NRCS Natural Resources Conservation Service Helping People Help the Land...

Vermont – Biology Technical Note #4

Pollinator Habitat

Pollinators are a diverse group including bees, wasps, flies, beetles, butterflies, moths, and hummingbirds. In many places, such as Vermont, bees are the "workhorses" when it comes to pollination. Major crops pollinated by bees in Vermont include apples, blackberries, raspberries, blueberries, cucumbers, pumpkins, squash, tomatoes, peppers, watermelons, and more. In addition, many plants in our natural areas depend on bees and other pollinators. This in turn produces wild food sources for wildlife such as serviceberry, apples, hawthorns, dogwood, viburnum, brambles, blueberry, willow, etc.

Vermont has a good variety of native bees including bumble bees, mining bees, sweat bees, mason bees, leafcutter bees, long-horned bees, polyester bees, yellow faced bees, carpenter bees, cuckoo bees, and even a squash bee. While the European honey bee is extremely important for pollination in agriculture and for honey, there is already a good deal of information devoted to that species. The decline of the honey bee over the years and resulting pollination challenges for growers have given new attention to our native bees that can provide pollination services. However, some of our native bees are also experiencing significant population declines and in Vermont in 2015 three species of bumble bee were listed as threatened or endangered. While sometimes overlooked, our native bees provide tremendous pollination services in agriculture and natural areas. By providing habitat for these native species landowners can benefit agricultural crops as well as our natural areas and wildlife.

Honey Bee on Milkweed

Where to Begin

As with any effort in habitat management it is wise to first determine what is needed or wanted. Is there a need for pollination services for a certain crop? Or, is there a general desire to improve pollinator habitat across a property? In both cases it makes sense to inventory the property and surrounding landscape to determine what habitat elements are present or absent. Depending upon the interest and commitment level of the landowner, this inventory may also include a detailed inventory of the nearby flowering plants. This can assist with planning habitat management and potential plantings around the property to address identified foraging deficiencies during the spring, summer or fall. Fortunately, Vermont is a rural state that has a good deal of natural and semi-natural habitats from forest to farms which provides good habitat for pollinators. While some parts of the state have concentrated and intensively used row crop agriculture with little value to pollinators (e.g. silage corn), most current and past agricultural lands have a diversity of flowering plants and cover for pollinators.

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What Makes Good Habitat?

The best habitat generally will have all necessary habitat components (e.g. food, cover, water) within close proximity. This limits energy expenditure as well as exposure to predators. When planning a habitat project for pollinators, aim for connectivity of important habitats. Be sure to consider the various habitat needs from nesting to foraging areas. Avoid mowing down those "weedy" or overgrown looking field borders as they may be providing nesting and foraging habitat as well as connectivity to other habitats for pollinators. Delay the mowing of old fields or mow only part of it each year. This will keep areas open and herbaceous but limits disturbance. Don't clean up the forest or forest edge – maintain down woody material, brush piles and dead or dying trees (snags).

This "weedy" idle land is providing good Pollinator habitat – red clover, sweet white clover, and black-eyed susan

Finally, eliminate or minimize insecticide use. Foraging bees can be poisoned when they absorb the toxins (including residue on plants) through their exoskeleton, drink tainted nectar, or eat insecticide covered pollen (includes young bees). Neonicotinoids are a particularly troubling and widely adopted group of chemical pesticides used on some farm crops, ornamental landscape plants and trees. They are toxic to honey bees and native bees. Neonicotinoids are absorbed by plants and are transferred through the vascular system, which can make all parts of the plant toxic to insects including pollen and nectar. In addition, Neonicotinoids can persist in the soil for months to years after application and untreated plants may absorb these residues. Be cautious when planning pollinator habitat near suspected insecticide use areas; avoid these areas if possible. Note that even some pesticides approved for organic agriculture are highly toxic to bees. Be sure to research available reference material.

Nesting Sites

About 70% of the approximately 4,000 North American native bee species excavate their nests underground. These **ground nesting bees** need direct access to the ground surface and typically are found in poorer quality sandy or loamy sand soils. These bees are mostly solitary nesters but some will nest in large aggregations sharing entrance holes but with separate chambers or nests.

Another group, the **wood nesting bees**, makes up most of the remaining bees in North America (~30%). They will nest in tree cavities and some nest in hollow stems of woody trees and shrubs. These wood nesting bees are also solitary and generally nest in abandoned beetle tunnels in dead (snags) or dying trees, stumps and logs.

Ground nesting site (photo M. Shepherd)

Dead trees or "snags" are good for wildlife and wood nesting bees that make use of beetle tunnels

Most bee species are considered solitary bees, which simply means the female bee will construct and provision her own nest without any help.

The remaining bees – only about 47 species in the United States with 21 in the east – are the social **bumble bees**. Social bees live in colonies defined as having at least two adult females that live in the same nest. Usually one female is an egg layer and the others are workers that help construct, provision and defend the nest. Our social bumble bees are some of our most effective pollinators. The bumble bee's large size, dense fur, and ability to generate heat and regulate body temperature make them especially important pollinators in cooler northern latitudes both in agricultural and natural settings. Bumble bees build nests in small cavities, often in old rodent burrows, either underground or above ground beneath plant matter (e.g. tussocks of grass, grass clippings, mulch pile, brush piles, etc.). Sometimes they will even use old bird nests in bird houses.

See Conservation Bumble Bees - Guidelines for Creating and Managing Habitat for America's Declining Pollinators

Management for Nesting

For **ground nesting bees**, maintain open (not shaded) areas with patchy vegetation. Avoid tilling and other soil disturbance when ground nesting areas are occupied. In some cases, cutting back some vegetation on flat to gentle south facing slopes may provide ground nesting habitat.

For **wood nesting bees**, avoid cutting down dead and dying trees unless the tree poses a hazard. Maintain large and small woody material on the forest floor. For the **wood tunnel nesting bees**, maintain or plant trees and shrubs with pithy or hollow stems, such as elderberry (*Sambucus* spp.), raspberry and blackberry (*Rubus* spp.), boxelder (*Acer negundo*), and sumac (*Rhus* spp.).

For **bumble bees**, studies have shown that they often occupy the grassy interface between open fields and hedgerows or forest. This area should be at least five feet wide, consist of a mix of grasses and forbs, and mowed every two to three years in late fall after the colonies have died for the year and the queen is dormant. In old fields, maintain some un-mowed grassy thickets and

Un-mowed field borders can be good nesting habitat for bumble bee queens.

brushy areas where vegetation can grow dense and tall and then fall over. This will create cover where bees can make use of old rodent nests.

For all nesting situations, be sure to tolerate nesting bees when they are encountered and limit human activity if possible. There are various opportunities to take a more active role in nest site construction including bee boxes, bee blocks, stem bundles, etc. which can be found through the resources below and especially Chapter 7 of Farming for Bees – Guidelines for Providing Native Bee Habitat on Farms.

Foraging Sites

Foraging sites are areas where flowering plants grow and produce pollen and/or nectar. Bees will often feed on nectar in the flowers and then carry pollen back to their nests (only females' carry pollen) as a protein source for the young. Bees will create "bee bread" by mixing nectar and pollen and this "loaf" is typically where the egg is laid in a brood cell. This cell in the nest is typically sealed off and once the larvae hatches it grows rapidly as it feeds on the bee bread.

Foraging sites can range from a small flower garden to an old field to a large hayfield with legumes (clover/alfalfa). The best foraging sites will have a variety of flowering forbs, shrubs and trees through the spring, summer, and fall. Different bees have different preferences and feeding abilities based upon their size and tongue length and due to accessibility of pollen and nectar in the flower. Most bees, including bumble bees, are considered generalist pollinators and they will visit a wide range of plants. Other species, such as certain mining bees, are much more selective and get their pollen from only a certain plant. See Specialist Bees of the Mid-Atlantic and Northeastern United States for more info.

Shrub willow in flower in April

It is very important to be able to identify common plants of Vermont that are important to pollinators and especially bees. This will assist in the process of inventorying a site to determine what seasonal group of important pollinator plants may be in low supply or missing. Listed below are some examples of some valuable plants that are commonly found around the Vermont landscape from agricultural fields, old fields, wetlands and forest. Note that many of the valuable early season pollinator plants are woody species. Native willow is especially important as a very early foraging source for bumble bee queens emerging in the spring.

Examples of a Few High Value Pollinator Plants Commonly Found in Vermont – by Bloom Period

- **Early Spring** – Native Willow (e.g. pussy willow), Spring Ephemerals (Dutchman's breeches, squirrel corn, spring beauty, bellwort, trillium), Dandelion*, Coltsfoot* (*Tussilago farfara*), Ground Ivy (*Glechoma hederacea*)*#, Henbit (*Lamium amplexicaule*)*#, Serviceberry (*Amelanchier* spp.), native honeysuckle (*Lonicera canadensis*)

- **Spring** – Cherries (Choke, Pin, Black), Apple*, Hawthorn+, Dogwoods (*Cornus* spp.), Chokeberry (*Aronia* spp.), Rose+, Blueberry, *Rubus* spp.+ (raspberry, blackberry), Lupine+, Trout Lily, Virginia Waterleaf, Clovers*, Vetch*, Black Locust*#, etc.

- **Summer** – Milkweed, St. John's Wort[+], Dogwoods, Sweet Clovers*, Clovers*, Vetch*, Alfalfa*, *Spiraea* (meadowsweet, steeplebush), Wild Bergamot, Beardtongue, Avens, Early Goldenrod, Purple Coneflower*, dogbane (*Apocynum* spp.), Jewelweed (*Impatiens* spp.), Mints[+], Viper's bugloss*, Thistle (*Cirsium* spp.)[+#], Hemp-nettle (*Galeopsis* spp.)*[#], Knapweed*[#], Basswood, Trefoil (Lotus spp.)*, Monkey Flower, etc.

- **Late Summer-Fall** – Goldenrods, Asters, Joe Pye-weed, Boneset, Turtlehead, Jewelweed, etc.

*Non-native in Vermont, [+] some native and non-native species in Vermont, [#]can be weedy or invasive

Early spring: On open land, dandelions are a great food source for bees while spring ephemerals such as spring beauties are available in the forest.

Later in spring, various cherries blossom and provide a good food source. Typically pin cherry first (pictured) then choke and black.

Vetch is commonly found in open lands and hayfields in summer. It is a good food source for bees and for butterflies such as this skipper.

Goldenrods are high value and very common through late summer/fall. Bees and butterflies (red admiral pictured) alike visit the flowers.

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Early Successional Habitats

Many of the species of plants listed above are found in open areas that get plentiful sunlight. Plants that need a lot of sunlight are considered "shade intolerant." Plants that perform better under shaded conditions are considered "shade tolerant." Shade intolerant grasses, forbs and shrubs or small trees typically dominate early successional habitats. Many of these types of plants are quite valuable for wildlife and tend to be those that provide fruit. If these predominantly open areas are not periodically mowed, cut, brush hogged, grazed or disturbed in some other fashion they will eventually grow into forest. While a well-managed forest is beneficial to pollinators, maintaining some open areas provides more foraging opportunities through the spring, summer and fall due to the abundant flowering plants. Common early successional habitats found throughout Vermont include hayfields, pastures, idle lands, old fields or pastures, wetlands shrubland, and young forest. While large acreages of these types of habitats is ideal, small areas such as field edges can be managed to maintain a mix of grass, forbs and shrubs that will benefit pollinators.

Old field habitat – grasses and flowering forbs and shrubs. Un-mowed areas provide late foraging sites and structure for nesting bees and other wildlife.

Managing open areas for pollinators and other wildlife can be done through various mowing/brush hogging regimes as well as hand cutting (trees/large shrubs) and even tree/shrub planting. First and foremost these habitats need to be kept open to maintain favorable conditions for many of the important pollinator plants. This could be done through **delayed mowing** (till late in growing season) or **rotational mowing** where different parts of a field are mowed over multiple years. When setting up a management for a field, it would be important to maintain some un-mowed areas for a few years as potential bumble bee nest sites. In old field settings, where clumps of shrubs and trees may be found, focus on maintaining and encouraging the most valuable pollinator and wildlife shrubs and removing invasive plants and less desirable plant species. Maintain pithy stemmed woody plant species such as elderberry and sumac for wood tunnel nesting bees to have locations to nest. Maintain dead and dying trees for other wood nesting bees within or at the edge of the managed areas. Striving for a mosaic of different disturbance regimes can be quite beneficial, as it will create a patchy habitat with a variety of interspersed grass, forbs, shrubs and trees.

Potential NRCS Practices include Early Successional Habitat Management 647, Brush Management 314, and Tree and Shrub Planting 612

Early Successional Habitat Information Sheet

Pasture

A well-managed pasture can provide good pollinator habitat. Pastures can range from management intensive grazing systems with daily rotations of many animals to continuous grazing (no paddock movements) at very low stocking with scattered woody areas. At a minimum, grazers will want to have protein rich legumes such as clovers, trefoil and vetch as part of their forage inventory. These legumes are high value pollinator plants that will benefit bees and soil health as well as livestock. Where paddocks are intensively grazed, a management option could be to defer grazing on a certain paddock until bees have had the opportunity to forage upon the flowering legumes. Once legumes have matured (gone to seed), the paddocks can be grazed; the seeds will then pass thru the rumen and re-seeding new areas may occur via livestock manure. Manual or mechanical re-seeding or frost seeding pastures can also improve this valuable resource on pastures. Bumble bees will primarily use red clover as they have tongues long enough to reach into the deep nectaries. Ladino and alsike clover will be utilized by more species of bees.

Wildlife can thrive on pasture; particularly those with lower animal stocking. Light stocking allows forbs to flower and hawthorn and apple trees to thrive -good for pollinators and wildlife.

Maintaining some shrubby areas on or nearby the pasture can provide good cover for wildlife and also key early foraging opportunities for bees. Often times, pastures are in less intensively used portions of the farm and may have apple, hawthorn, serviceberry, raspberries and other valuable trees and shrubs around the periphery. These can be encouraged with selective removal of competing trees. Wet areas may present an opportunity for fencing and potentially planting valuable species such as dogwood and native willows. If there are bedrock outcrops or rocky areas within the pasture, beneficial forbs and shrubs could be allowed to grow. If there are limited tall grassy areas, consider a field border between any forest land and the pasture as a potential bumble bee nesting area. In addition, maintain large old trees or snags on the pasture unless they are a hazard. These will provide nesting sites for wood nesting bees as well as feeding/nesting/denning sites for a variety of other wildlife.

Potential NRCS Practices include Fence 382, Prescribed Grazing 528, Forage and Biomass Planting 512, Field Border 386, Hedgerow Planting 422

Hay Land

Similar to pastures, hay land can provide a good foraging area but typically there is limited species diversity. The primary forbs that are planted and occur in hayfields are alfalfa and clovers. As the fields are cut during the growing season this will set back the plant growth and allow for flowering to occur again. In older hay fields there may be some volunteer species such as aster, goldenrod, milkweed, St. John's wort, etc. that could provide additional foraging opportunities. Generally hay land will be harvested through the season so there may not be a lot of opportunity for set aside or delayed mowing. As long as there is an insecticide free field with a good component of legumes the hayfield can provide a good foraging source. Some hayfields may be dominated by undesirable wildlife/pollinator species such as reed canary grass. This may require re-seeding the entire field with the inclusion of beneficial forbs in the planting.

Pollinators may find abundant forage in hayfields. Legumes such as clovers and alfalfa are commonly part of hay seed mixes in Vermont. Red clover pictured with some "volunteer" vetch.

Potential NRCS Practices include Forage and Biomass Planting 512, Field Border 386

Orchards, Vegetables, Berries

If a single crop flowers all at the same time this provides an abundant foraging opportunity but only for a short period of time. Providing other foraging opportunities (and nesting habitat) will allow for maintaining a larger pollinator population in the area. Adding some earlier or later varieties of the same crop or adding an entirely new and different crop can accomplish this, in part. Foraging improvements should also include some enhancements to non-cropped areas. One option is to add some **understory plantings** between the rows of berries, vegetables or trees in an orchard. This can provide a ground cover where there is none or enhance lawn type ground cover that is often found in orchards. Sowing a diverse, low growing, understory of legumes such as red and white clover, vetch and trefoil will provide good foraging opportunities to the local bees and other pollinators. This type of understory planting can be cut short when the crop is in flower, but then be allowed to bloom afterwards.

Longer term cover crops, allowed to flower, are another option on vegetable and fruit farms to increase foraging habitat. Cover crops can improve soil health, fertility and suppress weeds but can also provide high quality foraging areas for local populations of bees. Cover crops valuable to bees include buckwheat, phacelia, hairy vetch, mustards, etc. Do not plant flowering cover crops for pollinators in fields where neonicotinoid treated seed or crops were previously planted.

Tri-colored bumble bee helping to pollinate raspberry flowers.

Another benefit to managing habitat for pollinators is that it will also benefit another group of **beneficial insects** that suppress crop pests. This service is especially important in fruit and vegetable production areas. Habitat management for these other beneficial insects is quite similar to management for pollinators. Maintaining or creating a diverse mix of habitats in and around the farm will benefit these insects. Old fields, field borders, and transitional areas with brush/rock piles can all be beneficial. There is also a good deal of overlap in favorable plants for pollinators and the other beneficial insects. Plants species to favor and/or plant for beneficial insects include aster, boneset, daisy fleabane (*Erigeron* spp.), golden Alexanders, goldenrod, dogbane (*Apocynum* spp.), ironweed, milkweed, mountain mint (*Pycnanthemum* spp.), angelica, self-heal, sunflower, yarrow, clovers, sweet clover, buckwheat, hairy vetch, mustards, basswood, buttonbush, elderberry, hawthorn, meadowsweet and steeplebush (*Spiraea* spp.), cherries (*Prunus* spp.), roses, willow and more.

Other opportunities may exist for managing early successional habitats in the area to maximize pollinator friendly plants. Field borders could be established or improved to provide better foraging and nesting opportunities through disturbance management, plantings of forbs, trees and shrubs or both. If there are idle areas on the farm, consider focusing management attention on these areas.

For more information on Cover Cropping for Pollinators and Beneficial Insects
For more information about Beneficial Insect see Farming with Native Beneficial Insects.

Potential NRCS Practices include Conservation Cover 327, Tree and Shrub Establishment 612, Field Border 386, Early Successional Habitat Management 647, Cover Crop 340.

Forest Management

Since nearly three quarters of Vermont is forested, it is important to understand how forests can be managed to benefit pollinators. Managing forests to benefit pollinators is not that different from managing forests for other wildlife and forest health. A good diversity of flowering forbs, shrubs and trees is ideal. Open areas either within or nearby the forest can be beneficial. These habitats will have a good deal of sunlight providing space for shade intolerant (wildlife/pollinator friendly) plants such as raspberry, blackberry, chokecherry, goldenrod, bergamot, etc. Forest skid trails and especially log landings may be important pollinator habitats as they periodically receive disturbance and then grow unmanaged. They naturally can have a great variety of valuable pollinator plants but could be enhanced with disturbance management or plantings. Sites lacking pollinator plants could be planted with shrubs or beneficial forbs. A low cost and simple alternative is to seed clover into these areas as clover can withstand traffic and disturbance.

Breaks in the forest canopy can happen through natural disturbance (e.g. wind-throw or a large old tree falling over) or be planned through silvicultural thinning, crop tree management or regeneration treatments small and large. Large canopy breaks of an acre or more will tend to favor shade intolerant plants whereas small openings will favor more shade tolerant plants. Canopy breaks, even small, can also be beneficial to understory shrubs and forbs that can provide very early season foraging opportunities for bumble bees and other bees. The early season forbs and shrubs of rich northern hardwood forests are quite valuable to our native bees. Bellwort, squirrel-corn, Dutchmen's breeches, spring beauties, trout lily, columbine, trillium, waterleaf, and leatherwood (shrub) are a few of the early flowering plants of the rich northern hardwood forest that are especially important to bumble bee queens emerging in spring.

Spring beauty (*Claytonia spp.*) flowers are an in important early season pollen and nectar source in forests.

Maintaining and encouraging large snags and large woody material is good for both pollinators (especially wood nesting bees) and a variety of vertebrate wildlife. In general, larger snags will provide for more species of wildlife both small and large. Leaving tree tops in the forest, following timber harvests, will leave nutrients for forest soils and help protect flowering plants from browsing animals.

Timber harvest canopy gaps can provide good habitat for bees and other pollinators. Nesting habitat is found in the large wood and brush piles. The flush of sunlight will promote beneficial raspberry, cherry (both pictured) and other plants.

While some invasive plants actually provide good forage for bees (e.g. barberries, exotic honeysuckle, multiflora rose, etc.), it is wise to remove them or keep them at a low level in the forest. Invasive plants can dominate an area leaving a single species understory, which prevents growth of other flowering plants as well as regeneration of the future forest. See the Invasive Plant Information Sheet for more information.

Crop tree release is a forest management approach that focuses attention on a limited number of desirable and/or valuable trees in a forest stand. Nearby trees that are competing with the crop tree's crown are either cut down or girdled. This frees up the crop tree from competition allowing the tree to grow a bigger healthier crown, increase diameter growth and produce more seeds, nuts or fruit (mast). Crop tree release can also be used for very specific purposes such as to improve

wildlife habitat by increasing mast production. For this purpose the technique is called "mast tree release." This same forest management approach can be used to improve habitat for pollinators. Selecting high value pollinator trees such as black cherry or basswood to release will significantly increase potential flowering in the crown as it expands. See the Forest Stand Improvement – Mast Tree Release job sheet for more information. Another variation of this "tree release" approach can be used in younger forests, old orchards and at the forest edge. Typically in these settings there are smaller trees such as serviceberry, apple, and hawthorn that are valuable pollinator foraging sources. These trees need full sunlight and will grow a bigger crown, flower more and produce more fruit when they are in full sun. Since these trees are shorter in stature than forest trees, a greater number of trees may need to be cut to release these properly. For more information on this approach see the Upland Habitat Management – Apple Tree Release job sheet.

Potential NRCS Practices include Conservation Cover 327, Tree and Shrub Establishment 612, Forest Stand Improvement 666, Upland Wildlife Habitat Management 645, Early Successional Habitat Management 647

For more information see the Forest Stand Improvement Information Sheet.

Wetlands and Riparian Areas

Wetlands and riparian areas can be quite valuable to pollinators. While there may be seasonally high water tables that limit nesting opportunities for ground nesting bees, there is often good foraging opportunities and nesting habitat potential for wood nesting bees. In wetlands and riparian areas that have been cleared and used for agriculture, the natural plant community may be compromised or simplified. Aiming to restore a natural condition with a good mix of native forbs, shrubs and trees is a good goal. In the case of wetlands, it may be necessary to first restore wetland hydrology before addressing deficiencies in vegetative habitat.

Wetlands may range from open water to wet meadow to scrub-shrub to swamp. Having a variety of wetland types is ideal. As with upland forests and habitats, generally the more valuable pollinator habitats will have some open areas with abundant flowering plants. There can be a good deal of overlap between wetland/riparian plants, as many grow fine in moist soil conditions. Some plants of value to pollinator and native bees that can be found in wetlands and wet riparian areas include water lilies (*Nymphaea* spp.), pickerelweed, swamp milkweed, blue flag iris, buttonbush, swamp loosestrife (*Decodon verticillatus*), turtlehead, monkey flower, boneset, joe pye-weed, purple loosestrife (invasive exotic Quarantine don't plant!), native loosestrife (*Lysimachia* spp.), jewelweed, highbush blueberry, red osier and silky dogwood, Spiraea spp., and native willows.

This riparian area had fence installed to exclude livestock and trees and shrubs were then planted. Primary species are shrub willow, dogwoods, viburnum and alder.

Woody plants dominate many of our wetland and riparian natural community types in Vermont. In general, establishing this native woody cover is wise as it provides a valuable habitat type with native plants used by local wildlife (including pollinators). In areas lacking native plant cover, re-establishing this cover may be as simple as stopping whatever disturbance is happening on that land. For instance, in a farm setting, with poor grazing management livestock may be degrading a wetland or wet riparian area at the edge of the productive pasture land. In other instances judicious grazing may be maintaining an early successional condition and good plant species richness. Continuous stocking of animals in the wetland is not helping their productivity and their grazing and trampling is limiting the flowering of wetland forbs and shrubs. Simply installing a fence or moving the fence back from the wet area may solve the resource problem. In some cases it may be necessary for more active measures. These can range from supplemental planting of shrubs to a full re-plant of an area.

As with upland habitats, early successional management can be used in some of these settings but be sure wetland/riparian functions and values are addressed. In addition, maintaining and encouraging snags and woody debris will be beneficial to pollinators in these settings.

Potential NRCS Practices include Fence 382, Wetland Restoration 657, Conservation Cover 327, Tree and Shrub Establishment 612, Early Successional Habitat Management 647

Planting for Pollinators

It is important to be able to identify key habitats and important foraging resources for pollinators and maintain them. Vermont has a wealth of natural and semi natural habitats ranging from different aged of forest, to wetlands/riparian areas, to old fields/orchards and to various types of open agricultural lands. In many places there may already be a good deal of nesting sites and foraging opportunities through the growing season. However, in most places there is at least some opportunity for improvement in nesting habitat, foraging habitat or both. There are various management approaches to improving pollinator habitat (as discussed in this technical note) beyond just planting a tree, shrub or forb. Managing a large field or entire property may do more for pollinators than just a small planting. But, planting can enhance existing areas or create a forage rich area that will be heavily used by pollinators.

Dogwood (*Cornus spp.*) shrub being planted in a wetland.

Plantings should complement existing foraging sources in the area; they should be specifically designed to fill in the gaps in flowering during the growing season. Some producers (e.g. fruits/veggies) may need to examine flowering periods of their crops and then plant pollinator plants that will flower at other times of the year to ensure crop pollination but to also maintain a healthy pollinator population on the farm.

Tree and shrub planting is a fairly easy conservation practice but there are many things to consider to ensure success. Proper care, handling and planting techniques are necessary for success of the practice. See the VT NRCS Tree and Shrub Establishment Specification Guide Sheet for

detailed information about tree and shrub planting. Planting trees and shrubs is an excellent way to improve early season foraging sources for native bees and other pollinators. Generally, most of the commercially available, pollinator friendly forbs tend to flower in later spring, summer and fall. Woody plants such as willow, serviceberry, cherry and dogwoods can provide excellent wildlife habitat (food and cover) and also a key early season foraging source for our native bees. Early season food sources are key to bees that overwintered and are emerging in spring (e.g. especially bumble bee queens). Consider planting pithy stemmed species such as elderberry to provide that nesting habitat for wood tunnel nesting bees.

Trees and shrubs native to Vermont should be the primary focus as this fits the local natural communities and native wildlife habitat needs. While there are some high value non-native pollinator trees such as black locust (and ornamental honey locust) they can act weedy or invasive in some settings.

Planting pollinator forb mix at a field scale is usually more involved than tree planting. Simply adding legumes to hay or pasture plantings is a standard forage improvement practice but trying to establish a field dominated by non-traditional pollinator friendly plants that will flower throughout the growing season can take some work. Commitment and attention to detail will be important in establishing these types of plantings. Native plants to Vermont would be ideal to use but in some cases it can be difficult to have a completely native species mix due to availability and other factors. Often times' regionally-specific pollinator mixes may have species native to Vermont but others that are native to further south or west. These plants may not do as well in all parts of Vermont due to harsh winter conditions.

A successful pollinator planting takes good planning and preparation.

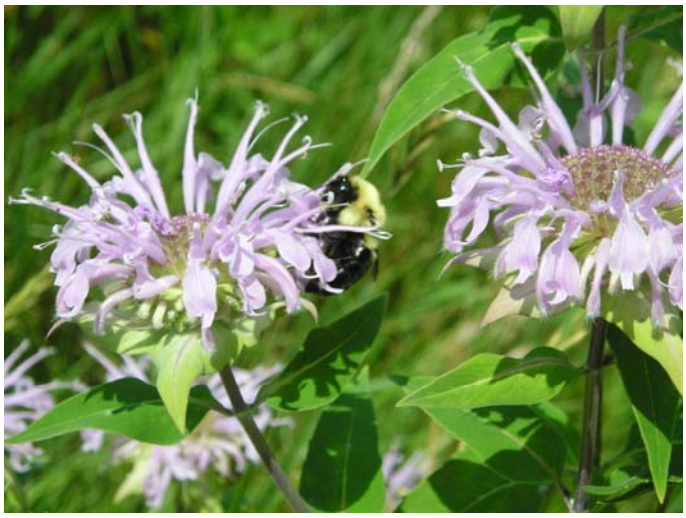
The Vermont Fish and Wildlife Department Wildlife Diversity Program (formerly Heritage Program) recommends that plantings do not include plant species that are Uncommon (S3), Rare (S2) or Very Rare (S1) in the State. The concern is that importing plants (seeds) from another part of the country may lead to genetic pollution of our strain of rare plant here in Vermont. Perennial lupine is a perfect example of this perplexing problem. It is an excellent pollinator plant but the native Vermont species is considered very rare (S1) so NRCS will not include it in our planting mixes.

Another challenge and consideration with planting forbs for pollinators is that the seed and mixes can be quite expensive. Seed costs can range from $30-$600+ per pound depending upon the species. For seed mix alone it can cost $300-$1,000+ an acre depending upon species and amount used. Thus, careful planning is very important.

Seed rate calculators are available through Xerces Society and other organizations to help design a pollinator planting. Seed rate calculators will simplify the process of building a seed mix and quantifying how much (ounces or pounds) of each species you will need depending upon the square foot or acreage of the project area. While traditional seedings of forage grasses are done on a pounds/acre basis, pollinator plantings are usually designed on a seeds per square foot basis. The target range is 40-60+ seeds per square

foot, which is calculated by determining number of seeds per pound for each species (available from seed dealer) and then dividing total number of seeds in the mix by 43,560 ft^2 (acre). This will give the number of seeds per square foot. Seed sizes are quite variable with some species having 20,000 seeds per pound while others have more than three million seeds in a pound. This means there may only be a few ounces of seed of a certain species planted per acre for some seed mixes.

At a minimum, pollinator plantings should have nine species total with at least three species providing foraging opportunities (flowering) in spring, summer and fall. This will meet the goal of providing foraging opportunities through the growing season. Many mixes will contain numerous additional species beyond the minimum of nine. More flower variety and flowering periods will benefit more species of bees and other pollinators. Remember, it may be advisable to also include some shrub plantings nearby as well to meet the foraging needs of emerging bees in early spring. Warm season and cool season bunch grasses are often added to mixes. Grasses are larval host plants for some butterflies (skippers), provide potential nesting sites for bumble bee colonies, and can be overwintering habitat for bumble bee queens as well as other beneficial insects.



Wild bergamot (*Monarda fistulosa*) is a high value pollinator plant that is readily established.

There are a number of regional and state pollinator mixes available. These should be selected based upon site condition with adjustment of species (added or deleted) for the specific site. In general the sites should get a lot of sun, as most plant species in mixes do not tolerate a lot of shade. Another important site factor to understand is the soils. Mixes available may fit dry, mesic or wet sites. Determine soils for the site using either Web Soil Survey or other GIS based soils map. Evaluate soil conditions on site as well because soil maps may not be accurate for a small planting. Resource professionals proficient in plant identification and hydric soils should be able to help determine the type of site and what mix would fit best. Most good seed mixes and dealers will include the wetland indicator status for the plants to aid in matching plants to the site. Plant wetland indicator status is a rating, which provides the likelihood of the plant occurring in wetlands or uplands. Plants that do not have an indicator status may not have been classified or may be upland plants. Plant species wetland indicator status can be found on the USDA Plants Website or through the US Army Corps of Engineers National Wetland Plant List.

State/Regional Seed Mixes and Plant Lists for Pollinators: Xerces Society-NRCS Pollinator Habitat Planting Installation Guide for Conservation Cover 327 – New England, Xerces Society Pollinator Plants – Northeast Region, Xerces Society-NRCS Pollinator Habitat and Biology – New England Pollinator Handbook. Vermont NRCS has mixes available upon request.

Site Preparation is critical to the success of any pollinator planting since weed control options are limited when the wildflowers start to germinate. Site prep is equally important as good plant selection. Poor site prep can lead to a poor stand of flowering forbs overcome by grass or weeds, which can shorten the life of the practice. Site preparation may begin a year or more ahead of the scheduled planting so good planning is important. Sites that have been under cultivation (cropped) for multiple years have generally lower weed pressure and may be a good spot. Before planting, be sure that the prior crop was not treated with a neonicotinoid; if so, find another site for the planting.

A weed free seed bed is critical to a successful planting. Site preparation can be done with herbicide, solarization and, in some cases, tillage.

There are various methods for establishing a weed free seed bed but generally herbicide or "solarization" are two of the primary recommended methods. Tillage is generally not recommended as it brings significant weed seed to the surface. However, for larger planting areas on organic farms, deep moldboard plowing to invert the entire sod layer may be the best option. The herbicide approach would involve the use of a non-selective and non-persistent herbicide on the site starting in spring for a fall planting. The solarization process uses a large sheet of UV-stabilized, high-tunnel greenhouse plastic (with the edges buried) to heat the ground, killing weeds and weed seeds below. Solarization is also begun in the spring for a fall planting. Fall or dormant season planting of wildflower mixes is generally recommended as many perennial plant seeds need exposure to cold, damp conditions over time to successfully germinate. Although spring plantings are possible, they tend to favor establishment of grasses over wildflowers. For more detailed information about site prep and other aspects of planting see the Xerces Society Installation Guide for New England.

Summary

Pollinators play a key role in in agriculture as well as in natural areas. The declines of both honey bees and various native bees are a cause for concern. Landowners and land managers can make a conscious effort to improve pollinator habitat with the wealth of information available. Even making small changes on a farm or managed land can help pollinators. This could include leaving some areas idle for nesting and foraging, favoring (leaving) beneficial plant species and changing how pesticides are applied to minimize or eliminate risk to bees and other beneficial insects.

Landowners and managers with a greater interest in pollinators can take a more active approach to management by inventorying plants on their land to make up for deficiencies in flowering during the growing season, managing open areas to maximize floral diversity, managing for healthy forests and creating or improving nesting areas. Planting high value pollinator plants can be accomplished in many settings through a number of NRCS Conservation Practices. Early season foraging sources can be improved through planting tree and shrub species like willow, serviceberry and cherry through practices such as Riparian Forest Buffers 391, Hedgerow Planting 422, and Tree and Shrub Establishment 612. Pasture and hay land can be improved through additions of various legumes and potential adjustments in management through the Forage and Biomass Planting 512 practice. Where there is a pollination need for a crop, a pollinator

planting may be a good approach through Conservation Cover 327 or Field Border 386. Good planning is key including site preparation and seed mix selection.

Vermont is blessed with good mix of natural and semi-natural habitats for pollinators on farms, fields, forests and wetlands. The conservation community can do a great deal to help pollinators simply by raising awareness of habitat needs. Private landowners can make a big difference for pollinators by implementing beneficial habitat improvement activities on the ground.

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