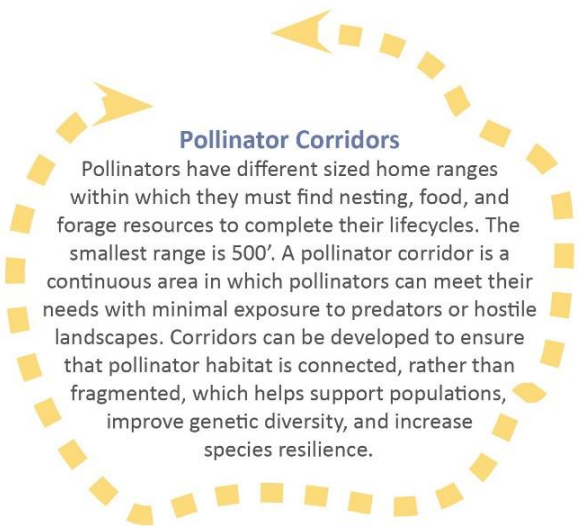
[10] Beecology Project, "Native Pollinator Decline and Conservation: The Ecological Perspective": https://beecology.wpi.edu/website/learn#section2

[11] Marinelli, Janet, "How Non-Native Plants Are Contributing to a Global Decline," *Yale Environment 360* (2020): https://e360.yale.edu/features/how-non-native-plants-are-contributing-to-a-global-insect-decline

REGIONAL STRATEGIES FOR ENHANCING POLLINATORS

Wild pollinators and their habitat need to be protected and expanded to reverse the declining population trends seen in important pollinator species, including many vulnerable and endangered species. Pollinator protection strategies must provide for the critical requirements of native pollinators and be implemented across multiple landscape scales: from site to town to region.

Collaboration at a regional scale is needed to address native pollinator decline, to ensure their recovery and long-term well-being, and to sustain diverse, healthy ecosystems. Pollinator lifecycles and their ecosystem roles require that they be able to visit a variety of sites and habitats via connected pollinator-friendly pathways. The regional strategy builds on site-specific and town-wide strategies by identifying, protecting and enhancing existing pollinator habitat, and by creating or expanding "corridors" and "stepping stones" that connect existing habitat and resource areas across the region.



The following section describes the types and characteristics of pollinator habitat and resource areas that are valuable to pollinators and deserve protection and good stewardship. This section also identifies some of the best opportunities to enhance corridors and stepping stones, which are discussed in more detail in each of the town plans. The *Prime Pollinator Land Cover Types* map identifies potential pollinator corridors crossing and linking the eight participating towns.

Pollinator Habitat and Resource Areas

Ecologically Important Areas: NHESP Priority Habitat and BioMap2 Core Habitat

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) has mapped the geographic extent of state-listed rare plant and animal species as Priority Habitat. [12] Priority Habitat maps are used to determine whether a proposed project must be reviewed for compliance with the Massachusetts Endangered Species Act and the Wetlands Protection Act. With BioMap2 Core Habitat, the NHESP has identified exemplary natural communities, areas in Massachusetts that are critical for rare and other native species and their habitats. These ecosystems are the most in need of protection, as are the landscapes that support ecological processes and a wide array of natural communities and animal species over long time frames. BioMap2 data focuses primarily on state-listed rare species and exemplary natural communities and was developed to guide statewide strategic biodiversity conservation by focusing land protection and stewardship efforts.

The presence of so much BioMap2 habitat (see *Habitat and Water Resources* map in the Regional Pollinator Corridor Opportunities section of this plan) confirms what many residents are already aware of: that Franklin County is home to a range of vibrant ecosystems that are vital to supporting a diversity of species, including rare and endangered species. When thinking about pollinators, the presence of Priority Habitat and Core Habitat indicates the presence of rare or endangered species, and likely pollinator species or the plants that support them. The presence of Priority Habitat and Core Habitat also indicates a high proportion of native species and intact native ecosystems, generally good habitat conditions for pollinators. Many BioMap2 habitat areas are unique open habitats such wetlands or grasslands, which generally support pollinators better than closed-canopy habitats. Finally, BioMap2 can inform habitat improvement and conservation efforts for wild, native pollinators that would have the co-benefit of supporting high-value species and ecosystems.

Open Lands

Open (unforested) habitats are typically favored by pollinators, as the sun exposure supports the flowering vegetation that pollinators prefer. In the context of contiguous forests, patches of open land can foster ecotones—rich transitional areas between two biological communities. Because this broad landscape category is optimal for pollinators, the habitat protection strategies and habitat typologies presented in this plan will focus on a number of open landscape conditions: farms, meadows, residential landscapes, and village/urban centers. As with any site, the actual value of an open site for pollinators must be ground-truthed through direct observation.

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[12] Department of Fish and Game: http://maps.massgis.state.ma.us/dfg/biomap2.htm

Agricultural land cultivated for crops and hay has both benefits and drawbacks for pollinators. While edge habitat and flower crops can mean a food bonanza for pollinators, monocropping (growing a single crop year after year) and pesticide application can be harmful to pollinators. In addition, agricultural mowing creates an environment with little to no benefit to pollinators. More discussion of agricultural management practices that benefit pollinators is included under the Local Strategies – Agriculture section of this plan and reviewed again in each *Town Pollinator Action Plan*.

Water Resources

Water resources, including wetlands, streams, rivers and ponds, are critically important to pollinators. Not only are waterways often open to the sun and home to high concentrations of flowering plants that feed native pollinators, they also connect different ecosystems and greater land areas, from uplands to wetlands. Regional water resources within the eight participating towns are shown in the *Habitat and Water Resources* map (see the Regional Pollinator Corridor Opportunities section of this plan).

Key water resources include riparian areas—land along rivers, streams, lakes, wetlands, wet meadows, and large stormwater catchment areas. Riparian areas are typically sunny and vegetated but are also vulnerable to invasive species colonization, Japanese knotweed in particular. Within riparian streambanks there is often also good nesting substrate, such as exposed sand and clay, for ground-nesting bees. Wet meadows and riparian zones are featured in the design typologies of the *Regional Pollinator Habitat Implementation Toolkit*.

Forests

Franklin County is primarily forested. Many native shade trees are important hosts for pollinators, especially butterfly larvae (caterpillars). Trees also function as butterfly day perches, nighttime roosts and refuge during bad weather. When forests are left to fully mature, a diverse understory can be expected to develop, including a number of species that bloom early in the spring before trees leaf out. The forest canopy and understory can be managed to increase the diversity of the plants and the pollinators they support. Leaving forests intact and allowing them to naturally diversify in species and age class may also enhance the diversity and abundance of understory plants, which receive little protection under current forestry practices. Overall, however, mature forests contain fewer resources for pollinators and their potential is minimally explored in this plan.

Large Scale Solar Arrays

Large-scale ground mounted solar facilities have popped up across Franklin County in recent years, with around 20 installations, a few as large as 25 acres of land or more.[13] According to recent research at Clark University, nearly 7,000 acres of ground-mounted solar arrays have

[13] MassGIS, "Solar Installation Sites": https://mass-eoeea.maps.arcgis.com/apps/webappviewer/index.html?id=8cc5f2322f194015b5364e32689a0b20

been installed in the Commonwealth since the year 2000, at a median size of 7 acres.[14] In rural areas like Franklin County, ground-mounted solar is often sited on important habitat for native wildlife, such as grassland, shrub land and unfragmented forest, because they are presently among the lowest-cost settings in which to install these arrays. According to a recent study by Harvard Forest, photovoltaic growth in the Pioneer Valley, which includes Franklin County, is linked to the conversion and loss of forests, agricultural lands, and associated plant and animal habitats, and the impacts of this land cover conversion at this scale is poorly understood.[15]

One way to compensate for the impact of habitat loss is to encourage the management of vegetation under and around solar PV arrays to support native flowering plants and pollinator species. Solar installations are advantageous places to manage for pollinator habitat because they equate to very large areas of contiguous sunny, dry, open space where flexible mowing needs can accommodate pollinator lifecycles. In reality, there are few other kinds of developed land uses that provide good conditions for managing pollinator habitat at that scale.

Utility Corridors

Several types of utility corridors—also known as Right-of-Ways (ROWs)—traverse Franklin County, and include ROWs for electricity, gas transmission lines, and railroads. These ROWs bisect a variety of landscapes and sometimes contain greater plant diversity than adjacent lands, which might make them excellent pollinator forage and nesting habitat. Where utility corridors cross open wetlands, the pollinator habitat value could be even greater. ROWs frequently intersect each other and other open habitats, creating an extensive network of continuous, linear open space that is generally free of major disturbances and protected from future development. While these conditions could create highly valuable connected corridors of high-quality habitat, the use of herbicides to manage vegetation in these areas negate their value as habitat. Historically, utility companies have sprayed herbicides to keep infrastructure free of interfering brush and woody vegetation, which indiscriminately kills native vegetation and pollinator habitat when broadly applied. There are indications that some utility companies are using a low-volume, low-pressure herbicide application method on targeted plants. Herbicide application for each corridor is typically detailed under the utilities' vegetation management plans and available upon request. Efforts to get utility companies to stop using herbicides and instead rely on mechanichal means should be encouraged.

Roads and Trails

As with ROWs, modifying or managing existing roads to serve as corridors for pollinator movement could create effective connections between important pollinator habitat. Roads

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[14] Rogan, John and Shiqi Tao. "Mapping Solar Installations in Massachusetts and Their Direct Ecolgoical Impact," *Solar Siting Reform for Massachusetts and Rhode Island*: https://masscptc.org/training/webinar-2021/e-workshop-21.html#solarsite

[15] Johnson, et.al.,2019, Harvard Forest, Harvard University, Plymouth State University, Westfield State University, The siting and impact of photovoltaic systems in Franklin, Hampshire, & Hampden counties: A preliminary study

often have a vegetated shoulder that is mowed to keep brush at bay. Reducing the frequency of mowing, or even planting wildflowers in strategic places along the road edge, can provide small stepping stones to connect larger pollinator habitat areas. The gravel and sandy soils on Franklin County's dirt roads also provide ample space and attractive nesting medium for many native bees. Reducing the use of herbicides, following the Massachusetts Right-of-Way Management law (M.G.L. c. 132B), protects both pollinator forage and nesting sites along road corridors. Though not within the jurisdiction of private residents or municipalities, state and Federal highway medians and roadsides can also be productive areas when planted and/or managed for pollinator habitat. Refer to the References and Resources section for guidance for road and highway right-of-ways. Hiking and recreational trails also offer potential for connectivity across the landscape and could be evaluated for the same purpose.

Goldenrod and asters as pollinator habitat along roadsides (Xerces Society/Jennifer Hopwood)

Regional Pollinator Corridor Opportunities

According to the Natural Resources Conservation Service (NRCS), the best pollinator habitat will generally have access to food, cover, and water within close proximity, as well as connectivity to other important habitats, such as deciduous forests. Sunny and open conditions, field edges, and hedgerows are needed for ground nesting sites, as well as wood and pithy-stem nesting pollinators.[16]

Method of Landscape Analysis

Statewide GIS data was used to conduct a landscape analysis to identify existing and potential pollinator habitat at both the local and regional scale. Identifying pollinator habitat through desktop analysis involved the following GIS data:

- Land cover and land use

[16] Natural Resources Conservation Service, "Vermont – Biology Technical Note #4" (2017): https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1431219&ext=pdf

- Rivers, streams, reservoirs, and wetlands
- NHESP Priority Habitat and BioMap2 Core Habitat
- Paved and gravel roads

These data layers show habitat, infrastructure, and development patterns, and areas of habitat fragmentation. Regional scale analysis shows that rivers in the county are a prominent, continuous natural resource for pollinators. Rivers converge on the Connecticut River from all four corners of the county (see the *Habitat and Water Resources Map*). Among these rivers, the Deerfield, South, Green, West Branch of the Tully, and a section of the Sawmill contain NHESP priority habitat that may provide an added boost to these reaches as pollinator resource areas. Although Bernardston and Wendell have fewer obvious waterways that serve as corridors, they are home to networks of tributaries and wetlands that branch into neighboring towns.

Existing pollinator habitats and resources areas can be inferred from the "Sunny Open Landscapes" and "Forested and Open Wetlands" data displayed in the *Prime Pollinator Land Cover Types* map. These two composite prime pollinator land cover data layers consist of the MassGIS 2016 land cover types listed in Table 2. These land cover types meet the characteristics described by the NRCS as beneficial for pollinators, and therefore provide the basis for inferring the presence of the pollinator corridors and stepping stones.

Table 2: Prime Pollinator Land Cover Types[17]

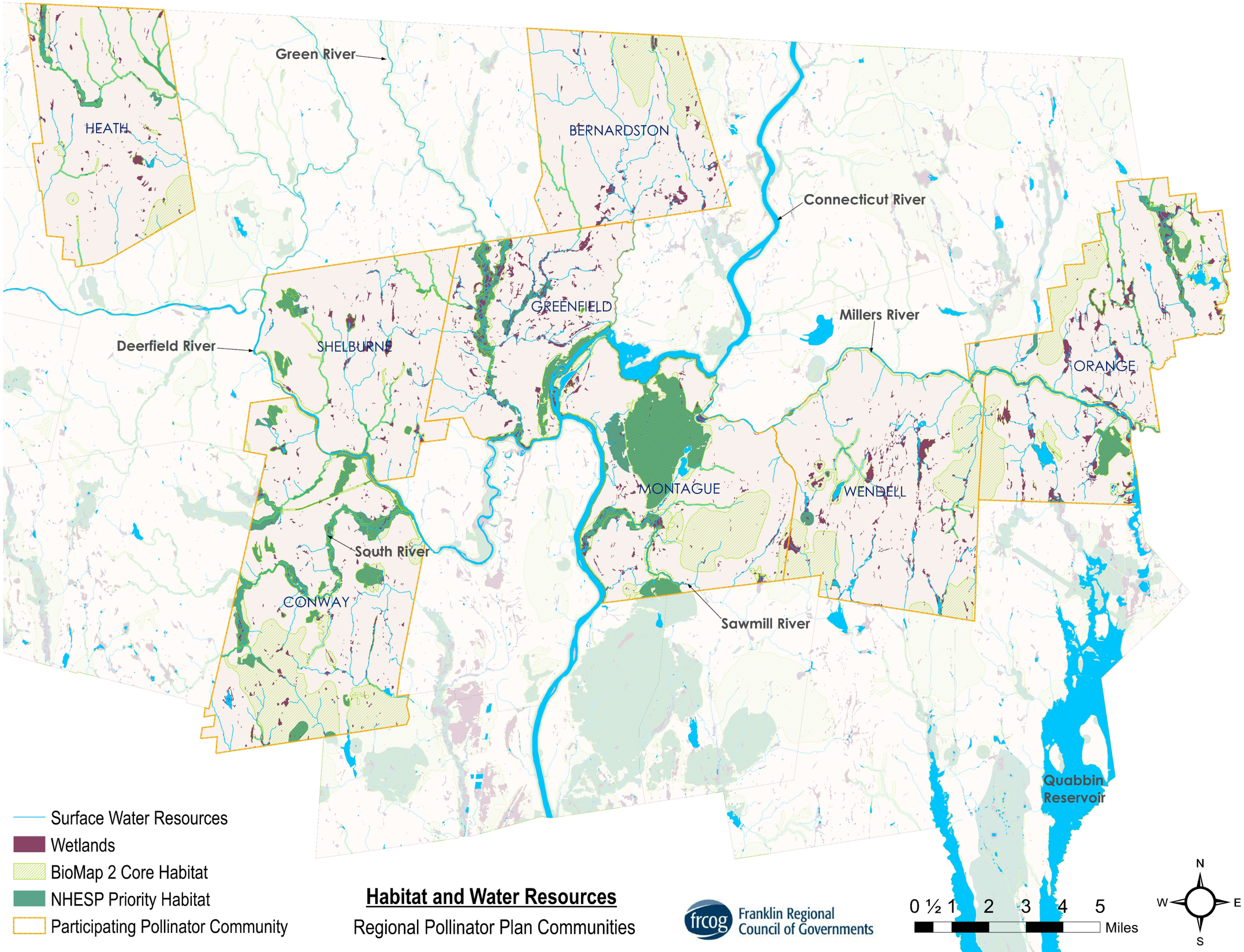
Sunny Open Landscapes	**Forested and Open Wetlands**
Cultivated	Forested wetland
Pasture/hay	Non-forested wetland
Developed open space	
Grassland	
Scrub/shrub	

At the regional scale, this land cover analysis shows sunny, open landscapes well distributed across the regional plan communities except within large blocks of intact forest in Bernardson, Conway, Montague, and Wendell. Some of the large forest blocks, particularly in Wendell, contain networks of forested wetlands that can extend pollinator access across the landscape. Like rivers, utilty corridors present the potential for networks of continuous habitat across the county—connecting Heath, to Greenfield, to Wendell, for example. The short corridors and stepping stones identified in the *Prime Pollinator Land Cover Types* map can be enhanced to support pollinators' ability to move across the landscape in search of needed resources. The

[17] Extracted from MassGIS 2016 Land Cover/Land Use data by Future Lands Design in collaboration with the FRCOG Planning Department

lands and waters can be managed with pollinators in mind (see the Local Strategies for Enhancing Pollinators section of this plan).

The same method of landscape analysis and assessment was used to identify pollinator corridors and habitat stepping stones for each town participating in the *Regional Pollinator Action Plan.* Municipal-level corridors and stepping stone maps, as well as additional maps showing detailed land cover, water and habitat resources, municipal and protected open space parcels, and existing and potential pollinator sites are included in with each individual *Town Pollinator Action Plan*, available at: https://frcog.org/franklin-county-regional-pollinator-plan/.


Green River
HEATH
BERNARDSTON
Connecticut River
GREENFIELD
Millers River
Deerfield River
SHELBURNE
ORANGE
MONTAGUE
WENDELL
South River
CONWAY
Sawmill River
Quabbin Reservoir
Surface Water Resources
Wetlands
BioMap 2 Core Habitat
NHESP Priority Habitat
Participating Pollinator Community
Habitat and Water Resources
Regional Pollinator Plan Communities
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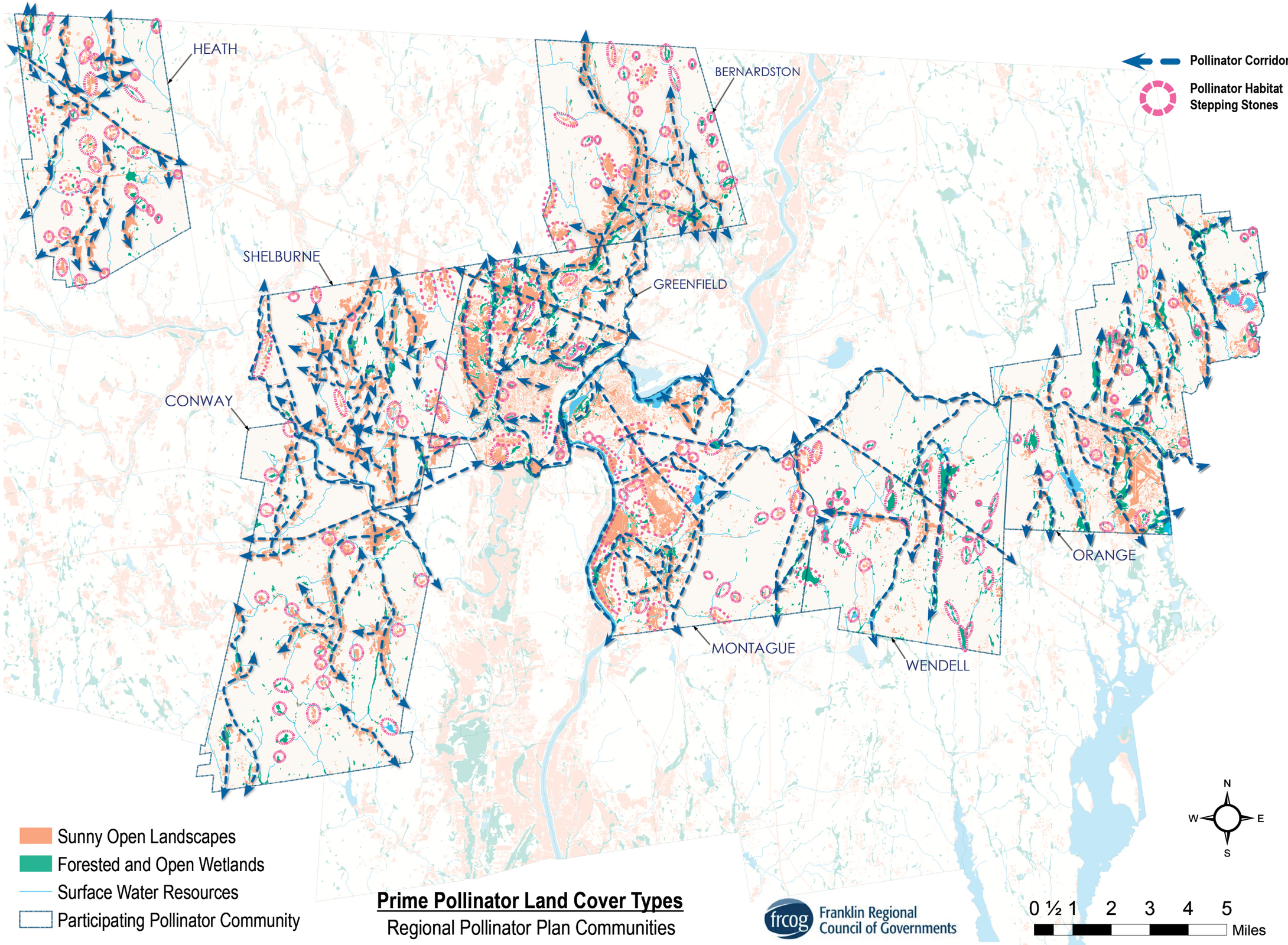

Prime Pollinator Land Cover Types

Regional Pollinator Plan Communities

Franklin Regional Council of Governments

Prime Pollinator Land Cover data extracted from MassGIS Land Cover and Land Use (https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use) by Future Lands Designs in collaboration with the FRCOG Planning Department

POLLINATOR-FRIENDLY LAND USE REGULATIONS

One way to support the creation and protection of pollinator habitat is by updating land use regulations to address pollinator habitat. Planning Boards can review potential changes and decide whether to pursue amending their Zoning Bylaw and/or Subdivision Regulations.

The key areas where pollinator-friendly changes can be incorporated are:

- Site Plan Review
- Special Permits
- Large Scale Solar Facilities
- Open Space Residential Development/ Conservation Development/ Major Residential Development
- Subdivision Regulations

As part of the *Regional Pollinator Habitat Corridor Implementation Toolkit,* recommeded pollinator-friendly land use regulations were developed in order to equip Planning Boards in other Franklin County towns with helpful guidance and model language for updating local land use regulations (see the *Regional Pollinator Habitat Corridor Implementation Toolkit*).

The FRCOG also reviewed the land use regulations of each participating pollinator community - Greenfield, Montague, Conway, Bernardston, Shelburne, Heath, Wendell and Orange - and identified potential zoning bylaw and/or subdivision regulations updates for each town. Pollinator-friendly land use regulation updates recommended for each town are included in each *Town Pollinator Action Plan*, available at: https://frcog.org/franklin-county-regional-pollinator-plan/.

LOCAL STRATEGIES FOR ENHANCING POLLINATORS

The protection of pollinators at the regional scale will rely, in large part, on the efforts of Franklin Country residents thinking regionally and acting locally. Landscape projects and habitat implementation strategies like developing pollinator gardens, implementing pollinator-friendly mowing practices at the residential and municipal scale, managing invasive species, and fostering the protection and expansion of native vegetation in the wild are examples of the types of projects that will protect native pollinators. Towns have the ability to mandate pollinator-friendly landscaping practices on certain new developments through land use regulations, but the absence of such regulations should not stop residents, farmers, municipal workers and businesses from voluntarily adopting the wide range of pollinator-friendly management practices described here and in other available resources.

Pollinator-Friendly Management Practices

According to the Xerces Society for Invertebrate Conservation, **"establishing wildflower habitat for pollinators is the single most effective course of action to conserve pollinators that can be taken by anyone at any scale."**[18] Effective pollinator habitat includes the critical requirements of food, shelter, and protection from pesticides and harmful cultivation practices. The following strategies are best management practices for establishing and maintaining pollinator food and shelter resources that any individual can do.

Critical requirements vary from species to species, but always include:

- **Food** – pollen, nectar
- **Shelter** – places to nest, places to lay eggs and develop larvae
- **Protection from pesticides** and other harmful management practices

[18] Xerces Society, "Establishing Pollinator Meadow from Seed," p. 1: https://xerces.org/publications/guidelines/establishing-pollinator-meadows-from-seed

Pollinator Gardening[19]

Establishing and stewarding pollinator gardens is critical to conserving native pollinators and helping all pollinators thrive. Flowers can serve as valuable food sources—in the form of pollen and nectar—even in small spaces.

Food supply for pollinators is critical especially early and late in the year, as native bees actively forage starting in March and do not wind down until November. Pollinators are thus best supported by a variety of native plant species with staggered blooming times. Bee diversity is maximized in landscapes where 15 or more flowering plant species are present, and where a minimum of three plant species are blooming at any given time. Having a combination of gardens and fruit-bearing trees and shrubs helps creates a succession of bloom times. Planting species that flower very early in the season, such as willows, tolerating "weeds" such as dandelions in the spring, and holding off on fall clean up to leave late-blooming flowers and fallen fruit can provide critical food sources for early- and late-season bees.

A variety of plant species also provides the range of color, shape, and scent that pollinators have evolved with over time. Bees have different tongue lengths, requiring different shaped flower blossoms, so a good goal is to have three plants, each with different tube lengths, blooming at all times. Purple, blue, and yellow flowers are the most attractive colors for bees, red the most attractive for hummingbirds, and red, yellow, orange, pink, and purple the most attractive for butterflies.

Pollinators love sunny gardens. Bees and butterflies use the sun to help warm their bodies to a temperature where they can fly around. Plants that receive more than six hours of sunlight have also been shown to produce more nectar.[20]

Dutch white clover (Trifolium repens) and Self-heal (Prunella vulagaris) as lawn (University of Minnesota Bee Lab)

Lawn Care

Mown lawns are food deserts to pollinators. Studies have shown that allowing flowers living in lawn to bloom by reducing mowing frequency can greatly increase foraging opportunities. Researchers at the University of Massachusetts who tested 16 lawns in Springfield, MA found that reducing mowing intervals from once every week to once every two and three weeks increased spontaneous lawn flowers by as much as 2.5 times and

[19] Information in this section relied heavily on information from the Beecology Project: https://beecology.wpi.edu/website/learn

[20] University of Maine Cooperative Extension, "Bulletin #7153 - Understanding Native Bees, the Great Pollinators: Enhancing Their Habitat in Maine": https://extension.umaine.edu/publications/7153e/

improved both species abundance and species richness.[21] Their results highlight a "lazy lawnmower" approach to providing bee habitat. Mowing less frequently is a cheaper and timesaving alternative to lawn replacement or planting pollinator gardens. One alternative to mowing every three weeks is to mow one third of the lawn once a week on rotation.

Other tactics to increase pollinator habitat in lawn include:

- Never mowing below three inches. This can also increase lawn health by increasing the root system to improve drought tolerance and shading bare soil to decrease broadleaf weed and crabgrass pressure.
- Dedicating less area to lawn; mowing borders or paths for needed access to these areas.
- Using lawn alternatives such as sedges, groundcovers, and low wildflowers.

Some homeowners may never be interested in changing the look of their lawn. At a minimum, education and outreach should encourage home gardeners and land stewards across the spectrum to use less pesticide.[22]

Managing Lawn for Ticks

Short and frequent lawn mowing is often recommended for tick prevention. However, the same study of 16 lawns in Springfield also found no evidence that mowing every three weeks increased black-legged/deer tick populations (the carrier of Lyme Disease). Maintaining lawns between three and six inches will likely keep ticks in check. For areas of the yard left to grow taller, five-foot wide paths can provide safe access and circulation.

Meadow Establishment and Management

The process of establishing a species-rich pollinator meadow planting consists of five basic steps: site selection, site preparation, plant selection, planting techniques, and ongoing management.[23]

Site Selection

First, native wildflower and flowering shrub meadows require full sunlight to thrive, so sites with full sun throughout most of the day work best. Second, certain plants are more suitable to different soil types, so site and plant selection must consider soil type. Third, high weed pressure from neighboring sites can inhibit meadow establishment and be a persistent problem if not actively controlled.

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[21] Lerman, Susannah B. et. al, "To mow or to mow less: Lawn mowing frequency affects bee abundance and diversity in suburban yards," *Biological Conservation* 221 (2018): 160-174.

[22] UMass Amherst Center for Agriculture, Food, and the Environment, "Protecting Bees and Pollinators from Pesticides in Home Gardens and Landscapes": https://ag.umass.edu/home-lawn-garden/fact-sheets/protecting-bees-pollinators-from-pesticides-in-home-gardens-landscapes

[23] Information in this section relied heavily on the Xerces Society, "Establishing Pollinator Meadow from Seed": https://xerces.org/publications/guidelines/establishing-pollinator-meadows-from-seed

Marginal land such as septic fields, parking strips, or road medians and roadsides are well suited for meadow establishment. Deep-rooted native plants have the potential to bring benefit to otherwise unproductive sites by supporting other wildlife, improving water infiltration, filtering runoff, and storing carbon.

Black-eyed susan (Rudbekia hirta) and beebalm (mondarda spp.) meadow (Creative Commons)

Site Preparation

Site preparation is of paramount importance for meadow establishment, especially on sites with high weed pressure or where sod-forming grasses and fast-spreading forbes are the dominant cover. Seeds and roots of perennial weeds in particular need to be eliminated prior to planting or seeding; annual and biennial weed seeds can more easily be controlled after planting. Weed control over one or two years can be done without the use of herbicides through smother cropping, repeated shallow cultivation, solarization, soil inversion, sod removal, or a combination of methods. However, herbicide-free methods are typically more expensive and labor-intensive and may be more feasible on smaller sites. Landowners and stewards planning site preparation should reach out to qualified ecological land managers to develop a plan for effective and efficient site preparation that is in line with their values and budget.

A key step in establishing pollinator plants and habitat areas more permanently is finding strategies for out-competing European cold season grasses early in the growing season.

Although not listed as invasive plants, European grasses such as timothy (*Phleum pratense*), orchard grass (*Dactylis glomerata*), and quack grass (*Elymus repens*) are highly aggressive and will overtake efforts to maintain native pollinator plants. Cold season grasses must be removed or suppressed on a regular basis as part of ongoing maintenance in areas attempting to establish favorable pollinator conditions. This issue remains a major obstacle in native habitat management and April and May are a critical time to do maintenance on pollinator habitat that is still establishing, especially in open grassy conditions.

Plant Selection

Meadow plants should primarily be selected based on their suitability for the growing conditions and their staggered bloom times. For reasons outlined in the Native Plants section of this plan, land stewards should strongly consider using native, locally sourced seeds. Ordering seed in individual lots, and not as a mix, helps ensure that small and large seeds can be evenly distributed when spreading. The recommended seeding rate for wildflowers and other herbaceous plants ranges from 40 to 60 seeds per square foot, but it is always helpful to consult a seed rate calculator or the seed vendor.

In addition to pollen- and nectar-rich flowering plants, bunch grasses and sedges are recommended for pollinator meadows because they serve as larval host plants for some butterflies and provide nesting and overwintering sites for some bumblebees and other insects. Grasses also help facilitate successful burning if burning is used as a management strategy. See the Pollinator Gardening section of this plan and Recommended Plants by Landscape Type sections (in the *Regional Pollinator Habitat Corridor Implementation Toolkit*) for further plant selection guidance.

Planting Techniques

Wildflowers do best in Franklin County when seeded in fall (October thru December), as many perennial plant seeds required a period of cold and dampness in order to germinate. Winter precipitation also helps seeds settle into the soil and stimulates germination. Spring planting favors grasses and annual species.

Broadcast seeding can be performed by hand or with mechanically hand-operated crank seeders. Seeds broadcast most successfully when mixed with an equal or greater volume of slightly damp, inert materials such as coarse-textured sand, vermiculate, rice hulls, or sawdust, as the material helps mix seeds and gives a visual representation of distribution on the field. Seeding in a cross pattern (i.e. covering the field in a vertical orientation followed by a horizontal orientation) and broadcasting small seeds and large seeds separately also help with even distribution.

Ongoing Management

Watering is typically not required unless a meadow is seeded under drought conditions. Once established, native plants typically do not need supplemental irrigation; irrigation may in fact

favor weed seed proliferation. Likewise, fertilizing is not typically necessary under normal conditions and may actually encourage weed growth.

The best management strategy to control annual weeds during the first growing season is regular mowing or weed-whacking of the seedbed when a large number of weeds reach 12 inches tall or begin to flower. In the second year, mowing and raking away the first season's debris in early spring helps eliminate almost all annual seeds. Most of the remaining weeds will be biennial species, which need to be mowed when they are about to flower. In small areas, string trimmers, hand weeding, or organic herbicide spot-application is possible.

Meadow establishment can take up to five years. For long-term meadow management, see the Mowing and Burning and Invasive Species Control sections sections of this plan. After several years, re-seeding of the pollinator meadow may be necessary to support long-term plant diversity.

Meadow Establishment and Maintenance on Ground-Mounted Solar Sites[24]

Pollinator-friendly practices and programs are relatively new to the Northeast; therefore, little research is available on best practices to establish native plants at solar PV facilities. Much of the best management practices for large-scale solar arrays are likely the same as those for meadow planting (see Meadow Establishment and Management). However, installing and managing pollinator habitat in solar facilities likely requires a number of adaptations. First, it is important to select relatively low-growing species with some degree of shade tolerance. As long

Pollinator meadow dominated by black-eyed susan (Rudbekia hirta) surrounding a solar installation (Creative Commons)

[24] Information for this section derived from UMass Clean Energy Extension, "Best Management Practices for Pollinator-Friendly Solar Arrays": https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/pollinator_friendly_bmps_for_solar_arrays_0.pdf

as species can tolerate these conditions, the selection of wildflower, grass, sedge, and shrub varieties can be flexible. See also Meadow Establishment and Management – Plant Selection and Recommended Plants by Landscape Type in the *Regional Pollinator Habitat Implementation Toolkit* for more information.) Second, within the array footprint the management goal should be to create conditions that require only one mowing of the entire per year. This is in contrast to other kinds of meadow sites, where no more than one third of the overall site should be mowed each year. Mowing should occur between October 1 and May 1 to reduce the impact on pollinators still active during the shoulder seasons, or mid-June or mid-July in sites where milkweed comprises a significant proportion of flowering species. Mowing more frequently may be necessary during the establishment period (first three to five years), or if plants (including weeds or invasives) are growing tall enough to shade panels. Selective weed whacking of invasive species and tall plants can also be used to manage these issues without mowing the entire footprint. In the array perimeter, the classic guideline of mowing only 1/4 or 1/3 of the area should be followed once the meadow is established. In the trim zone, management can be limited to selective weed whacking and mowing to control invasive species. Vegetation in this area need only be trimmed to the height necessary to avoid shading of the array and to successfully manage for desired plant species.

Agriculture

Many species of native bee are much more effective than honey bees at pollinating flowers on a bee-per-bee basis, so agricultural growing practices that support native bees tend to be good for crop pollination, increasing yields, and farm profit.[25] Agriculture, in all of its forms, creates both opportunities and challenges for pollinators and the completion of their life cycle. A number of common agricultural practices that tend to have "neutral" or deleterious effects on pollinators: monocropping, regular mowing, and broad-spectrum pesticide application. Monocropping, in which a singular crop is planted over multiple acres, creates a feast-to-famine effect wherein pollinators who are attracted to the abundant forage of a crop in flower can be suddenly stranded without a food source when the crop is harvested. In general, mowing hayfields, cereal crops, and field edges even a couple times per summer significantly reduces the benefit of those areas as pollinator habitat. Finally, conventional pesticides are almost universally harmful to pollinators, as are some organic options.

There are a number of strategies for reducing the harm brought on by these widespread agricultural practices, as well as additional options for enhancing pollinator habitat:

- Diversify crops and consistently include flowering crops in crop rotation.

[25] The Xerces Society, "Farming For Bees: Guidelines for Providing Native Bee Habitat on Farms," 2015: https://www.xerces.org/publications/guidelines/farming-for-bees
Landis, Joy, "National study documents U.S. specialty crop farmers can increase yields through improved pollination," 2020: https://www.canr.msu.edu/news/national-study-documents-u-s-specialty-crop-farmers-can-increase-yields-through-improved-pollination

- Intercrop cash crops with insectary plants in the form of intercropping systems or pollinator planting strips.[26]
- Leave some flowering weeds.
- Reduce tillage to protect ground-nesting bees and provide nesting locations (see Provision of Nesting Habitat).
- Tailor spraying practices to protect pollinators (see Protection from Pesticides).
- Seed wildflowers in unproductive fields, field edges, or steeply sloped sections of field.
- Limit mowing on non-crop areas (including woodland, road, and wetland edges) to one or two times per season, after flowers have gone to seed (preferred) or staggering mowing so one area remains flowering at all times.
- Create or restore hedgerows—lines of woody vegetation that can also serve as visual screens, windbreaks, and zones for shrub- or tree-based crop production.

*Clockwise from top: Pollinator strip between crops (*entymologytoday.org*); Pollinator-friendly hedgerow along pasture (*Hawthorne Valley Farm*); Former farmland left fallow for pollinators (*Hawthorne Valley Farm*)*

[26] Insectary plants are grown to attract, feed, and shelter insect parasites and predators to enhance biological pest control. University of California Agriculture & Natural Resources Statewide Integraded Pest Management Program, "Insectary Plants": http://ipm.ucanr.edu/mitigation/insectary_plants.html

Water and Mud Sources

Pollinators and other wildlife benefit from having a clear, perennial water source available nearby to foraging habitat. A stormwater retention basin can provide for this need, or a birdbath if the water is changed frequently. Water sources with shallow or gently sloping sides allow insects to approach the water without drowning. Water sources that also create a little mud benefit bees, as mud is an important nesting material for several bee species.

Provision of Nesting Habitat

In addition to season-long food sources, nesting locations are important to pollinator survival. The majority of native bees nest in the ground; small, very circular holes in the ground surrounded by piles of displaced dirt are the signature of a ground-nest. Ground-nesting bees prefer well-drained soil in sunny areas. Features such as woody snags, brush piles, patches of bare soil, piles of stone, and clump-forming grasses can support cavity-nesting bees. Wood-nesting bees require pithy twig or vine centers, rotting wood and existing cavities in wood. Bumblebees are more generalist, nesting under leaves, in abandoned rodent tunnels and in other above- or below-ground cavities.

Miner bee species in ground nest

In allowing for ample nesting habitat for native pollinators, it is important to avoiding tillage and land management practices that would smother or destroy a ground nest, including plastic mulch. Creating a variety of natural landscape features on a property, including hedgerows and set-asides (areas left undisturbed), ensures nesting habitat for a variety of species. See the References and Resources section for more info on creating and preserving nesting habitat for bees.

Mowing and Burning

Mowing and burning are reliable techniques for suppressing annual and biennial weeds in meadow plantings. However, mowing and burning must be done strategically to avoid killing insects and reducing habitat availability to a detrimental degree. Mowing when pollinators are less active—cool, overcast, and/or windy days, or late in the evening—is important for protecting insects. Mowing between October 1 and May 1 reduces the impact on pollinators (particularly native bees) still active during the shoulder seasons. However, recent research has shown that on sites where milkweed comprises a significant proportion of flowering species, mowing mid-June or mid-July allows regeneration of fresh milkweed for the fall monarch butterfly migration.[27]

[27] Haan, Nathan L. and Douglas A. Landis, "Grassland disturbance increases monarch butterfly oviposition and decreases arthropod predator abundance" *Biological Conservation* 233 (2019): 185-192.

Mowing and burning should be contained to one third or one quarter of the overall meadow area in each season. No single area should be burned or mowed more frequently than every two years to protect dormant insects. Leaving the majority of the area unmowed or unburned ensures a population of insects large enough to recolonize treated areas.

Mowing in a low gear at slow speeds and from the center toward the periphery allows wildlife to escape the tractor and mower. Setting the mower height at 7 to 12 inches above ground level provides a layer of protection for wildlife. Mowing equipment should also be cleaned between mowing locations to ensure that invasive species are not introduced to the site.

Protection from Pesticides

The widespread use of pesticides is one of the most significant risks to pollinators. Many residential and garden pesticides do not include bee toxicity information on the label, and products that do list this threat only mention danger to honey bees. Many native bees are much smaller than honeybees and vulnerable to spraying practices that might not affect the larger honeybees. Even products approved for organic gardening, such as rotenone and spinosad, are dangerous to bees. Some researchers believe widespread use of systemic pesticides results in death or harm (such as impaired brood production) to insects like bees and butterflies when sequestered in flower nectar. The use of one group of insecticides that have been shown to be particularly dangerous for bees, the neonicotinoids, will be banned from use in Massachusetts starting in July 2022.

The safest course of action is to avoid pesticides entirely. The UMass Pollinator-Friendly Solar PV certification does not allow the use of insecticides or fungicides; herbicides are permitted in limited application for the control of non-native invasive plant species.[28] If herbicides must be used, they should be applied by a qualified personnel with commercial pesticide applicator licenses. Use should be highly restricted and contact with blooming plants or areas where bees are nesting avoided. Evening spraying when bees are less active is one way to reduce some of the harm. Morning spraying when plants are covered with dew is less ideal, and may result in longer residual toxicity. Choosing a liquid formulation, rather than a powder, which may become trapped in a bee's pollen collecting hairs, may also reduce some of the risk.

An important consideration is that the same landscape features that support healthy pollinator numbers also support other beneficial insects. A diverse mix of species are strategies that home gardeners and land stewards can employ to help mitigate or prevent major pest outbreaks. Integrated Pest Management (IPM) strategies that combine biological, cultural, mechanical, and chemical controls are also important tools for the pollinator protector's toolkit.

(https://www.sciencedirect.com/science/article/pii/S0006320718318184)

[28] UMass Clean Energy Extension, "Pollinator-Friendly Solar PV for Massachusetts": https://ag.umass.edu/clean-energy/services/pollinator-friendly-solar-pv-for-massachusetts

Invasive Species Control

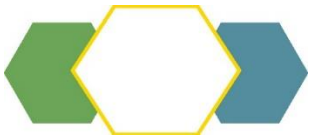
The proliferation of invasive plant species is one of the most challenging aspects of stewarding pollinator habitat. See the References and Resources Section for excellent resources for invasive species identification and management in Massachusetts.

Mowing, cutting, pulling, girdling, spot burning, and covering invasive plants are viable methods of mechanical control, depending on the species and size of infestation. Mechanical control of large infestations can be overwhelming, but local organizations can often mobilize volunteers to help. Organic herbicide application is an additional option for invasives control, and best done by qualified personnel when pollinators are not active and away from pollinator-friendly plantings that are currently in bloom. Whenever possible, herbicides should only be applied using targeted stem or stump application.

Leveraging Permanently Protected Open Space

Local land trusts are also committed to protecting and enhancing pollinator habitat. For example, the Mount Grace Conservation Trust, who serves much of Franklin County, recently received funding to control invasive species and improve early successional bird and pollinator habitat at their headquarters, the Skyfields Arboretum in Athol. Some land trusts have also recognized that there may be opportunities to fold support for pollinator habitat into conservation restrictions (CRs) that they hold on private lands, just as some CRs held by the Commonwealth reserve the right to do management for the purpose of preserving, conserving, or promoting natural habitat.

Monarch butterfly on butterfly bush, Dan Little, Greenfield Recorder



NEXT STEPS: COORDINATING THE POLLINATOR-FRIENDLY MOVEMENT

There are a variety of challenges limiting pollinator habitat expansion and protection in any given town. Accomplishing pollinator conservation goals will require navigating a range of factors, including broadening support from the community, earning buy-in from municipal and other stakeholders, and demonstrating the value, effectiveness, and ecosystem benefits of implementing projects and strategies.

Convening Stakeholders

The successful implementation of this plan requires a broad and coordinated effort among diverse stakeholders: residents and landowners, municipal and state government, conservation groups and land trusts, businesses and corporate sponsors, and industry and utilities companies. It also relies on the willingness of stakeholders at every level to help each other learn and apply these strategies. Attendance at the pollinator workshops held in each of the eight participating towns demonstrated that there is already a core group of individuals passionate about pollinators, biodiversity, food system security and climate resilience. Workshop participants may go on to form a loose network of pollinator advocates, educators, and implementers, or they may form formal organizations; Greening Greenfield and the Wendell Pollinator Protectors stand out as organizations whose ongoing commitment to improving pollinator habitat has resulted in more pollinator plantings and greater awareness in their towns.[29]

Towns can look to regional partners for support as well. The Western Mass Pollinator Network, the Western Massachusetts Master Gardener Association, Greenfield Community College's Food and Farm Systems program, and the UMass Amherst Center for Agriculture, Food, and the Environment are examples of organizations invested in protecting pollinators and whose expertise is an asset to the region. Many towns have local gardening clubs and food justice/food security non-profits that can be tapped for collaboration (e.g. the Greenfield Garden Club, the Nolumbeka Project, the North Quabbin Garden Club, Just Roots, Great Falls Apple Corps, and the Heath Agricultural Society). It is important for local pollinator leaders to continue to seek out potential partnerships among all types of stakeholders.

[29] Greening Greenfield: https://www.greeninggreenfieldma.org/latest-news/53-main-page-news/26-pollinator-campaigns-1

Local communities can be essential allies for wild native pollinators. The relationship between people and nature extends from the spiritual and cultural values held within a community. The variation in these human-nature relationships is called biocultural diversity. Contemporary strategies for pollinator conservation in the 21st century can explore ways to build upon varying biocultural approaches to land management, particularly the practices of valuing biocultrural diversity and developing and adopting more ecological landscape management practices and diversified farming systems.[30] Depending on the existing spiritual and cultural values of a given place, pollinator conservation work may result in significant landscape change, while other places may only show subtle, complementary changes.

Pollinator work can also be conducted through the framework of equity and food justice. In many places, the food system does not provide reliable access to nutritious foods and falls short of protecting environmental justice populations from the harm of industrial processes, including some farming practices. Land access for environmental justice and indigenous populations can play an important role in improving both food access and pollinator habitat. Ensuring that land stewardship can be learned and practiced by all interested members of society supports social equity, environmental sustainability and creates space for diversified biocultural approaches to land management. Making room for the return of indigenous seeds, practices, and stewards of traditional lands can have an integral role in pollinator protection efforts.

Advocating for Designated Municipal Leadership

The participating pollinator communities in this *Regional Pollinator Action Plan* have demonstrated that there is significant local volunteer capacity for pollinator projects as well as an overwhelming interest in a pollinator-friendly social movement. The benefit of officially designated, trained and paid oversight for pollinator work in each community could be substantial. However, that might not be financially feasible given that rural towns already have many demands on limited staff time and resources. Yet, creating a point person in charge of pollinator projects, such as a sustainability coordinator, could increase the pace at which pollinator management strategies are implemented, funding is identified and pollinator habitat and resource areas are expanded and protected. Managing land as pollinator habitat and educating residents and businesses to do so as well has many economic, cultural and environmental co-benefits.

[30] Hill, Rosemary, et. al, "Biocultural approaches to pollinator conservation," *Nature Sustainability* 2 (2019): 214-222.

Expanding Educational Initiatives

Getting involved in pollinator work at any level provides people an opportunity to discover the value of the local landscapes and natural resource areas from a wild pollinator's perspective. Because pollinator-landscape interactions can be observed, educational activities such as plant walks, habitat hikes, garden tours and demonstrations, volunteer planting and maintenance days, invasives species pulls and citizen science are some of the ways that people can raise awareness and respond to the issues that pollinators face. Public presentations, school curriculum, and Town websites are also important avenues for building public awareness. Using public properties such as civic buildings, schools and libraries to install demonstration gardens or management techniques and including interpretive signage provides low-cost, ongoing education.

Pollinator Campaigns

Pollinator workshop participants also had excellent ideas for pollinator awareness campaigns and challenges. *What are your ideas?*

NO MOW MAY would challenge homeowners to resist mowing their lawns until the end of May to allow lawn-growing flowers such as dandelions, purple henbit, violets, and fleabanes to bloom through the early season when native pollinators are active and have limited forage.

THE 10 % CHALLENGE would challenge lawn owners and farmers to leave 10% (or another % amount) of their mowable area unmown until the late season when wildflowers have passed.

Changing Aesthetic Perceptions

Landscape aesthetics are a common and widely shared concern because pollinator gardens necessarily involve cultivating native plant species, which have been largely ignored by the horticulture industry and the planting palates of formal gardeners in recent generations. Native plants can be wild and unwieldy compared to domesticated counterparts that have been hybridized, genetically selected for a tidy, diminutive form and extra-showy features that are appealing to people, but that don't necessarily aid pollinators in their quest for food or habitat. Pollinator advocates can make the case that pollinator gardens can be orderly and beautiful and they can be an aesthetic asset to the community as well as an ecological benefit for pollinators and biodiversity. In order to achieve these seemingly competing objectives, people attempting

to create pollinator gardens for the first time should be well-supported with guidance on how to plan a garden with attractive, well-timed blooms and how to demonstrate "cues to care" to ensure that gardens can live up to their dual claim of aesthetic and ecological value.[31]

> ***Cues to Care***
>
> The term "cues to care" was developed by landscape designer Joan Nassauer to describe strategies used by gardeners and landscapers to indicate that a landscape is well cared for and meets cultural expectations for maintenance, despite being home to native plants with a more messy appearance that function better as an ecosystem. Employing cues to care, such as selective mowing or trimming, or maintaining orderly paths, can help people appreciate wilder aesthetics.

Overcoming Funding Limitations

Planting and maintaining landscapes can be expensive and the ecological benefits of new gardens can be a tough sell for anyone, but especially for municipalities, given the demands on staff time and Town resources. Even just changing existing landscape maintenance practices can represent a budget and training challenge that officials are reluctant to address. Demonstrating that pollinator gardens and habitat areas can be maintained as easily as conventional landscapes, or even more so because they are adapted to the soil and require less frequent watering and tending, is an important step in earning the buy-in from municipalities to develop them further in public spaces and right-of-ways. Showing that implementation costs can be shared by private and non-profit funders, folded into other grant opportunities, and powered by volunteer labor is also important. All participating towns expressed a need for funding for establishing nad maintaining pollinator habitat areas.

Farms are also uniquely positioned to protect and enhance pollinator habitat but may have very little time and room in their budget. Civic groups tend to be rich in volunteer labor, but have limited funding for planning and purchasing materials. Pollinator education is essential to restoring and enhancing pollinator populations but funding is needed and challenging to secure. Where educational strategies cannot be funded alongside implementation, communities may need to look toward cultural councils and other arts- or education-based resources for help. Table 3 outlines potential local, state, and national funding sources for pollinator-friendly gardening and land management and for climate-resiliency projects that may have the potential to incorporate pollinator-friendly landscaping. Local funding opportunities specific to towns are listed in the respective town plans.

[31] Nassauer, Joan, "Messy Ecosystems, Orderly Frames," *Landscape Journal* 14, no. 2 (1995): 161-170.

Table 3. Potential Funding Sources

	Eligible parties
Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) Allows farm business owner to hire a technical service provider to write a plan for adding pollinator habitat to their operation, practices for planting pollinator resources, and practices for tree/shrub plantings that can have a pollinator focus	*Farm business owners*
NRCS Conservation Stewardship Program (CSP) Supports similar planning to EQIP, also involves a 5-year commitment to maintaining the current stewardship level of the land while also improving at least one aspect of the operation	*Farm business owners*
Greenfield Garden Club Supports Franklin County projects that involve gardening, plant science, ecology, or any related subject matter	*Anyone involved with qualifying projects*
Municipal Vulnerability Preparedness Action Grants Supports projects that improve municipal climate resiliency such as stormwater management and food security	*Municipalities with MVP designation*
Complete Streets Program Provides technical assistance and construction funding for pedestrian and bicycle safety and connectivity; some streetscape and water management improvements incorporate planting	*Muncipalities with a Complete Streets Policy and Prioritization Plan*
MassDEP 319 Nonpoint Source Competitive Grants Program Funds projects that prevent, control, or abate nonpoint source pollution or restore beneficial uses to help waters meet quality standards such as riparian buffers that include pollinator habitat	*Municipalities, RPAs, conservation organizations*
Department of Conservation Services Grants DCS grants, such as the Parkland Acquisitions and Renovations for Communities (PARC) Program funds acquisition, construction, or renovations of municipal parks	*Municipalities*
Green Communities Awards technical support and financial assistance via the designation grant than can be used for zoning bylaw rewrites, net-zero planning and solar installations that all have the potential to incorporate pollinator habitat	*Municipalities with Green Communities Designation*

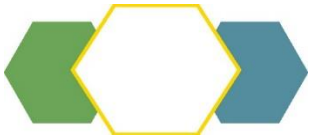
Something towns should consider when exploring the possibility of incorporating pollinator habitat into Complete Streets-funded work is that although bump-outs, curb extension, tree planting, and new transit stops may provide space to incorporate pollinator plantings, the Complete Streets funding will probably not cover any additional costs associated with pollinators. Municipalities are responsible for funding their own Complete Streets designs, allowing for flexibility in how improvements are designed. However, Complete Streets designs must be completed by a certified transportation engineer who might have limited experience with pollinator plantings. Volunteers and municipal officials could share this plan and the *Regional Pollinator Habitat Corridor Implementation Toolkit* with the engineer and request that plants are pollinator friendly.

Improving Infrastructure Maintenance

Infrastructure occupies an enormous amount of area on the landscape and often serves singular purposes: fuel storage, energy generation or delivery, wastewater capture and filtration, safe transportation, and so on. There are some incompatibilities between pollinator-friendly plants and different kinds of infrastructure, and there are legitimate concerns regarding the potential for recurring infrastructure maintenance to impact pollinator plantings and resource areas. However, there are also often straightforward and low-cost opportunities to integrate pollinator friendly plantings in and around infrastructure currently serving the public. Examples include planting utility strips that are periodically dug up to access buried pipes and conduits and residential septic mounds that have to be kept free of deep-rooted vegetation, both of which otherwise serve little ecological purpose and are often an eyesore in the landscape.

The issue of pesticide and herbicide use through utility corridors, especially high-tension wire corridors, is another area where additional research, innovation, and cooperation could lead to mutually beneficial solutions. Utility corridor management represents an opportunity to increase the value of the land within the right-of-way and integrate sustainable principles and practices into already ongoing vegetative management. Unfortunately, Towns have very limited jurisdiction over how ROWs are managed by utilities. The exact leverage points and their power are unknown, but landowners and municipalities do have the right to review vegetation management plans, ask questions, and advocate for minimizing impacts to the environment, including habitat resources. Conservation Commissions specifically could play an important role by reviewing vegetation management plans. Landowners may be able to ask to monitor herbicide application on their property or to do manual vegetation management themselves. The Pollinator Habitat Scorecard developed by the *Rights-of-Way as Habitat Working Group* is a tool for energy and transportation ROW organizations and land mangers to evaluate pollinator

habitat and management practices.[32] The potential for widespread adaption of utility corridor management for pollinator habitat is still unknown, but communities can engage with utility companies to ask for information about what practices are being used in the ROWs that traverse their town and work to explore alternative ways for managing them in order to achieve mutually beneficial goals.



CONCLUSION

The *Regional Pollinator Action Plan*, together with the *Regional Pollinator Habitat Corridor Implementation Toolkit* and *Pollinator Action Plans* for the eight participating pollinator communities of Heath, Shelburne, Bernardston, Greenfield, Conway, Montague, Wendell, and Orange, represent a major step forward for Franklin County to connect, conserve, and foster habitat for wild, native pollinators. These documents can assist local and regional efforts to protect and create pollinator habitat across the region.

FRCOG worked closely with members of each community to reflect the current interests and capacities for pollinator work and to idenitfy collaborative strategies that will engage diverse stakeholders. Successful partnerships will be important for coordinating the substantial work, costs and effort that will surely be involved with pollinator work, including the implementation of pollinator habitat in different settings, involving residents and the greater community in meaningful education and outreach, and advocating for the climate resiliency benefits of integrating pollinator habitat with municipal projects and regulations.

The *Regional Pollinator Action Plan, Regional Pollinator Habitat Corridor Implementation Toolkit,* and *Town Pollinator Action Plans* provide communities with the information they need to identify mutual goals and opportunities for improving biodiversity, climate resiliency, and the sustainability of local farms and the food system. These communities can now work together more strategically to address pollinator decline as a pressing problem facing Franklin County. In doing so, they will provide examples for other communities to follow across the Commonwealth.

[32] Rights-of-Way as Habitat Working Group, "Pollinator Habitat Scorecard," http://rightofway.erc.uic.edu/pollinator-habitat-scorecard/

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U.S. Fish & Wildlife Service, “Rusty Patched Bumble Bee Guidance on ESA Implementation”: https://www.fws.gov/midwest/Endangered/insects/rpbb

United States Department of Agriculture Natural Resources Conservation Service, New York - “Pollinator-Friendly Plants for the Northeast United States”: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/ny/plantsanimals/?cid=NRCS144P2_027390

Images

Hawthorne Valley Farm: hvfarmscape.org/blog/encouraging-fall-flowers-and-their-insect-visitors-farms-hudson-valley

The Xerces Society: xerces.org/blog/helping-pollinators-on-road-to-survival

U.S. Fish and Wildlife Service: https://digitalmedia.fws.gov/digital/collection/natdiglib/

Canadian Wildlife Federation: www.hww.ca

U.S. Forest Service: www.fs.fed.us

Kansas State University: blogs.k-state.edu/kansasbugs/2015/09/11/be-on-the-look-out-for-goldenrod-soldier-beetles/

Resources

Books

100 Easy-to-Grow Native Plants, by Lorraine Johnson

100 Plants for Feed the Bees, by The Xerces Society

Bringing Nature Home: How You Can Sustain Wildlife with Native Plants, by Doug Tallamy

Garden Revolution, How our Landscapes can be a Source of Environmental Change, by Larry Weaner and Thomas Christopher

Lawns into Meadows, by Owen Wormser

Nature's Best Hope: A New Approach to Conservation That Starts in Your Yard, by Doug Tallamy

Native Plants for New England Gardens, by Mark Richardson and Dan Jaffee

Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes, by Thomas Rainer and Claudia West

Pollinators of Native Plants, Attract, Observe and Identify Pollinators and Beneficial Insects with Native Plants, by Heather Holm

The Living Landscape, Designing for Beauty and Biodiversity in the Home Garden, by Rick Darke & Doug Tallamy

The Pollinator Victory Garden: Win the War on Pollinator Decline with Ecological Gardening, by Kim Eierman

Online Resources by Topic

Pollinators

Gegear Lab at UMass Dartmouth gegearlab.weebly.com/

Greening Greenfield's List of Lists greeninggreenfieldma.org/action/campaigns/70-native-plant/58-campaigns/pollinators/70-native-plant/570-plant-lists-to-help-you-make-decisions

International Union for Conservation of Nature iucn.org

Mass Audubon massaudubon.org/learn/nature-wildlife/help-pollinators-thrive/

The Beecology Project beecology.wpi.edu/website/home

The Xerces Society xerces.org/pollinator-resource-center/northeast

Pollinators Welcome pollinatorswelcome.com

Pollinator Partnership / Pollinator Week pollinator.org

Pollinator Pathways Northeast pollinator-pathway.org/

UMass Center for Agriculture, Food, and the Environment ag.umass.edu/resources/pollinators

Native Plants and Management

Ecological Landscape Alliance https://www.ecolandscaping.org/

Native Plant Trust (Formerly New England Wildflower Society) plantfinder.nativeplanttrust.org/Plant-Search and gobotany.newenglandwild.org

National Wildlife Federation https://www.nwf.org/NativePlantFinder/

The Xerces Society xerces.org/pollinator-resource-center/northeast

The Xerces Society Project Milkweed xerces.org/milkweed

Western Massachusetts Master Gardener Association wmmga.org/

Agriculture

Natural Resources Conservation Service:

- nrcs.usda.gov/wps/portal/nrcs/site/national/home/
- nrcs.usda.gov/wps/portal/nrcs/detailfull/national/plantsanimals/pollinate/?cid=stelprdb1044847

Northeast Organic Farming Association (NOFA) Massachusetts nofamass.org

The Xerces Society Agriculture and Working Lands resources page xerces.org/publications/habitat-and-land-management/agriculture-and-working-lands

Nesting

Sustainable Agriculture Research and Education sare.org/Learning-Center/Books/Managing-Alternative-Pollinators

The Xerces Society:

- xerces.org/wp-content/uploads/2008/11/nests_for_native_bees_fact_sheet_xerces_society.pdf
- xerces.org/wp-content/uploads/2009/11/tunnel-nest-management-xerces-society.pdf

Solar

UMass Amherst Clean Energy Extension ag.umass.edu/clean-energy/services/pollinator-friendly-solar-pv-for-massachusetts

Electric Power Research Institute rightofway.erc.uic.edu/wp-content/uploads/2020/02/000000003002014869.pdf

Golf Courses

Xerces Society https://xerces.org/sites/default/files/2018-05/06-001_02_XercesSoc_Making-Room-for-Native-Pollinators.pdf

USGA https://www.usga.org/course-care/regional-updates/northeast-region/practical-pollinator-programs.html

Right-of-Ways (Roadsides and Utility Corridors)

Rights-of-Way as Habitat Working Group:

- Monarchs rightofway.erc.uic.edu/wp-content/uploads/2019/06/000000003002015435.pdf
- Roadside BMPs rightofway.erc.uic.edu/wp-content/uploads/2018/05/1A8-BMPs_pollinators_roadsides.pdf
- Roadsides Technical Manual rightofway.erc.uic.edu/wp-content/uploads/2019/01/Maintaining_Roadsides_for_Pollinators.pdf
- Roadsides rightofway.erc.uic.edu/wp-content/uploads/2018/05/1A11-pollinators_BMPs_in_highway_ROW-1.pdf
- Roadsides rightofway.erc.uic.edu/wp-content/uploads/2018/05/1A9-pollinatorbmpsroad-1.pdf

Invasive plant species:

Invasive Plants of New England eddmaps.org/ipane/

Connecticut Invasive Plant Working Group cipwg.uconn.edu/invasive_plant_list/

New York State Department of Environmental Conservation dec.ny.gov/docs/lands_forests_pdf/tftismg17.pdf