

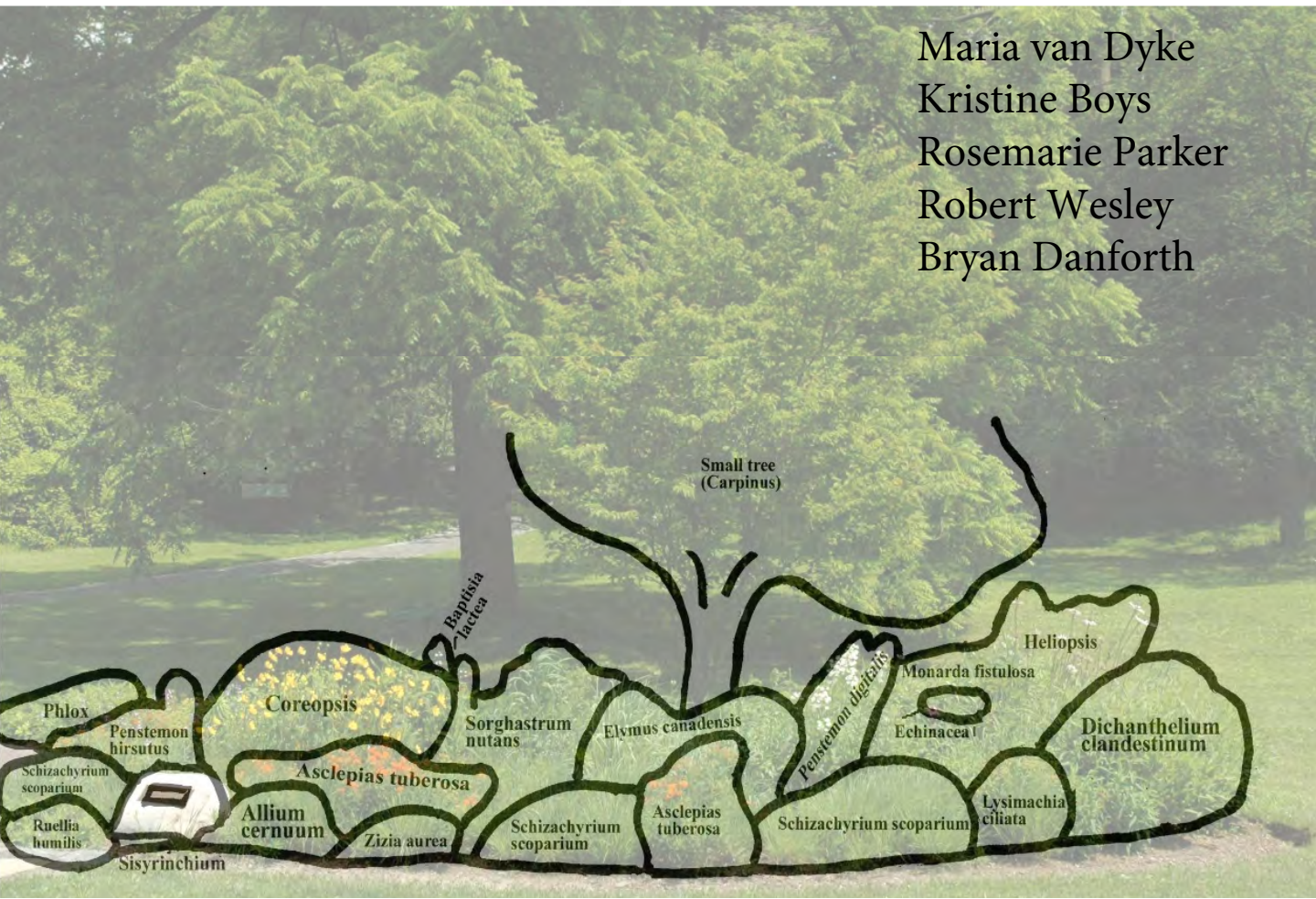
# Creating a pollinator garden for native specialist bees

*of New York and the Northeast*



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From Cover Photo: Additional species not readily visible in photo - *Baptisia australis*, *Cornus sp.*, *Heuchera americana*, *Monarda didyma*, *Phlox carolina*, *Solidago nemoralis*, *Solidago sempervirens*, *Symphotrichum pilosum var. pringlii*. These shade-loving species are in a nearby bed.

### **Acknowledgements**

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# Creating a Pollinator Garden for Specialist Bees in New York

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# How to Build a Pollinator Garden for Specialist Bees in the Northeast

## Introduction

There has been a massive increase in interest in the conservation of bees. Dramatic losses of managed honey bee colonies beginning in 2007 created serious concerns about bee populations in general. Since then, we have discovered many bumblebee species are also in decline worldwide. However, these social bee species are not the only bees that are under threat. Long-term studies based on 140 years of museum records document even steeper species declines in native solitary and semi-social bees (see *Bee life history and social behavior*). The causes of bee decline are varied. Native, wild bees in general—like the specialist bees we are focusing on in this guide—may be threatened in different ways than honey bees. The most likely threat to native bees is habitat loss, and the associated loss of key floral and nesting resources. Faced with this discouraging news, what can a homeowner, backyard naturalist, or Master Gardener do?

Several guides to building a pollinator garden focus on plants that will attract a wide variety of generalist bees (e.g., guides available from the Xerxes Society; <https://xerxes.org/pollinator-resource-center>). Our guide is different. This guide is focused on providing rich resources for the *specialist* bees of the northeastern US, New York in particular, and is inspired by Jarrod Fowler’s 2016 publication, *Specialist bees of the northeast: host plants and habitat conservation*. What are specialist bees? **Specialist bees** are bee species that visit just one host-plant species, genus, or plant family to gather pollen (**Box 1**), while generalist bees collect pollen and nectar from many different plant species. Host-plant specialist bees are completely dependent on a small group of native plant species for pollen, nectar and sometimes floral oils (**Box 2**).

**Box 1: Host plant specialists** - Bees range widely from host plant generalists (which collect pollen and nectar from many different host plant families), to host plant specialists (which visit just one species, genus, or tribe of host plant). Host-plant specialization in bees is largely driven by pollen specialization. Nectar from flowers provides carbohydrates and lipids to bees, but pollen is the major source of protein required for bee growth. Host-plant specialists have an innate preference for one kind of host plant pollen. They have anatomical and morphological features that are highly adapted to harvesting, manipulating, and transporting the pollen of their preferred host-plant. For example, female squash bees (*Eucera* (Peponapis) *pruinosa*; Apidae) have scopa with widely spaced hairs perfectly sized for transporting the large pollen grains of the only host plants they visit: squash and pumpkins (genus *Cucurbita*; Cucurbitaceae).

Host-plant specialists in the Northeast include many species of *Andrena* and *Perdita* (Andrenidae), *Melitta* and *Macropis* (Melittidae), *Dufourea* and some species of *Lasioglossum* (Halictidae), *Chelostoma*, *Heriades*, some species of *Osmia* and *Megachile* (Megachilidae), and *Ptilothrix* (Apidae). Numerous studies have documented that these host-plant specialist bees are more likely to be impacted by anthropogenic changes to the landscape -- such as fragmentation and habitat loss -- than generalist bees.



This guide provides easy access to the information needed to build a pollinator garden for these rare and sometimes threatened specialist bees. The guide provides a detailed informational table (**Table 1**) listing the native plants of New York that are crucial for supporting native specialist bees; including, where the region or habitat the plant occurs naturally, date of bloom, color of bloom, plant structure, how to obtain seeds and transplants, and general propagation methods for each species. The last column of the plant table lists the names of the specialist bees that visit these plant species. Prior to the table we

discuss the life history of specialist bees, the specific needs of specialist bees, why native plants *species* are important, the problem with cultivars, and step-by-step instructions for planning and installing a bee garden for specialist bees (how to choose a site, sourcing native plants, garden layout). At the end of this document we have included a list of places to source native plants and a list of organizations that can provide additional guidance. If you are interested in learning more about bee biology, we have included several informational boxes throughout the text and a table at the end listing all the specialist bee species in our area along with information on social behavior and nesting biology (**Table 2**).

Many solutions exist for supporting pollinators. Enhancing nesting sites, improving foraging resources (flowers), and reducing pesticide use are all good, general recommendations. But one of the best solutions that individual homeowners can adopt is to develop a pollinator garden in your back yard. To that end, we developed this guide to help homeowners with an interest in bee conservation develop a pollinator garden to support those native bee species most in need of assistance.

**Box 2: “Oil bees”** - One extremely interesting group of host-plant specialist bees are the “oil bees” which have developed an intimate partnership with certain plants that provide floral oils as a pollinator attractant. Oil producing plants provide thick, nutritious, packets of oil. The oil bees have specialized scrapers, mops, rakes, and sponges on their legs for collecting and transporting these floral oils. The oils are used by the bees to line and waterproof the brood cell, and are mixed with pollen as food for developing larvae. Oil producing plants and their “oil bees” are most diverse in the tropics but we have three closely related oil bee species in New York, all in the genus *Macropis* (*M. nuda*, *M. ciliata*, *M. patellata*; *Melittidae*).

*Macropis* bees only live in areas where the oil-producing *Lysimachia ciliata* (fringed loosestrife; Primulaceae) occur. The females collect and use oils produced by special hairs at the base of the petals and stamens of the loosestrife as an ingredient to mix with their watery secretions to line their brood cells (see DuFour’s gland in glossary). They also mix the floral oils into the pollen provisions. Since *Lysimachia* flowers, like almost all oil flowers, do not produce nectar, female *Macropis* bees forage on other flower species for nectar. In the past, these bees were found in ephemeral wetland areas, ditches, and along waterways. While we can still find these bees at the Huyck Preserve in Rensselaerville NY, recent searches for *Macropis* species in other historic New York locations have fallen short. Many of their nesting sites have been destroyed –some covered by asphalt for shopping centers and other plowed under for agriculture. When *Lysimachia ciliata*, *nuda*, *patellata* populations are locally extirpated, the local *Macropis* population is likely to follow. \**Macropis* sp. do not utilize the floral resources of the invasive non-native purple loosestrife, *Lysimachia salicaria*.



The first things to keep in mind is that solitary bee species, including specialists, have a very short period of adult activity. Specialist bees in particular have a narrow period of adult activity that can span just a few weeks: it is crucial they find their host-plant during this brief time! In New York we have early spring specialist bees that visit early spring flowering trees, mostly Rosaceae (apple, pear, cherry, blackberry) and Ericaceae (rhododendrons and berries); mid-summer bees that visit a variety of mid-summer wildflowers, such as *Lysimachia* (yellow loosestrife) *Viola* (violets), *Penstemon* (beardtongues) and early asters; and late summer bees that specialize on squash or the massive bloom of goldenrod and other late-summer Asteraceae. To support the full diversity of solitary, host-plant specialist bees, one needs to remember that each bee species has its preferred host-plant(s), which bloom(s) exclusively during a narrow time period.

## Native bees and plants

When building a garden for native pollinator species you must remember that native bees evolved with the native plants of your local region, so using locally sourced native plant seeds or seedlings is optimal. If you cannot find a local source, look for stock or seed in your broader geographic region (i.e., Northeast states, mid-Atlantic states). Do not be lured by horticultural cultivars with double flowers, odd colors, or colored leaves. These cultivars have been selected for reasons other than to provide nectar and pollen to bees. These crucial energy and nutrition resources are often bred out of the cultivar when breeders are favoring aesthetic qualities. Research shows that **hybridized native varieties** (aka nativars) often have less nectar, less sugar in the nectar, less pollen or lower pollen quality. For example, the hybrid of the native cardinal flower, *Lobelia x speciosa*, has 20% less nectar than the native species, *Lobelia cardinalis*. Studies have also found that nativars often attract *non*-native honey bees more than the native bees, and have a lower abundance of native bees, while native plant species attract more native bees than *non*-native honey bees<sup>1</sup>. Non-invasive horticultural varieties can be used for design, but they should be kept to a minimum.

When possible, avoid planting naturalized European plant species that only support *non*-native bee species like honey bees<sup>2,3</sup>. *Non*-native *bee* species may compete with native bee species for floral resources and in some cases nesting resources. *Non*-native *bee* species may also carry pathogens that can infect native species<sup>1</sup>. Certain *non*-native *plant* species can out-compete native plant species for space and pollinator visitation.

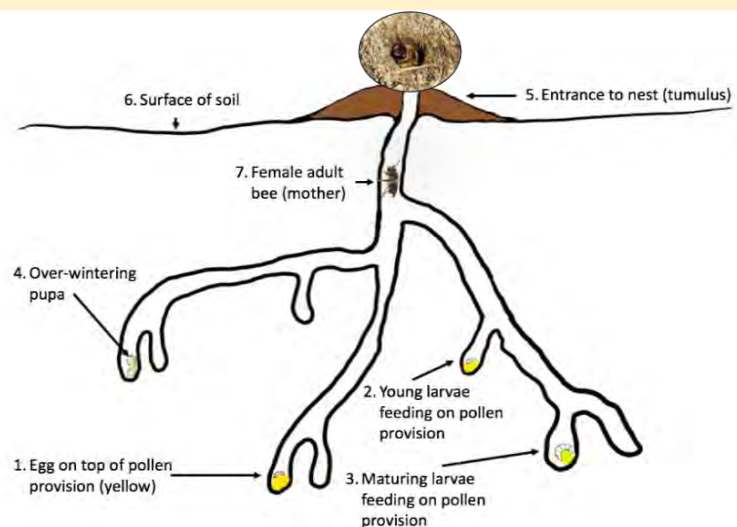
### Nesting resources

Incorporating nesting resources for all types of nesters is crucial in creating a successful bee habitat (**Table 2**). Preparing and provisioning brood cells in which to lay eggs is time consuming and constrains reproductive output of solitary bees (**Box 3**)! Bees construct their nests close to their preferred floral resources, and usually don't fly more than 500 meters from their nests (this is called their "foraging range"). This is especially important for specialist bees because their population is limited by the abundance of their associated host-plant species in proximity to their nest sites. Bees are less likely to frequent an area if there are no nest sites nearby.

The majority of *specialist* bee species (75 of 79 species), are ground-nesting, solitary bees, such as *Macropis*, *Melitta*, *Andrena*, *Lasioglossum*, *Colletes*, and *Melissodes*. There are only

#### Box 3: What does a "solitary bee" nest look like?

Solitary bee females each manage their own nest without help from other adult bees. In the case of ground nesting bees, they construct "brood cells", one for each baby bee, underground, in small chambers off a long main tunnel. Each cell is lined with waterproof secretions from glands in their bodies (see *Nesting Biology and Diversity*). The waterproof brood cell lining is essential in warding off fungal and bacterial growth inside the brood cell while the young bee consumes pollen and develops into an adult. Once a brood cell is constructed, the female provisions it with a mixture of pollen and nectar collected from flowering plants in the vicinity of the nest. Bees must make many trips each day to and from their nests. After the pollen ball is complete, an egg is laid on top. The brood cell is then closed to protect it and the female begins the next cell—for the next baby bee!



\*Different stages of bee developing that exist all at once in a ground-nesting bee brood cell in the nest.



**Figure 2.** *Ceratina* sp. nesting in hollow twig while a predator lurks nearby.

five *specialist* species that we know of in New York that are above-ground cavity nesters: the leaf cutter bee (*Megachile pugnata*), the mason bees (*Osmia chalybea*, *Osmia distincta*, *Osmia virga*), and the resin bee (*Paranthidium jugatorium*).

To provide opportunities for ground-nesting bees to establish nests, leave areas of bare ground in your yard or garden. Ground-nesting species often like recently disturbed soil (*van Dyke personal observation*). When preparing an area, it doesn't hurt to do an initial light till of a 1 sq m area. After bees have nested in the area, avoid disturbing the soil. Bees identify visual cues near their nests to more easily relocate their nest entrances. To help bees orient to their nests, place stones or attractive wood pieces within the nesting area. Be sure to observe your soil for a full season before deciding if it is inhabited or not—after all, these solitary bees are only active for a few weeks out of the year.

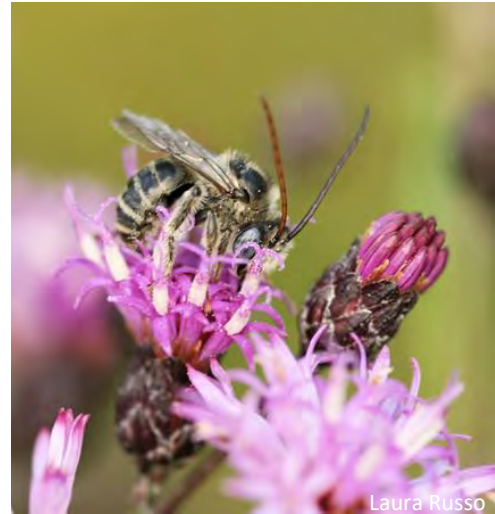
Cavity nesters, on the other hand, nest in preexisting above-ground naturally occurring and man-made tunnels, such as twigs, hollow stems, or beetle burrows. They use a variety of materials to line their nests depending on species (leaves, mud, flower petals, pebbles, and secretions). We suggest leaving dead stalks of long-stemmed grasses which provide hollow centers in which small bees can nest. Other attractive cavity nesting materials include old decaying tree snags, stumps and logs as well as stems of shrubs that have pithy stems. For example, elderberry, cranberry, gooseberry, cane berries (raspberry, blackberry, etc), sumac, joe pye weed, teasel and various grasses all provide hollow or pithy stems that are attractive to bees. Leaf cutter bees use a variety of leaf types from common shrubs (Rose, redbud, *Vaccinium* sp, etc.). Mason bees use mud to line their nest, so if you have silty clay or clay soils, allow standing water to keep the substrate muddy so that mason bees can collect mud in the spring.

Always ask these questions about the bee species you want to help: *Are they ground-nesters or do they nest above-ground? If they nest in above-ground, what do they nest in? What materials do they use to line their nest cells?* And finally, make sure nesting sites are safe from tilling and pesticide applications.

## Planning your Garden

There are a couple of planning steps needed to create a native plant garden that supports native bees, and specifically specialist bee species. In using this guide, review the plant and associated bee species listed in **Table 1** and determine which plant and bee species you want to support. The table also helps you determine if you are in the growing region of the plant species and if your landscape has similar habitat characteristics. Then it's time to plan, design, plant, establish, and manage your pollinator garden habitat! Below we will address garden composition, structure, and design for supporting bee foraging and nesting as well as all the steps in the process.

**A case for the “natural” look:** While classic formal gardens are noted for their clean lines and distinct boundaries, a garden that can support wild bees is pretty much the polar opposite. Leaving dead canes and dead grass stems in place and leaving piles of dead hollow twigs and stems may be considered lazy gardening; yet, these materials provide nest sites for cavity nesting species. You can make little bundles of dead hollow twigs and place them in an appealing configuration –luring the garden admirer to the deeper level of habitat function that the garden provides. Rotting-decomposing logs also provide nesting sites for *Augochlora pura*, a jewel-like green bee, and *Lasioglossum coeruleum*, a vibrant blue bee. Leave the dead stems of shrubs and grasses to overwinter for both fall and winter ‘interest’ while providing nesting sites for young bees and pupae in diapause, and roosts for perching birds. Even leaving leaf detritus in the garden as mulch is ‘functional messiness’ because bumble bees are known to nest under leaf layers. Adding bunch grasses provide nest sites both at the base of the plant and in the hollowed out stems of the flowering stalks if left to overwinter. Even with all this wildness, you can maintain clean garden borders with rocks or wood which create a tidy aesthetic.



Ironweed (*Vernonia sp.*) specialist,  
*Melissodes sp.*

### Site assessment and planning

Rarely do we get to choose our ideal garden site. We usually have to take a site ‘as is’ and let its soil characteristics and sun exposure dictate what we choose. You will find you can use these characteristics to your advantage. However, following a few planning guidelines will make an effective pollinator garden more likely. Drawing out a plan of your garden ahead of time helps in staying organized and making sure you have all the parts of the habitat included that the bee species needs.

To evaluate both *existing* and *potential* bee habitat, first take an inventory of the plant species and habitat characteristics already present. Do you already have any of the plants listed in Table 1 in your landscape? Can you identify habitats like wetlands, stream banks, or rock ledges? If you find a plant species on your land that is listed in Table 1, the specialist bee species may already be present. **In this case, your job now is to protect that habitat!** You can add more individuals of the host plant species and make sure nesting materials or space is present for the associated bee species (see Table 2; Nesting). If the host-plant species is not already present, then add plant species that can thrive in the identified microhabitats.



*Andrena erigeniae*, a specialist of Spring Beauty  
(*Claytonia sp.*).

**Site preparation:** Often the sites we choose are covered in sod grass, fescue or weeds. Eliminating unwanted existing vegetation, reducing weed seed pressure, and creating a smooth seedbed are key to successful pollinator garden establishment. Deal with weeds well in advance of planting. Methods of



controlling weeds include solarization, cover cropping, or herbicides. If you are transitioning a lawn, it is best to remove the sod. Herbicide-free methods are intensive and more expensive. This is very feasible for garden size projects, but a bigger investment for field size projects which require several rounds of cover cropping cycles, both in the Spring and Fall. Backyard garden and field size projects can be prepared organically within one year. Remember that any planting will take 2-3 years to mature and fill out. Avoid using herbicides if possible. Consult *Organic Site Preparation for Wildflower Establishment* published on the website for Xerces Society for Invertebrate Conservation, that you can find a link to in the resources section at the end of this guide.

**Design:** Soil type, soil moisture, and sun exposure typically control the layout of the garden. Within those constraints, create structure by incorporating host plant species of multiple heights. The plant species we choose and how we distribute them will determine the pollinator community we can attract. *See garden layout and planting examples 1 & 2 on pages 7-9.*

- Design your garden in layers, using small trees and, flowering shrubs, perennials, and finally grasses and sedges. Together, these provide floral resources and shelter for all sorts of insects. Each layer plays a role: for example, native bunch grasses leave protected sites of bare soil for ground-nesters, while large diameter stems on perennials (e.g. Joe Pye, Elderberry, cane berries, Sumac) provide shelter for cavity nesters.
- Make sure to set aside areas of bare ground for ground-nesting bees. You can often find unproductive spots in the existing site where the ground is naturally bare. Incorporate these bare spots intentionally.
- Incorporate nesting materials. Remember the value in having a 'messy and natural' look.



Laura Russo

**Soil:** Preferably, you can use the soil you already have. You could add amendments, e.g. compost or grit. But remember many native plants do better in poor soils, so read up about each plant species you have selected. Mulch deters ground-nesting bees from excavating and reduces their access to nest sites. It also prevents desirable plants from self-sowing, which is required for the long-term survival of native biennials which re-seed themselves. Avoid using thick wood mulch applications, instead, use local leaf debris that is as free as possible from weed-seed).

*Ptilothrix bombiformis*, a specialist of *Hibiscus moscheutos* and other 'Mallow' species, sunning itself at its nest entrance. Note the inconspicuous placement of this nest amongst the crabgrass.

**Sun Exposure:** Make sure when laying out the plan of your garden to get the sun exposure matched to each plant species. Take note of how the sun hits your site over the course of the day and season. A warm, western-facing edge with partial shade is best if not in full sun. Consider how sun changes moisture needs: plants that can tolerate both part shade and full sun will often need more moisture in full sun.

**Plant species selection:** Local native plant societies and botanic gardens can provide information on local seed exchanges and specialty nurseries in your area. The choice of plant species will determine which wild and/or specialist bees are attracted to the site. When choosing plant species use an identification guide to identify the plants already in your site. *You may want to contact a local botanist (i.e. Native Plant Society Member) to survey your vegetation.* To enhance the site, choose plant species that the specialist bee or bees you are targeting need and that are possibly already residing in your existing habitat (Table 1). In addition, remember that bees need structure in their environment. The use of Elderberry (*Sambucus* sp), Serviceberry (*Amelanchier canadensis*), ericaceous species (*Vaccinium* sp.), fruit trees and bunch grasses in the design will provide not only food but add soil stability, water filtration, protection, bare ground and cavity nesting resources for the bees.

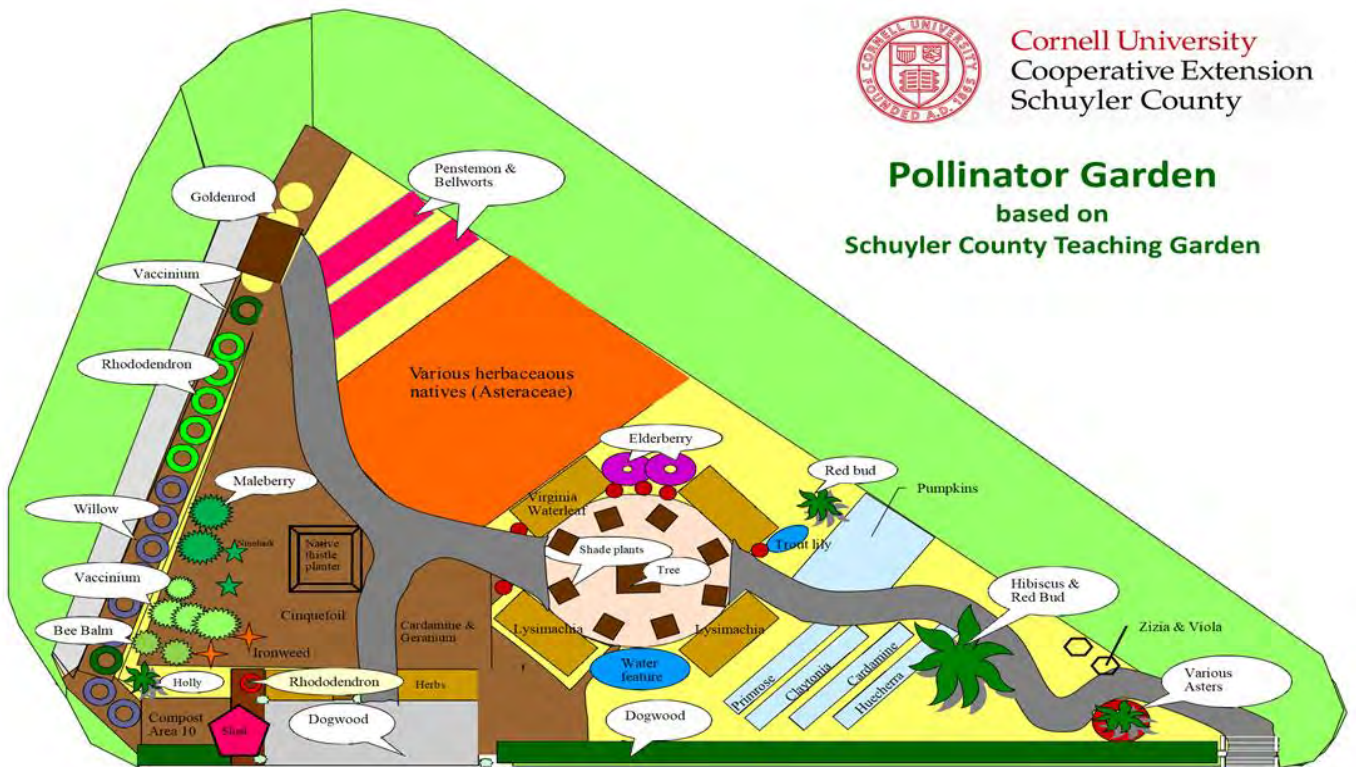


Robert Wesley

Serviceberry or Shadbush (*Amelanchier laevis*) has hollow stems that provide good nesting sites for cavity nesting bees.

The use of Elderberry (*Sambucus* sp), Serviceberry (*Amelanchier canadensis*), ericaceous species (*Vaccinium* sp.), fruit trees and bunch grasses in the design will provide not only food but add soil stability, water filtration, protection, bare ground and cavity nesting resources for the bees.

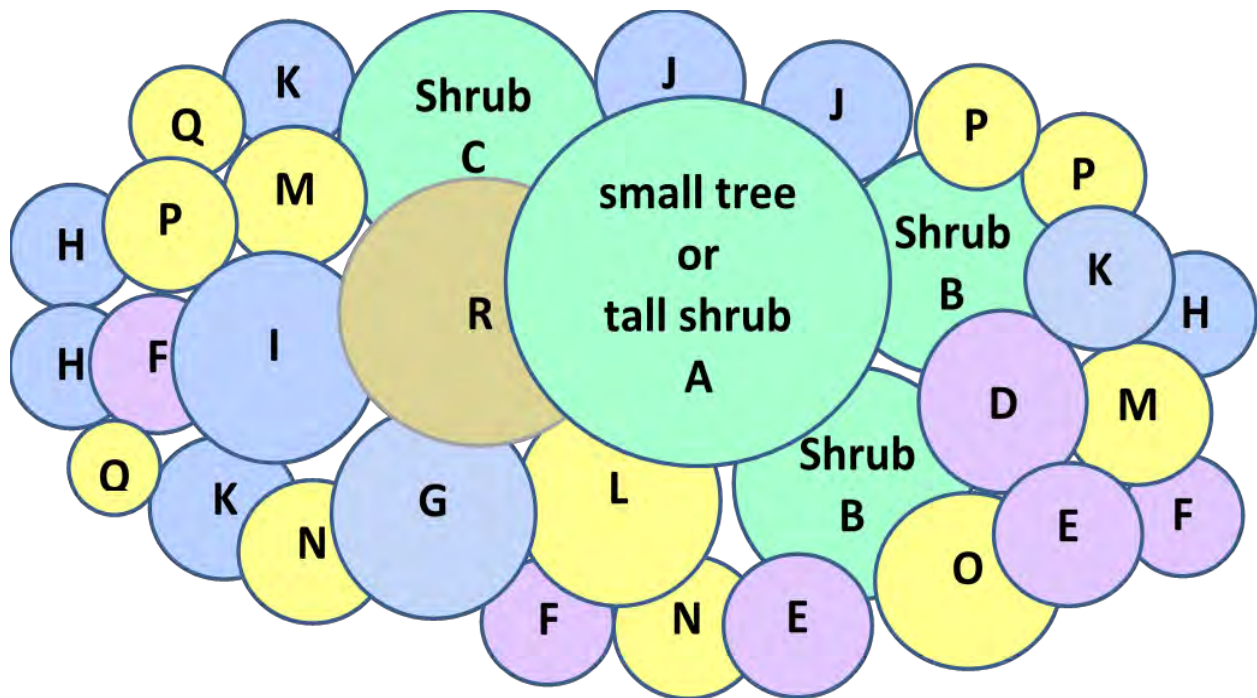
**Example 1: Specialist Pollinator Garden Layout (use with species table on next page)**



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**Example 2: Specialist Pollinator Garden Layout (use with species table on next page)**

**North**, usually shadier  
**South**, usually sunnier



- Except for woody plants, colors represent bloom season (see table). Letters refer to different species that bloom in the same season.
- Larger circles=larger plants at maturity. For example, if A=*Amelanchier* (~10-15' diameter), this bed would be roughly 30' x 18'. Using a tall shrub instead of a tree would result in a smaller bed.
- Each circle can be multiple plants, depending on size of plant at maturity. For example, G could be one Hibiscus, but it would take 3-5 *Lysimachia* to fill the same space initially. These plants will colonize. Ultimately, they sort themselves out, you can edit as needed for personal preferences.
- Shorter plants go mostly towards the edges, taller plants mostly toward the center, but vary the placement somewhat for interest.
- Use very short plants, e.g. *Violas*, as groundcover between taller plants where desired; leave some bare soil.
- The basic idea, using the same or different species, can be repeated for larger gardens.

## Suggested plant species across the season for a pollinator garden for specialist bees

Specialist bee plants underlined and listed first, then generalist pollinator plants. Choose plant species that fit the light, soil, available space and hardiness conditions for your chosen site. The resource section of this guide can provide contact information to those that can provide that information.

Plant Type & Season (letters refer to diagram)	Full or Mostly Sunny	Part to Full Shade
<b>A. Tall Shrub or Tree</b>	<u>Cornus<sup>Spr</sup></u> , <u>Ilex opaca<sup>Spr</sup></u> or <u>Ilex verticillata<sup>Spr</sup></u> , <u>Sambucus<sup>Sum</sup></u> , <u>Amelanchier<sup>Spr</sup></u> , <u>Carpinus<sup>Spr</sup></u>	<u>Rhododendron<sup>Sum</sup></u> , <u>Cornus<sup>Spr</sup></u> , <u>Ilex opaca<sup>Spr</sup></u> , <u>Amelanchier<sup>Spr</sup></u>
<b>B-C Lower shrub</b> , i.e. if A is a tree, use medium - tall shrub; if A is a tall shrub, use short-medium shrub	<u>Azalea calendulaceum<sup>Sum</sup></u> , <u>Ceanothus<sup>Spr</sup></u> , <u>Physocarpus<sup>Spr</sup></u> , <u>Rosa<sup>Sum</sup></u> , <u>Hypericum prolificum<sup>Sum</sup></u>	<u>Ilex glabra<sup>Sum</sup></u> , <u>Sambucus<sup>Sum</sup></u>
<b>D-F. Spring blooming</b> perennials or short-medium shrubs; use varying heights for interest	<u>Coreopsis</u> , <u>Viola</u> , <u>Sanguinaria</u> , <u>Aquilegia</u> , <u>Phlox stolonifera</u> or <u>P. subulata</u>	<u>Geranium maculatum</u> , <u>Packera aurea</u> , <u>Uvularia</u> , <u>Viola</u> , <u>Heuchera americana</u> , <u>Tiarella sp.</u> , <u>Phlox divaricata</u> , <u>Aquilegia</u>
<b>G-K. Summer blooming</b> perennials or short-medium shrubs; use varying heights for interest	<u>Hibiscus moscheutos</u> , <u>Zizia</u> , <u>Penstemon</u> , <u>Cirsium pumilum</u> (biennial), <u>Monarda fistulosa</u> ( <u>M. didyma</u> if moist), <u>Heliopsis helianthoides</u> , <u>Helianthus decapetalus</u> , <u>Lysimachia ciliata</u> , <u>Rudbeckia</u> , <u>Phlox paniculata</u> , <u>Pycnanthemum</u> , <u>Oenothera biennis</u> or <u>O. fruticosa</u> , <u>Potentilla</u> , <u>Eutrichium purpureum</u> , <u>Allium cernuum</u>	<u>Hydrophyllum</u> , <u>Zizia aurea</u> , <u>Monarda didyma</u> , <u>Lysimachia ciliata</u> , <u>Helianthus divaricatus</u> & <u>H. decapetalus</u> , <u>Campanula americana</u> (biennial), early blooming <u>Actaea</u> , <u>Thalictrum pubescens</u> , <u>Eupatorium sessilifolium</u>
<b>L-Q. Fall blooming</b> perennials or short-medium shrubs; use varying heights for interest	<u>Symphyotrichum</u> : <u>S. novae-anglia</u> or <u>S. patens</u> , <u>S. laeve</u> , <u>S. pilosum</u> var. <u>pringlei</u> ; <u>Solidago</u> : <u>S. nemoralis</u> , <u>S. juncea</u> , <u>S. patula</u> , <u>S. sempervirens</u> , <u>S. ulmifolia</u> , <u>S. rigida</u> ; <u>Pycnanthemum</u>	<u>Eurybia divaricata</u> or <u>E. macrophyllum</u> or <u>E. shreberi</u> , <u>Solidago caesia</u> or <u>S. flexicaulis</u> , late blooming <u>Actaea sp.</u> ,
<b>R. Grass</b> (most are med-tall)	<u>Sorghastrum nutans</u> , <u>Schizachryum scoparium</u> , <u>Andropogon gerardii</u> , <u>Dicanthelium</u> (has both short and medium species)	<u>Elymus hystrix</u> or <u>E. riparius</u> or <u>E. virginicus</u> or <u>E. canadensis</u>

## Installation

### When planning your garden, consider these recommendations:

1. *Purchase locally-sourced plants* – It is best to find a regional seed or plant source that supplies regionally grown choices (see Native Plant sources; p. 28). Local native plant societies and botanic gardens can often provide information on local seed exchanges and specialty nurseries in your area. The Finger Lakes Native Plant Society and The Cornell Botanic Garden’s Mundy Wildflower Garden both have regional seeds available in small quantities. The Cornell Cooperative Extension hosts an annual spring Garden Fair that brings together the Native Plant Society and many specialty nurseries with regionally propagated plants for sale. Always ask about the source prior to purchase.



Golden Alexander (*Zizia aurea*) an early spring flower visited by the specialist bee, *Andrena ziziae*.

2. *Pick a range of plants that will bloom from early spring to late fall* – Try to have at least 3 plant species in bloom at any given time over the course of the growing season.



*Andrena violae* specializes on the pollen of Canada violet (*Viola canadensis*) another early spring flower.

3. *Include a sufficient number of plants of each species to provide the necessary resources to support robust bee populations* – An abundance of flowers is more attractive than just a few individuals. Depending on the species, a female bee may need to visit anywhere from 1 to 1100 flowers to gather enough pollen to provision a single brood cell<sup>5</sup>.

4. *Protect your pollinator gardens from pesticide applications and pesticide drift* – This is especially important if your site is near a farm or a heavily managed landscape like a golf course, where lots of pesticides are typically sprayed. Hedgerows of trees and shrubs can provide protection from drift—as well as provide both forage and nest habitat for bees! (*People may or may not agree to share, but you can always ask landowners about their pesticide use*).

5. *When, how, and where you plant each species will determine establishment success* – Knowing exactly how to sow seeds and plant plugs of each plant species can help you determine the best method for a given plant species.

6. *Be careful not to plant aggressive native species* – For example, if using goldenrod, make sure to use the species listed in Table 1. Many other species are aggressive and can easily take over a pollinator planting in 5-7 years, be sure to ask your plant nursery person about which in-stock species are aggressive.

**Seeds vs Plugs:** Some native plants take to a site better when planted as plugs (in 1"-2" pots), while other species do better by direct seeding. Seeds are always less expensive per plant, and you get more plants. Berries and slow growing species may be best started in pots in an area protected from wildlife before setting out in a final location. Once large enough to survive some loss to herbivores, the established plants can be moved to the desired location. Protect them from herbivores with wire cages for 3-5 years depending on deer pressure. Finger Lakes Native Plant Society and the Cornell Botanic Garden's Mundy Wildflower Garden offer guidance on seed propagation, including seed storage, sowing, and growing needs. The Mundy Wildflower Garden has an active volunteer program, which includes experience in the full cycle of native plant propagation.



**Planting Season:** The species listed in this guide are all perennial species. These seeds frequently require exposure to cold temperatures and moist conditions to germinate; therefore, a fall planting is ideal. Late summer- early fall planting is also good for plugs because the winter rains will help settle the roots in the soil. Spring plantings are typically preferred for bunch grasses and annuals.

This pollinator garden was developed by using both seeds and plugs. Mundy Wildflower Garden, Cornell Botanic Gardens.

Lower and higher spots in the original grade can be incorporated into your plan to provide microhabitats for a more diverse array of species. Seed to soil contact is essential for successful broadcast seeding, so the seedbed should be raked relatively smooth leaving the elevational gradation intact. Make sure to include some sand or sawdust in the seed mix before spreading. These materials also help you see where you have spread seed and ensure proper seed distribution. Sawdust is often preferred because the large particles carry more seed farther if you are hand broadcasting. Tap the seed lightly into the ground with the back of a shovel or rake for better soil contact, but do not compact the soil. After seeding you may also want to cover the area with a sparse layer of hay or straw that is certified "weed free".

**Establishment:** Watering will be necessary for all newly planted species and during extended dry periods. Your overall placement of plugs should be very dense. Perennials and native bunch grasses should be 8-12 inches apart or closer, while cool season grasses can be 4-8 inches apart. You can even add seeds in between plugs and weed later. The extra seeding will prevent weeds from coming in. This is termed "living mulch." Avoid using landscape fabric and conventional mulch. Remember, in general, landscape fabric and mulch will prevent ground-nesting bees from establishing a nest.

## Management

If the initial planting was sufficiently dense, a successful native plant garden requires little weeding. Plant identification is critical to distinguish desired species from the occasional weed; make sure you are pulling true weeds. *Many of our native species are listed in weed guides!* If the wild natural look is your thing, let non-weedy volunteer plants stay. Depending on how well it is managed the first two years, a native planting has developed to maturity by year 3. If you don't see the bees in the first year: don't despair! It may take them a little time to find your plots, but they will figure it out.

**YEAR 1:** Because this is a garden for **specialist bees**, most of your native flower species will be **perennial**. Perennial plants put their energy into growing roots the first year, so not much will be happening above ground except a careful weeding program (or mowing if you have a large site). The **first** spring-summer season is vital in keeping weeds out of the plantings. Weed or mow seeded areas whenever they reach 6-8 inches to prohibit annual weeds from reseeding. Mowing allows your perennial plants to develop strong root systems and ultimately outcompete the annuals. If you have **transplants and plugs** mow around these individuals.

**YEAR 2:** During the **second** spring-summer season after planting, pull or mow weeds right before they flower or before the seeds ripen. If plants are felled after seeds begin to develop, make sure to remove cut foliage and seed heads by hand. Glyphosate can also be used both in the first and second year, but be careful to not get it on neighboring native plants. Just make sure you deal with all weeds before they produce seed.

**YEAR 3 and beyond:** If you have a small enough garden, pruning and weeding is all you will need to do. If you have a larger habitat site then it's best to pull back the reins, and only manage (mow or burn) a portion of the planting each year because many insect and animal species have now made their homes here and you do not want to obliterate the entire habitat all at once.. Mowing wildflower patches every 2-3 years is important to avoid unwanted woody plants. Leaving two-thirds of the planting untouched will allow mobile creatures respite and will protect a good portion of the non-mobile creatures. These animals and insects can then re-colonize the mowed or burned area after management action. This is also a good time to monitor aggressive native species and remove individuals to slow their encroachment.

**Garden Waste Management:** In the Fall, plan on not removing perennial garden waste until the following spring to allow bees who may be nesting in cut stems or branches to overwinter. Much of the material will break down over the winter and spring so there may not be much to clean up the following summer. Try not to move the decomposed materials until temperatures reach at least 50 degrees F, when most overwintering insects will have already emerged.



A first year native plant pollinator planting at Mundy Wildflower Garden, Cornell Botanic Gardens. Notice plants are still small. Not all species will flower in the first year.

## Bringing it all together

Specialist bees, and the plant species that they rely on, illustrate the kind of highly co-evolved partnerships that exist in nature but are often overlooked. In order to maintain current or future biological diversity it is important for us to have a working knowledge of these special relationships in order to preserve them. Our hope is that this guide and associated tables offer the layman and the gardener a jumping off point to get involved with preserving plant and bee diversity in New York. Now that you have been introduced to the basics of creating successful native plant and specialist bee habitats and gardens, it's time to peruse our plant list for specialist bees (Table 1) and are our information table that notes the nesting biology of all the species mentioned in this guide (Table 2). Growing native plants is a rewarding adventure that takes patience and keen observational skills. Rewards include providing function in the landscape and observing the bees and other wildlife that visit.

If you find yourself increasingly passionate about specialist bees after working with this manual, consider hunting these native species in the wild to see if you can witness the specialist bee visiting its host's flowers. This is one of our favorite activities in our native bee lab here at Cornell; travelling around the state searching for microhabitats that support the specific native plant species that support specialist bee populations.

If you like to stay closer to home there are several ways to get more involved in native plant and bee conservation. You can visit or volunteer at a local native plant garden like our Mundy Wildflower Garden at Cornell. Consider exploring the websites of local plant groups such as various New York Native Plant Societies like the Finger Lakes Native Plant Society, NY Flora Association, and the Finger Lakes Land Trust. These organizations offer educational talks about native plants, and provide local native plant walks that can help you learn about the native plants local to your region. Keep your eyes out for workshops on wildcrafting seed, propagating seed or designing habitat at your sites.



A mature native planting with a high amount of structure created by the Elderberry (*Sambucus racemosa*). Mundy Wildflower Garden, Cornell Botanic Gardens.

This guide grew out of an interest in educating the general public about a group of specialist pollinators that receive little attention but are important for the ecology of New York and the northeast. The preparation of the guide was inspired by and greatly facilitated by publication by Jarrod Fowler<sup>6</sup> in the journal, *The Northeast Naturalist* titled, *Specialist Bees of the Northeast: Host Plants and Habitat Conservation*<sup>6</sup>. In collaboration with Sam Droege, Jarrod also created an accessible webpage based on the Northeast Naturalist article that guided our development of Tables 1 and 2<sup>7</sup> for New York State.

Here we offer a strategy to create complex and novel pollinator habitats that focus specifically on native pollen specialist bees and their associated host plants and microhabitats. We encourage you to seek out these rarer plants. Enjoy the adventure.




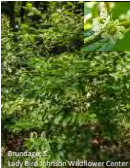



**Table 1 – Host plants and the native, specialist bees that visit them in New York state**



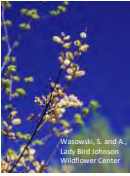




**TREES**

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Cercis canadensis</i> (Redbud)	Seeds and transplants commercially available; Propagate by seed; 12-36 ft	Woods, forest edge, upland, stream banks, limestone bluffs; Moist fertile well-drained soils; Part shade	Across NY	Apr-May	<i>Habropoda laboriosa</i>
 <i>Cornus amomum</i> (Silky dogwood)	Seeds, cuttings, and transplants commercially available; Propagate by seed and cuttings; 6-12 ft	Forested seasonal wetlands, floodplains, shrub wetlands, stream and pond banks; Clay, Loam and sandy soils; Part shade-Full shade	Across NY	Mar-Apr	<i>Andrena fragilis, Andrena integra, Andrena persimulata, Andrena platyparia</i>
 <i>Cornus racemosa</i> (Gray dogwood)	Seeds, cuttings, and transplants are commercially available; Propagate by seed, cuttings, and root division; 6-12 ft	Thickets, stream banks, open areas and uplands; wet-dry soils; Full sun to Full shade	Across NY	April-May	<i>Andrena fragilis, Andrena integra, Andrena persimulata, Andrena platyparia,</i>
 <i>Cornus sericea</i> (Red osier dogwood)	Seeds and cuttings commercially available; Propagate by seed and root division; 6-12 ft	River banks, lake shores, wooden or open, wet areas; well drained soils; Part shade	Across NY	May-June	<i>Andrena fragilis, Andrena integra, Andrena persimulata, Andrena platyparia,</i>
 <i>Hibiscus moscheutos</i> (Marshmallow Hibiscus)	Seeds and transplants commercially available; Propagate by seed and cuttings in July; 3-6 ft	Swampy forests, wet meadows, marshes; Moist slightly acidic soils; Full sun-Part shade	Mid-Hudson, Long Island, Central NY - Western NY	July-Aug	<i>Ptilothrix bombiformis</i>
 <i>Ilex glabra</i> (Appalachian tea, inkberry)	Seeds and transplants commercially available; Propagate by seed and cuttings; 5-12 ft	Bogs, woods, coastal plains; Moist, sandy to peaty, acid soil; Part shade	Long Island	June-Sept	<i>Colletes banksi</i>
 <i>Ilex opaca</i> (American holly)	Seeds and transplants commercially available; Propagate by treating seed or semi-hardwood cuttings; 15-30 ft	Coastal; Long Island; Moist, well-drained acidic soils, sandy- medium loam; Full sun-Full shade	Across NY	Mar-June	<i>Colletes banksi</i>



## SHRUBS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Ceanothus americanus</i> (New Jersey Tea)	Seeds, cuttings, and transplants sold commercially; 1-3 ft	Edges and openings of hardwoods forests, exposed cliffs, rights-of-way; Dry-mesic thin rocky, sandy loamy to lime soils; Part shade	Across NY	Mar-Apr	<i>Pseudopanurgus pauper</i>
 <i>Hibiscus syriacus</i> (Rose of Sharon)	Seeds and transplants commercially available; Self seeds, propagates by seed; 8-12 ft	<u>Non-native</u> horticultural species that tolerates deer, drought, clay soil and Black walnut; Full sun-Part shade	Mid-Hudson - Long Island	June-Sept	<i>Ptilothrix bombiformis</i>
 <i>Ilex verticillata</i> (Winterberry)	Seeds and transplants commercially available; Propagate by seed; naturalizes easily; 6-12 ft	Swamps, stream banks, ponds and lakes; Dry-Wet acidic, Sandy-Clay Loam soils; Full sun-Full shade	Across NY	Apr-July	<i>Colletes banksi</i>
 <i>Lyonia ligustrina</i> (Maleberry)	Seeds and transplants commercially available; Propagate by seed; 6-12 ft	Moist to wet forests, wet forest edges, peatlands and swamps; Wet poorly drained, acidic soils; Part shade	Long Island, Downstate, very rare in Upstate NY	May-July	<i>Colletes productus</i>
 <i>Philadelphus inodorus</i> (Scentless mock orange), <i>Philadelphus pubescens</i> (Hairy mock-orange)	Seeds and transplants commercially available; Propagate by seed or softwood cuttings; 6-12 ft	Moist, rocky woods, stream banks; Moist well-drained soils; Full sun-Part-shade	Upstate to West-Central NY	June	<i>Chelostoma philadelphi</i>
 <i>Rhododendron calendulaceum</i> (Flame Azalea)	Seeds and transplants commercially available; Propagate seed in moist sphagnum moss; 6-12 ft	Rocky mountain woods and heath; Moist-dry acidic soils; Part sun	Downstate	May-June	<i>Andrena cornelli</i>
 <i>Rhododendron maximum</i> (Great Laurel)	Seeds and transplants commercially available; Propagate seed in moist sphagnum moss; 12-36 ft	Dense woods, slopes, and stream banks; Moist, well-drained acidic soils; Full shade-Part shade	Downstate	June	<i>Andrena cornelli</i>
 <i>Rhododendron prinophyllum</i> (Early Azalea)	Seeds and transplants commercially available; Propagate seed in moist sphagnum moss;	Damp shrubland, open woods, shores, well-drained, moist, neutral to acidic soil; Full shade	Across NY	May-June	<i>Andrena cornelli</i>
 <i>Rhododendron viscosum</i> (Swamp Azalea)	Seeds and transplants commercially available; Propagate seed in moist sphagnum moss; 6-12 ft	Coastal, swamps, bogs, stream banks; Wet, acidic soils; Part shade	Across NY	May-Aug	<i>Andrena cornelli</i>









## SHRUBS

Host Plant Species	Source/Propagation/Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <p><i>Salix bebbiana</i> (Beaked willow), <i>Salix discolor</i> (Pussy willow), <i>Salix eriocephala</i> (River willow), <i>Salix humilis</i> (Prairie willow), <i>Salix interior</i> (SandBar willow), <i>Salix sericea</i> (Silky willow)</p>	Cutting and transplants rarely available commercially; Easily propagate by cuttings; 12-36 ft	Along edges of water features, moist forest edge habitat, upland sites; Moist soils; Full sun	Across NY	April-June	<i>Andrena bisalicensis</i> , <i>Andrena clarkella</i> , <i>Andrena erythrogaster</i> , <i>Andrena frigida</i> , <i>Andrena illinoiensis</i> , <i>Andrena macoupenensis</i> , <i>Andrena mariae</i> , <i>Andrena nida</i> , <i>Andrena nigrae</i> , <i>Andrena salicaria</i> , <i>Andrena sigmundi</i>
 <p><i>Vaccinium angustifolium</i> (Lowbush blueberry)</p>	Seeds and transplants commercially available; Propagate by root division and less easily by seed; 1-3 ft	Open conifer woods, sandy to rocky balds and old fields; Acidic, moist to dry soils; Full sun-Full shade	Across NY	May-June	<i>Andrena bradleyi</i> , <i>Andrena carolina</i> , <i>Colletes validus</i> , <i>Habropoda laboriosa</i> , <i>Osmia virga</i>
 <p><i>Vaccinium corymbosum</i> (Highbush blueberry)</p>	Seeds and transplants commercially available; Propagate by seed with variable success and by root division; 6-12 ft	Wetlands, thin soils to upper slopes, fens, bogs, mesic forests; Acidic soils, Dry-wet, rocky soils; Full sun-Full shade	Across most of NY	May-June	<i>Andrena bradleyi</i> , <i>Andrena carolina</i> , <i>Colletes validus</i> , <i>Habropoda laboriosa</i>
 <p><i>Vaccinium pallidum</i> (Hillside blueberry)</p>	Seeds and transplants commercially available; Propagate by seed, cuttings, and root division; 2-3 ft	Dry-Moist forests, forest edges, rocky summits; Acidic soils; Full sun-Part shade	Across NY	May-June	<i>Andrena bradleyi</i> , <i>Andrena carolina</i> , <i>Colletes validus</i> , <i>Habropoda laboriosa</i>
 <p><i>Vaccinium stamineum</i> (Deerberry)</p>	Not available commercially; Propagate by soft wood cutting; 3-12 ft	Dry, open woods, floodplain thickets; inundated shrublands; moist to dry, acidic soils; Part shade	Adirondacks to southern and western NY	May-June	<i>Andrena bradleyi</i> , <i>Andrena carolina</i> , <i>Colletes validus</i> , <i>Habropoda laboriosa</i> , <i>Melitta americana</i> , <i>Melitta eickworti</i>








## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <p><i>Arabis pycnocarpa</i> (Hairy rockcress)</p>	Rarely commercially available; Propagate by seed; 1-1½ ft	Dry thin forests, woodlands, and bluffs often over calcareous soils; Part shade-Full sun	Adirondacks, Lake Ontario, and Upstate NY	May-July	<i>Andrena arabis</i>
 <p><i>Bidens cernua</i>, <i>Bidens connata</i>, <i>Bidens discoidea</i> (beggarsticks) plus other NY <i>Bidens sp.</i></p>	Rarely commercially available; Propagate by seed; 1-1½ ft	Wetlands, floodplains, marshes, stream banks, ponds, floating logs, and disturbed areas; Moist soil; Full sun	Across NY	Aug-Sept	<i>Andrena aliciae</i> , <i>Colletes compactus</i> , <i>Melissodes boltoniae</i> , <i>Melissodes dentiventris</i> , <i>Perdita bequaerti</i> , <i>Pseudopanurgus compositarum</i>










## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Cardamine concatenata</i> (Cutleaf toothwort)	Seeds and rhizome commercially available; Propagate by seeds and root division; 1-1½ ft	Rich woods, banks and bluffs, limestone outcrops, before trees leaf out; Rich mesic soils; Shade	Across NY	March-May	<i>Andrena arabis</i>
 <i>Cardamine diphylla</i> (Crinkleroot)	Seeds and rhizome commercially available; Propagate by seeds and root division; 1-3 ft	Moist woodlands and edge habitats; semi-shady (flower before trees leaf out); Moist, humus-rich, acidic soil; Full Shade-Part shade	Across NY	May-June	<i>Andrena arabis</i>
 <i>Cirsium discolor</i> (Field thistle); <i>Cirsium pumilum</i> (Pasture thistle)	Seeds and transplants commercially available; Collect seed - avoid it's weedy relative, Bull thistle; 1-3 ft	Old fields, roadsides, rights-of-way, woodlands; Dry-Mesic, well-drained acid granitic soils; Full sun	Adirondacks to Long Island and over to Western NY	July-Sept	<i>Osmia chalybea</i> , <i>Melissodes desponsus</i> , <i>Melissodes subillata</i>
 <i>Cucurbita pepo</i> (Squash and Pumpkin)	Seeds and transplants commercially available; Propagate by seed; 1-2½ ft	Introduced species in widespread cultivation across the U.S.	Across NY	July-August	<i>Eucera pruinose</i>
 <i>Chrysopsis mariana</i> / <i>Heterotheca subaxillaris</i>	Seeds and transplants commercially available; Propagate by seeds, cuttings and division; 1-3 ft	Dry, open sandy sites; Full sun-Part shade	Long Island	July-Oct	<i>Andrena fulvipennis</i> , <i>Melissodes subillata</i> , <i>Perdita boltoniae</i>
 <i>Claytonia caroliniana</i> (Carolina Spring Beauty)	Seeds, corms, and transplants are commercially available; Propagate by seeds and corms; 1-1½ ft	Forests and forest edges; Rich, moist soils; Part shade	Across NY except Southern Tier and Long Island	April-June	<i>Andrena erigeniae</i>
 <i>Claytonia virginica</i> (Spring Beauty)	Seeds, corms, and transplants are commercially available; Propagate by seeds and corms; ¼-1 ft	Forests, forest edges to open fields: Dry-moist soils; lawns in the Spring; Part shade	Variable across NY	April-June	<i>Andrena erigeniae</i>
 <i>Erythronium americanum</i> (Eastern Trout Lily, Yellow Dog-toothed Violet)	Seeds are commercially available; Propagate by seed and root division; ½-1 ft	Slopes and bottomlands, hardwood forests to coniferous forests across NY; Moist rich soils; Part shade	Across NY	April-May	<i>Andrena erythronii</i>








## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <p><i>Eurybia divaricata</i> (Wood aster), <i>Eurybia macrophylla</i> (Lg-leaved aster), <i>Eurybia radula</i> (Rough aster), <i>Eurybia schreberi</i> (Schreber's aster), <i>Eurybia spectabilis</i> (Showy aster)</p>	Not all <i>Eurybia</i> species are available commercially (seeds and transplants); Collect seed or propagate by root division in Spring; 1-2½ ft	Well drained soil; Part shade-Full shade	Across NY	Aug-Sept	<i>Andrena canadensis</i> , <i>Andrena placata</i> , <i>Pseudopanurgus andreoides</i>
 <p><i>Euthamia caroliniana</i> (Slender goldenrod)</p>	Seeds and transplants commercially available; Propagates easily by seed; 1-3 ft	Sandy open areas; Dry soils; Full sun	Adirondacks region, Long Island, Rockland & Orange Cty	Aug-Oct	<i>Andrena hirticincta</i> , <i>Andrena braccata</i> , <i>Colletes simulans</i>
 <p><i>Euthamia graminifolia</i> (Flat-top goldenrod)</p>	Seeds and transplants commercially available; Propagate by seed and easily by root division; 3-5 ft	Open areas; Loamy-sandy, damp to dry soils; Full sun	Across NY	Aug-Oct	<i>Andrena hirticincta</i> , <i>Colletes simulans</i>
 <p><i>Geranium maculatum</i> (Wild geranium)</p>	Seeds and rhizomes commercially available; Propagate by root division; 1-3 ft	Forests, forest edge and shaded roadsides;	Across NY	April-July	<i>Andrena distans</i>
 <p><i>Grindelia squarrosa</i> (Rayless and Curlytop Gumweed); naturalized in NY</p>	Seeds rarely available commercially; Propagate by root division - can be aggressive; 1-3 ft	Prairies, hillsides, woodlands 4,000-8,000ft elev; Dry sandy clay and sub-alkaline soils in disturbed sites; Full sun	Spotty across NY	July-Sept	<i>Andrena accepta</i> , <i>Andrena canadensis</i> , <i>Andrena chromotricha</i> , <i>Perdita octomaculata</i> , <i>Melissodes agilis</i> , <i>Melissodes boltoniae</i> , <i>Paranthidium jugatorium</i> , <i>Megachile pugnata</i>
 <p><i>Helianthus decapetalus</i> (Ten-petaled sunflower), <i>Helianthus divaricatus</i> (Woodland sunflower), <i>Helianthus helianthoides</i> (Smooth oxeye)</p>	Seeds and transplants commercially available; Self seeding, propagate by seed and root division; division helps maintain vigor; 2-5 ft	Woodland, forest edge, stream banks; Moist, rich lowland soil to Sandy bank soil; Full sun-Full shade	Across NY	July-Sept	<i>Andrena accepta</i> , <i>Andrena aliciae</i> , <i>Andrena chromotricha</i> , <i>Andrena helianthi</i> , <i>Melissodes agilis</i> , <i>Melissodes druriellus</i> , <i>Melissodes trinodis</i> , <i>Megachile pugnata</i> , <i>Melissodes subillatus</i> , <i>Perdita bequaerti</i> , <i>Paranthidium jugatorium</i>
 <p><i>Heliopsis helianthoides</i> (Smooth Oxeye)</p>	Seeds and transplants commercially available; Easily propagate by seed; 3-6 ft	Open woodlands, prairies, fields; Moist lowland soils to dry sandy soils; Full sun-Part shade	Across NY	Jun-Sept	<i>Melissodes agilis</i> , <i>Melissodes trinodis</i> , <i>Megachile pugnata</i> , <i>Andrena accepta</i> , <i>Andrena aliciae</i> , <i>Andrena helianthi</i> , <i>Perdita bequaerti</i> , <i>Paranthidium jugatorium</i>









## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Heuchera americana</i> (Alumroot)	Seeds and transplants commercially available; Propagate by seed and root division; division helps maintain vigor; 1-3 ft	Woods and rock outcrops; humus-rich, acidic soils but can tolerate poor soils with low moisture; Full-Part shade	Parts of Eastern NY	Mar-Aug	<i>Colletes aestivalis</i>
 <i>Hydrophyllum canadense</i> (Waterleaf)	Seeds and transplants commercially available; Propagate by root division; 1-3 ft	Hardwood forest habitats; nutrient rich, calcareous soils; Full shade-Part shade	Across NY except Adirondacks	April-May	<i>Andrena geranii</i>
 <i>Hydrophyllum virginianum</i> (Virginia waterleaf)	Seeds and transplants commercially available; Propagate by seed and root division; ½-1 ft	Hardwood forest habitats; nutrient rich, calcareous soils; Full shade-Part shade	Across NY except NE corner	April-May	<i>Andrena geranii</i>
 <i>Lysimachia ciliata</i> (Fringed Loosestrife)	Seeds and transplants commercially available; Propagate by seed or root division; 1-3 ft	Shrubland, woods, streambanks, Moist-Acidic organic soils; Full shade-Full sun	Across NY	June-Sept	<i>Macropis nuda, M. ciliata, M. patellata</i>
 <i>Krigia biflora</i> and <i>Krigia virginica</i> (Two flower dandelion, Virginia dwarf dandelion)	Seeds and transplants commercially available; Propagate by seed or root division; 1-2 ft	Open woods and meadows; Sandy soils; Full sun	Functionally NYC and Long Island but sold across NYS.	May-Sept	<i>Andrena krigiana,</i>
 <i>Monarda didyma, M. punctata, M. clinopodia</i> and other spp. (Beebalm)	Seeds and transplants commercially available; Propagate by seeds, root division, or cuttings; 1-3 ft or 3-6 ft depending on region	Moist open woods, meadows stream banks, mountains to 6500 ft; Rich, moist, acidic soils; Full sun-Part shade	Across NY		<i>Dufourea monardae</i>
 <i>Oenothera biennis</i> (Evening primrose)	Seeds and transplants commercially available; Propagate by seed and cuttings; 3-6 ft	Dry, rocky plains, disturbed areas, lake shores, open woods, weedy gardens; Rocky, sandy soils; Full sun-Full shade	Across NY	July-Sept	<i>Lasioglossum oenotherae</i>
 <i>Osmorrhiza longistylis</i> (Anise root)	Seeds and transplants commercially available; Difficult to propagate; 2-3 ft	Woodlands; Deep, moist, fertile soils; Full sun-Part shade	Across NY	May-June	<i>Hylaeus sparsus</i>
 <i>Penstemon hirsutus, Penstemon pallidus.</i> (Hairy and Pale Beardstongue)	Seeds and transplants commercially available; Propagate by seed; 1-3 ft	Dry woods, rocky fields, bluffs, outcrops; Well drained soils, Full sun-Full shade	Across NY	June-July	<i>Osmia distincta</i>

## HERBACIOUS PLANTS






Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <p><i>Physalis heteropylla</i>, <i>Physalis longifolia subglabrata</i> (Ground cherry)</p>	Wild in disturbed landscapes; Seeds and transplants commercially available; Propagate by seed; Can be aggressive; 1½ -3½ ft	Forest edges and open fields; Dry soils; Part sun-Full sun	Across NY	June-Sept	<i>Colletes latitarsis</i> , <i>Colletes willistoni</i> , <i>Lasioglossum pectinatum</i>
 <p><i>Pontederia cordata</i> (Pickerel weed)</p>	Seeds and transplants commercially available; Propagate by root division in water; 1-3 ft	Acidic granitic soils; marshes, ponds, wet ditches; Sandy - Clay Loam soils; Full sun-Part shade	Across NY	June-Sept	<i>Melissodes apicatus</i> , <i>Dufourea novaeangliae</i>
 <p><i>Potentilla canadensis</i> (Dwarf Cinquefoil)</p>	Rarely available commercially; Propagate by seed or stolons; Field weed; 2-6 inches	Fields, roadsides, clearings, dry lawns; Dry loamy soils; Full sun	Across NY	May-June	<i>Panurginus potentillae</i> , <i>Andrena ziziaeformis</i>
 <p><i>Potentilla simplex</i> (Common Cinquefoil)</p>	Not available commercially; Propagate by seed or root runners; Collect seed or transplant from field; Field weed; ½-1 ft	Dry to moist, open woods, prairies, roadsides, waste places; Variable soils; Part shade-Full shade	Across NY	May-July	<i>Panurginus potentillae</i> , <i>Andrena ziziaeformis</i>
 <p><i>Pityopsis falcata</i> (Sickle-leaved golden aster)</p>	Not available commercially; Seed treatment: Propagate by stratified seed; 1-3 ft	Fields, pine barrens and woodland openings; dry, sandy soil near the coast, pine barrens; Full	Long Island	July-Oct	<i>Andrena fulvipennis</i> , <i>Perdita boltoniae</i> , <i>Perdita octomaculata</i> , <i>Melissodes dentiventris</i>
 <p><i>Rudbeckia laciniata</i> (Cutleaf coneflower)</p>	Seeds and transplants commercially available; Propagate by seed; 3-6 ft	Forest, forest edges, meadows, and along water edges; Moist soils; Full sun-Part shade	Across NY	July-Sept	<i>Andrena aliciae</i> , <i>Andrena rudbeckiae</i> , <i>Colletes compactus</i> , <i>Melissodes agilis</i> , <i>Melissodes boltoniae</i> , <i>Melissodes druriellus</i> , <i>Melissodes subillatus</i> , <i>Melissodes trinodis</i> , <i>Paranthidium jugatorium</i> , <i>Pseudopanurgus andreoides</i> , <i>Psuedopanurgus compositarum</i>
 <p><i>Solidago caesia</i> (Blue-stemmed goldenrod)</p>	Seeds and transplants commercially available; Propagate from seed or root division; 1-3 ft	Deciduous open woods, woods edge, forest and clearings; Rich and variable dry soils; Full sun-Part shade	Across NY	Aug-Oct	<i>Andrena asteris</i> , <i>Andrena canadensis</i> , <i>Andrena chromotricha</i> , <i>Andrena nubecula</i> , <i>Andrena simplex</i> , <i>Colletes solidaginis</i> , <i>Melissodes druriellus</i> , <i>Perdita octomaculata</i> , <i>Andrena placata</i> , <i>Pseudopanurgus aestivalis</i>

## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Solidago canadensis</i> (Canada goldenrod)	Seeds and transplants commercially available; Propagate by seed and root division; 3-6 ft	Prairie, Plains, Meadows, Pastures, Savannas, Stream banks, Wet to dry fields and disturbed areas; All soil types, dry-moist; Full sun-Part shade	Across NY	Aug-Oct	<i>Andrena asteris</i> , <i>Andrena canadensis</i> , <i>Andrena chromotricha</i> , <i>Andrena nubecula</i> , <i>Andrena simplex</i> , <i>Colletes solidaginis</i> , <i>Melissodes druriellus</i> , <i>Perdita octomaculata</i> , <i>Andrena placata</i> , <i>Pseudopanurgus aestivalis</i>
 <i>Solidago racemosa</i> (Riverbank goldenrod)	Seeds and transplants commercially available in local region; ½-1 ft	Rocks, ledges, cliffs, and riverbanks; Acidic to calcareous soils; Full sun-Part shade	NE part of NY, Adirondacks region	Aug-Oct	<i>Andrena asteris</i> , <i>Andrena canadensis</i> , <i>Andrena chromotricha</i> , <i>Andrena nubecula</i> , <i>Andrena simplex</i> , <i>Colletes solidaginis</i> , <i>Perdita octomaculata</i> , <i>Andrena placata</i> , <i>Pseudopanurgus aestivalis</i>
 <i>Symphyotrichum</i> sp.	Seeds and transplants commercially available; Propagate by seed, softwood cuttings, and root division; 1-3 ft	Grows almost anywhere; disturbed areas; Variable soils; Full sun	Across NY	July-Oct	<i>Andrena asteris</i> , <i>Andrena canadensis</i> , <i>Andrena chromotricha</i> , <i>Andrena nubecula</i> , <i>Andrena placata</i> , <i>Andrena simplex</i> , <i>Melissodes druriellus</i> , <i>Melissodes subillatus</i> , <i>Pseudopanurgus pauper</i>
 <i>Thaspium trifoliatum</i> , ( <i>Yellow parsnip</i> )	Infrequently available commercially yet easily found in the wild; Propagate by seed and root division; 1-2½ ft	Prairies, rocky open woods, thickets and along streams; Average, well-drained, moist soils; Full sun-Part shade	Across NY	May-June	<i>Hylaeus sparsus</i>
 <i>Uvularia grandiflora</i> (Large Bellwort)	Seeds and transplants commercially available; Propagate by fresh seed or root division; 1.5-2 ft	Spring blooming forest plants; Deciduous woods, thickets, floodplain woods; Moist humus-rich soils; Full shade	Across NY except mid Hudson and Long Island	April-May	<i>Andrena uvulariae</i>
 <i>Uvularia perfoliata</i> (Perfoliate Bellwort)	Seeds and transplants commercially available; Propagate by seed and root division; ½-1 ft	Forest woodlands; Moist, loamy soil; Full sun	Across NY except the North Country	April-May	<i>Andrena uvulariae</i>
 <i>Uvularia sessilifolia</i> (Spreading Bellwort)	Seeds and transplants commercially available; Propagate by seed and root division; ½-1 ft	Woods and clearings; Moist, thick humus layer and good drainage (acidic) soils; Full sun-Full shade	Across NY	April-May	<i>Andrena uvulariae</i>
 <i>Vernonia gigantea</i> (Giant ironweed), <i>Vernonia novaboracensis</i> (NY Ironweed)	Seeds and transplants commercially available; 5-8 ft	Woods along streams, valleys, low thickets, swamp borders, prairies, and meadows; Damp, rich soil; Full sun-Full shade; 5-8 ft	<i>V. gigantea</i> : upstate- west NY; <i>V. novaboracensis</i> : L.I.- upstate NY	Aug-Oct	<i>Melissodes boltoniae</i> , <i>Melissodes denticulatus</i> , <i>Melissodes dentiventris</i> , <i>Melissodes druriellus</i> , <i>Melissodes subillatus</i>



## HERBACIOUS PLANTS

Host Plant Species	Source/Propagation/ Height	Habitat/ Growing conditions	NY Distribution	Flowering season	Specialist bee species
 <i>Viola canadensis</i> (Canadian White Violet)	Seeds and transplants commercially available; Easily propagated by seed and division; 1-3 ft	Basic moist soils, open wooded areas; Full shade	Across NY except mid Hudson and Long Island	May-July	<i>Andrena violae</i>
 <i>Viola labradorica</i> (American Dog Violet)	Seeds and transplants commercially available; Seeds difficult to collect, propagate by root division; ½-1 ft	Damp or dry, open woods; Moist soils; Full sun-Part-shade	Across NY	Apr-June	<i>Andrena violae</i>
 <i>Viola sororia</i> (Blue violet)	Seeds and transplants commercially available; Self seeds, easily propagated by rhizomes and stolons; Self seeds; ½-1 ft	Moist woods and swamps; Rich humus, well-drained soils; Full sun-Part shade	Across NY	April-May	<i>Andrena violae</i>
 <i>Viola striata</i> (Striped Cream Violet)	Seeds and transplants commercially available; Propagated by seed and rhizome; ½-1 ft	Basic moist soils, open wooded areas; Moist rich loamy soil; Part shade	Spotty across NY except Adirondacks and Thousand Islands	Apr-June	<i>Andrena violae</i>
 <i>Zizia aurea</i> (Golden Alexander)	Seeds and transplants commercially available; Propagates by stratified seeds; 1½ -3 ft	Moist prairies, shrublands and open woods; sandy-sandy-clay soils; Full sun-Part shade	Across NY	Apr-Aug	<i>Andrena ziziae</i>



Cut-leaved Toothwort (*Cardamine concatenata*) and early spring understory flower that is specialized on by *Andrena arabis*

**Table 2 – Status, nesting behavior, social behavior, and host plant distinction of each specialist bee of NY listed in taxonomic organization.**

Family: Subfamily: Tribe:	Genus (Subgenus) species	Status	Nesting, Social behavior	Conservation status	Host plant Family: Genera
Andrenidae: Andreninae: Andrenini:	<i>Andrena</i> (Callandrena) <i>accepted</i>	Rare	ground nesting, solitary		Asteraceae: <i>Grindelia</i> sp., <i>Helianthus</i> sp.
	<i>Andrena</i> (Callandrena) <i>aliciae</i>	Rare	ground nesting, solitary		Asteraceae: <i>Bidens</i> sp., <i>Helianthus</i> sp., <i>Rudbeckia</i> sp., <i>Silphium</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Scaphandrena) <i>arabis</i>	Uncommon	ground nesting, solitary		Brassicaceae: <i>Arabis</i> sp., <i>Cardamine</i> sp.
	<i>Andrena</i> (Callandrena) <i>asteris</i>	Common	ground nesting, solitary		Asteraceae: <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Thysandrena) <i>bisalicis</i>	Common- Uncommon	ground nesting, solitary	declining in Northeast	<i>Salix</i> sp.
	<i>Andrena</i> (Callandrena) <i>braccata</i>	Common- Rare	ground nesting, solitary		Asteraceae: <i>Euthamia</i> sp., <i>Solidago</i> sp.
	<i>Andrena</i> (Conandrena) <i>bradleyi</i>	Common- Uncommon	ground nesting, solitary		Ericaceae: <i>Gaylussacia</i> sp., <i>Vaccinium</i> sp.
	<i>Andrena</i> (Cnemidandrena) <i>canadensis</i>	Common- Uncommon	ground nesting, solitary	declining in Northeast	Asteraceae: <i>Eurybia</i> sp., <i>Grindelia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Andrena) <i>carolina</i>	Common- Uncommon	ground nesting, solitary		Ericaceae: <i>Gaylussacia</i> sp., <i>Vaccinium</i> sp.
	<i>Andrena</i> (Cnemidandrena) <i>chromotricha</i>	Rare	ground nesting, solitary		Asteraceae, <i>Grindelia</i> sp., <i>Helianthus</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Andrena) <i>clarkella</i>	Common- Rare	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Andrena) <i>cornelli</i>	Uncommon	ground nesting, solitary		<i>Rhododendron</i> sp.
	<i>Andrena</i> (Ptilandrena) <i>distans</i>	Common- Uncommon	ground nesting, solitary	declining in Northeast	<i>Geranium</i> sp.
	<i>Andrena</i> (Ptilandrena) <i>erigeniae</i>	Common	ground nesting, solitary	declining in Northeast	<i>Claytonia</i> sp.
	<i>Andrena</i> (Tylandrena) <i>erythrogaster</i>	Common- Uncommon	ground nesting, solitary	declining in Northeast	<i>Salix</i> sp.
	<i>Andrena</i> (Leucandrena) <i>erythronii</i>	Uncommon	ground nesting, solitary		<i>Erythronium</i> sp.
	<i>Andrena</i> (Gonandrena) <i>fragilis</i>	Common	ground nesting, solitary		<i>Cornus</i> sp.
	<i>Andrena</i> (Andrena) <i>frigida</i>	Common- Uncommon	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Callandrena) <i>fulvipennis</i>	Rare	ground nesting, solitary		Asteraceae: <i>Chrysopsis</i> sp., <i>Heterotheca</i> sp., <i>Pityopsis</i> sp.
	<i>Andrena</i> (Euandrena) <i>geranii</i>	Uncommon	ground nesting, solitary	declining in Northeast	<i>Hydrophyllum</i> sp.
	<i>Andrena</i> (Callandrena) <i>helianthi</i>	Uncommon- Rare	ground nesting, solitary		<i>Helianthus</i> sp.
	<i>Andrena</i> (Cnemidandrena) <i>hirticincta</i>	Common	ground nesting, solitary		Asteraceae: <i>Euthamia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.

Family: Subfamily: Tribe:	Genus (Subgenus) species	Status	Nesting, Social behavior	Conservation status	Host plant Family: Genera
	<i>Andrena</i> (Micrandrena) <i>illinoensis</i>	Rare	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Gonandrena) <i>integra</i>	Uncommon	ground nesting, solitary	declining in Northeast	<i>Cornus</i> sp.
	<i>Andrena</i> (Callandrena) <i>krigiana</i>	Uncommon	ground nesting, solitary		Species of <i>Cichorieae</i> , Asteraceae: <i>Hieracium</i> sp., <i>Krigia</i> sp.
	<i>Andrena</i> (Andrena) <i>macoupinensis</i>	Uncommon	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Trachandrena) <i>mariae</i>	Uncommon	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Parandrena) <i>nida</i>	Uncommon	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Micrandrena) <i>nigrae</i>	Uncommon	ground nesting, solitary		<i>Salix</i> sp.
	<i>Andrena</i> (Cnemidandrena) <i>nubecula</i>	Common- Uncommon	ground nesting, solitary	declining in Northeast	Asteraceae: <i>Euthamia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Cnemidandrena) <i>parnassiae</i> *	Rare	ground nesting, solitary		<i>Parnassia glauca</i>
	<i>Andrena</i> (Gonandrena) <i>persimulata</i>	Uncommon	ground nesting, solitary		<i>Cornus</i> sp.
	<i>Andrena</i> (Callandrena) <i>placata</i>	Common	ground nesting, solitary	declining in Northeast	Asteraceae: <i>Eurybia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Gonandrena) <i>platyparia</i>	Uncommon	ground nesting, solitary		<i>Cornus</i> sp.
	<i>Andrena</i> (Callandrena) <i>rudbeckiae</i>	Rare	ground nesting, solitary		<i>Rudbeckia</i> sp.
	<i>Andrena</i> (Micrandrena) <i>salictaria</i>	Common- Rare	ground nesting, solitary	declining in Northeast	<i>Salix</i> sp.
	<i>Andrena</i> (Trachandrena) <i>sigmundi</i>	Common	ground nesting, solitary	declining in Northeast	<i>Salix</i> sp.
	<i>Andrena</i> (Callandrena) <i>simplex</i>	Common	ground nesting, solitary		Asteraceae: <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Andrena</i> (Derandrena) <i>uvulariae</i>	Rare	ground nesting, solitary	uncommon	<i>Uvularia</i> sp.
	<i>Andrena</i> (Iomelissa) <i>violae</i>	Common- Uncommon	ground nesting, solitary		<i>Viola</i> sp.
	<i>Andrena</i> (Micrandrena) <i>ziziae</i>	Common- Uncommon	ground nesting, solitary		<i>Zizia</i> sp.
Andrenidae: Panurginae: Panurgini:	<i>Panurginus potentillae</i>	Uncommon- Rare	ground nesting, solitary		<i>Potentilla</i> sp.
Andrenidae: Panurginae: Perditini:	<i>Perdita</i> (Cockerellia) <i>bequaerti</i>	Uncommon- Rare	ground nesting, solitary		Asteraceae: <i>Bidens</i> sp., <i>Helianthus</i> sp.
	<i>Perdita</i> (Hexaperdita) <i>boltoniae</i>	Rare	ground nesting, solitary		Asteraceae: <i>Chrysopsis</i> sp., <i>Heterotheca</i> sp., <i>Pityopsis</i> sp.
	<i>Perdita</i> (Perdita) <i>octomaculata</i>	Common- Uncommon	ground nesting, solitary		Asteraceae: <i>Baccharis</i> sp., <i>Chrysopsis</i> sp., <i>Euthamia</i> sp., <i>Grindelia</i> sp., <i>Pityopsis</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
Andrenidae: Panurginae: Protandrenini:	<i>Pseudopanurgus</i> <i>aestivalis</i>	Rare	ground nesting, solitary		Asteraceae: <i>Chrysopsis</i> sp., <i>Erigeron</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.

Family: Subfamily: Tribe:	Genus (Subgenus) species	Status	Nesting, Social behavior	Conservation status	Host plant Family: Genera
	<i>Pseudopanurgus andrenoides</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Eurybia</i> sp., <i>Rudbeckia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Pseudopanurgus compositarum</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Bidens</i> sp., <i>Rudbeckia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Pseudopanurgus pauper</i>	Rare	ground nesting, solitary		<i>Ceanothus</i> sp.
Apidae: Anthophorinae: Anthophorini:	<i>Habropoda laboriosa</i>	Common- Uncommon	ground nesting, solitary		Ericaceae: <i>Cercis</i> sp., <i>Vaccinium</i> sp.
Apidae: Eucerinae: Emphorini:	<i>Ptilothrix bombiformis</i>	Common- Uncommon	ground nesting, solitary		<i>Hibiscus</i> sp.
Apidae: Eucerinae: Eucerini:	<i>Eucera</i> (Peponapis) <i>pruinosa</i>	Common	ground nesting, solitary	declining in Northeast	<i>Cucurbita</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>agilis</i>	Common- Uncommon	ground nesting, solitary		Asteraceae: <i>Grindelia</i> sp., <i>Helianthus</i> sp., <i>Solidago</i> sp.
	<i>Melissodes</i> (Apomelissodes) <i>apicatus</i>	Uncommon- Rare	ground nesting, solitary		<i>Pontederia</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>boltoniae</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Bidens</i> sp., <i>Chrysopsis</i> sp., <i>Cirsium</i> sp., <i>Coreopsis</i> sp., <i>Grindelia</i> sp., <i>Helianthus</i> sp., <i>Helianthus</i> sp., <i>Heterotheca</i> sp., <i>Rudbeckia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp., <i>Vernonia</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>denticulatus</i>	Common- Uncommon	ground nesting, solitary		<i>Vernonia</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>dentiventris</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Bidens</i> sp., <i>Chrysopsis</i> sp., <i>Coreopsis</i> sp., <i>Helianthus</i> sp., <i>Pityopsis</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp., <i>Vernonia</i> sp.
	<i>Melissodes</i> (Heliomelissodes) <i>desponsus</i>	Common	ground nesting, solitary		<i>Cirsium</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>druriellus</i>	Uncommon	ground nesting, solitary	declining in Northeast	Asteraceae: <i>Euthamia</i> sp., <i>Helianthus</i> sp., <i>Rudbeckia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp., <i>Vernonia</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>subillatus</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Coreopsis</i> sp., <i>Cirsium</i> sp., <i>Rudbeckia</i> sp., <i>Symphotrichum</i> sp., <i>Vernonia</i> sp.
	<i>Melissodes</i> (Eumelissodes) <i>trinadis</i>	Uncommon	ground nesting, solitary		Asteraceae: <i>Helianthus</i> sp., <i>Rudbeckia</i> sp.
Colletidae: Colletinae:	<i>Colletes aestivalis</i>	Rare	ground nesting, solitary		<i>Heuchera</i> sp.
	<i>Colletes banksi</i>	Rare	ground nesting, solitary		<i>Ilex</i> sp.
	<i>Colletes compactus</i>	Common	ground nesting, solitary	declining in Northeast	Asteraceae: <i>Bidens</i> sp., <i>Chrysopsis</i> sp., <i>Rudbeckia</i> sp., <i>Solidago</i> sp., <i>Symphotrichum</i> sp.
	<i>Colletes latitarsis</i>	Uncommon	ground nesting, solitary		<i>Physalis</i> sp.
	<i>Colletes productus</i>	Uncommon- Rare	ground nesting, solitary		<i>Lyonia</i> sp., <i>Vaccinium</i> sp.

Family: Subfamily: Tribe:	Genus (Subgenus) species	Status	Nesting, Social behavior	Conservation status	Host plant Family: Genera
	<i>Colletes simulans</i>	Common	ground nesting, solitary		Asteraceae: <i>Euthamia</i> sp., <i>Solidago</i> sp., <i>Symphytotrichum</i> sp.
	<i>Colletes solidaginis</i>	Uncommon- Rare	ground nesting, solitary	regionally rare	<i>Solidago</i> sp.
	<i>Colletes validus</i>	Uncommon	ground nesting, solitary	declining in Northeast	<i>Vaccinium</i> sp.
	<i>Colletes willistoni</i>	Rare	ground nesting, solitary		<i>Physalis</i> sp.
Halictidae: Halictinae: Halictini:	<i>Lasioglossum</i> ( <i>Sphex</i> ) <i>oenotherae</i>	Uncommon	ground nesting, solitary		<i>Oenothera</i> sp.
	<i>Lasioglossum</i> (Hemihalictus) <i>pectinatum</i>	Rare	ground nesting, solitary		<i>Physalis</i> sp.
	<i>Lasioglossum</i> ( <i>Evylaeus</i> ) <i>nelumbonis</i>	Rare	ground nesting, solitary	rare; habitat specialist	Nymphaeaceae and/or Nelumbonaceae, but direct observations has not yet been made due to the difficulty of observing and collecting bees on aquatic vegetation.
Halictidae: Rophitinae:	<i>Dufourea monardae</i>	Rare	ground nesting, solitary		<i>Monarda</i> sp.
	<i>Dufourea novaeangliae</i>	Common- Rare	ground nesting, solitary		<i>Pontederia</i> sp.
Megachilidae: Megachilinae: Anthidiini:	<i>Paranthidium</i> ( <i>Paranthidium</i> ) <i>jugatorium</i>	Uncommon- Rare	ground-nesting, solitary, resin bee		Asteraceae: <i>Erigeron</i> sp., <i>Grindelia</i> sp., <i>Helianthus</i> sp., <i>Heterotheca</i> sp., <i>Rudbeckia</i> sp., <i>Silphium</i> sp., <i>Verbesina</i> sp.
Megachilidae: Megachilinae: Megachilini:	<i>Megachile</i> ( <i>Sayapis</i> ) <i>pugnata</i>	Uncommon	stem- and cavity nesting, solitary		Asteraceae: <i>Cirsium</i> sp., <i>Coreopsis</i> sp., <i>Erigeron</i> sp., <i>Grindelia</i> sp., <i>Helianthus</i> sp., <i>Rudbeckia</i> sp.
Megachilidae: Megachilinae: Osmiini:	<i>Chelostoma</i> ( <i>Prechelostoma</i> ) <i>philadelphia</i>	Uncommon	stem- and cavity nesting, solitary		Hydrangeaceae: <i>Philadelphus coronarius</i> , <i>P. inodorus</i> , <i>P. pubescens</i>
	<i>Osmia</i> ( <i>Helicosmia</i> ) <i>chalybea</i>	Rare	stem- and cavity nesting, solitary		<i>Cirsium</i> sp.
	<i>Osmia</i> ( <i>Melanosmia</i> ) <i>distincta</i>	Uncommon	stem- and cavity nesting, solitary		<i>Penstemon</i> sp.
	<i>Osmia</i> ( <i>Helicosmia</i> ) <i>texana</i>	Rare	stem- and cavity nesting, solitary	uncommon to rare	<i>Cirsium</i> sp.
	<i>Osmia</i> ( <i>Melanosmia</i> ) <i>virga</i>	Uncommon	stem- and cavity nesting, solitary		<i>Vaccinium</i> sp.
Melittidae: Melittinae: Macropidini:	<i>Macropis</i> ( <i>Macropis</i> ) <i>ciliata</i>	Uncommon- Rare	ground nesting, solitary	rare/endangered; declining in Northeast	<i>Lysimachia</i> sp.
	<i>Macropis</i> ( <i>Macropis</i> ) <i>nuda</i>	Uncommon- Rare	ground nesting, solitary	rare/endangered; declining in Northeast	<i>Lysimachia</i> sp.
	<i>Macropis</i> ( <i>Macropis</i> ) <i>patellata</i>	Rare	ground nesting, solitary	rare/endangered; declining in Northeast	<i>Lysimachia</i> sp.
Melittidae: Melittinae: Melittini:	<i>Melitta</i> ( <i>Cilissa</i> ) <i>americana</i>	Uncommon- Rare	ground nesting, solitary	rare/endangered	<i>Vaccinium stamineum</i>
	<i>Melitta</i> ( <i>Cilissa</i> ) <i>eickworti</i>	Rare	ground nesting, solitary	rare/endangered	<i>Vaccinium stamineum</i>

## Bee Life History and Social Behaviors

While most people are familiar with social bees (honeybees and bumblebees), there are other, far less well known life history patterns in bees. One can distinguish four main bee life history patterns: (1) solitary bees, (2) brood parasitic bees, (3) social bees, and (4) social parasites.

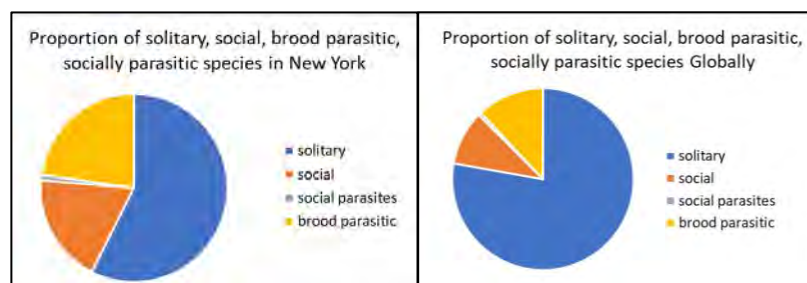
**Solitary** – a single, adult, reproductively active female builds and occupies each nest. She constructs her own brood cells, provisions them with pollen and nectar, guards her own nest, and lays her own eggs. Globally, 77% of bee species are solitary. In New York, we estimate that roughly 60% are solitary.

**Communal** – gregarious species where multiple actively reproducing females share a common nest entrance yet behave as a solitary bee not showing cooperative behaviors among nest mates.

**Social** (cooperative breeders and eusocial species) – Social taxa are characterized by three main features that distinguish them from solitary bees: (1) reproductive division of labor, (2) cooperative brood care, and (3) overlap of generations. In all social bees there are distinct, non-reproductive “workers” who forage for food, build and guard the nest and attend to the developing brood, and reproductive “queens” who remain almost exclusively within the nest and lay eggs. The social taxa can form large colonies of hundreds (bumble bees) to thousands (honey bees) of workers. They can also be highly aggressive – workers are willing to sacrifice their own lives in order to defend the colony. You may have experienced this hyper-aggressive behavior if you have ever disturbed a honey bee or bumble bee colony. Around 10% of bee species globally, and 19% of bee species in NY are considered to be social. A large proportion of NY’s social bee species are bumble bees (*Bombus* sp.) but we also have social halictid bees (*Lasioglossum* and *Halictus*).

**Socially parasitic** – Social parasites enter the nests of social bees and kill or replace the host female as the primary egg layer. These bees only attack social hosts and are often closely related to their hosts (e.g., the subgenus *Psithyrus* in bumble bees).

**Brood parasitic or “cleptoparasitic”** – In brood parasitic bees, females do not build nests or collect pollen and nectar for larval nutrition. In fact, these bees lack the structures for gathering, manipulating and carrying pollen. Instead, they enter the nests of solitary, pollen-collecting bees and lay their eggs in either open or closed brood cells. The adult female or her first instar larva kills the host egg or larva, and the brood parasite then consumes the pollen provisions of the host bee. Female brood parasites are often heavily armored to defend themselves against the attack of the host female. Brood parasitic bees comprise 13% of bee species globally and 23% of bee species in New York. The largest and most conspicuous genera in our area are *Nomada* (Apidae), *Sphecodes* (Halictidae), and *Coelioxys* (Megachilidae).



## Nesting biology and diversity

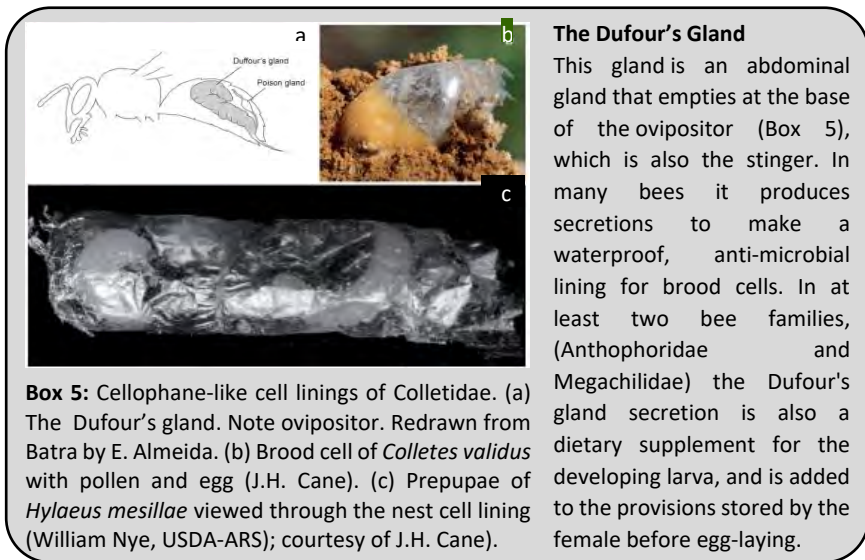
Bees exhibit a diversity of nesting strategies. Over half (54%) of bees in New York State are digger bees (ground-nesting, solitary bees, such as *Andrena*, *Lasioglossum*, *Colletes*, and *Melissodes*). Species of *Andrena* are typical of ground-nesting bees in their life history. At the start of the nesting season (in the spring, summer, or fall, depending on the species), female *Andrena* begin to construct burrows in

the soil. At the end of these subterranean burrows they construct brood cells, lined with waterproof secretions produced in the **Dufour's gland (Box 5)**. Once a brood cell has been constructed, a female provisions it with a mixture of pollen and nectar collected from flowering plants in the vicinity of the nest. Foraging ranges in these solitary bees are small – on the order of 500 m maximum – so nests are typically close to the floral resources. Once the provisions have been collected, the pollen/nectar mixture is sculpted into a spherical pollen ball and an egg is laid on top. The brood cell is then closed and the female begins another brood cell. Brood cells range in depth from a few inches to several feet. A typical solitary female might produce just 10–15 offspring over a period of two to three weeks of active foraging.

While the majority of bees in New York State are ground-nesting, several species make nests in preexisting cavities, such as twigs, hollow stems, beetle burrows, or in sites above ground. We refer collectively to these bees as “renters”. Above-ground, cavity nesters include the mason bees, the wool carder bees and various resin bees. Mason bees in New York state include genera such as *Osmia*, *Hoplitis*, *Prochelostoma*, and *Heriades*. Mason bees (*Osmia* sp) line their nest with excavated mud and comprise roughly 7% of the species of bees in New York. Other cavity- and stem-nesting bees include: the leaf-cutter bees in the genus *Megachile* who line their cells with circular pieces of leaf that they cut from rosebushes and other plants; the wool carder bees in the genus *Anthidium* that make their fluffy nests out of trichomes that they scrape off of the fuzzy leaves of Lamb’s Ear species; the resin bees of the genera *Paranthidium* and *Pseudoanthidium* that construct their nests of plant resins; and the yellow-faced bees in the genus *Hylaeus* who line their burrows (constructed in plant stems or other hollow tubes) with a cellophane-like secretion produced by the dufour’s gland. *Hylaeus* are unusual bees because they carry pollen internally and not externally like the majority of pollen-collecting bees.

Another important group of bees are the carpenter bees. In North America we have both small (*Ceratina*) and large (*Xylocopa*) carpenter bees. These bees construct nests in pithy stems and solid wood, respectively. Carpenter bee nests are conspicuous because males hover in front of the nests (typically located in fence posts, wooden park benches, and houses) and engage in aggressive territorial battles.

Our most common social species, the bumble bees (*Bombus* sp) are cavity nesters, preferring the vacated, below-ground chambers of small mammals and honey bees prefer cavities in hollowed out trees.



### The Dufour's Gland

This gland is an abdominal gland that empties at the base of the ovipositor (Box 5), which is also the stinger. In many bees it produces secretions to make a waterproof, anti-microbial lining for brood cells. In at least two bee families, (Anthophoridae and Megachilidae) the Dufour's gland secretion is also a dietary supplement for the developing larva, and is added to the provisions stored by the female before egg-laying.

## Where to find and how to propagate and grow native plant species

Here we have listed several native plant nurseries, gardens, and educational resources for obtaining native plants and propagating and growing native plants species. These resources can provide the detailed information to determine which plants might be successfully added to your site, and how to grow them. Native plant societies often have plant and seed sales or swaps. A fabulous and comprehensive resource is *the Xerces Society for Invertebrate Conservation* – Xerces hosts a webpage on their website titled Pollinator Conservation Resource Center <https://xerces.org/pollinator-resource-center>. The resource center houses pollinator resources for all parts of the US.

Keep in mind that you may have resources nearby, for example, garden fairs, plant sales or even plant swaps are great events to take advantage of. The New York Flora Association, the Native Plant Center at Westchester Community College and the Finger Lakes Native Plant Society websites are great resources for native plant gardening and sourcing native plants for your region.

### **A note on harvesting your own seeds**

Harvesting local seed will give you the best chance of providing a local regional plant type. If harvesting, always harvest with landowner permission taking no more than 10% of the available seed from as many individuals as possible given the population. Harvesting happens in the previous fall. Research how to propagate each species because vegetable seed planting rules do not apply to native seed planting. Talk with a local botanist or Native Plant Society Volunteer to learn about seed collecting in your area.

### **Native Plant sources in New York**

#### **Cornell Botanic Gardens' Mundy Wildflower Garden**

This is a demonstration native plant garden, that also provides education and access to plant material. They coordinate a volunteer gardener program- gardening, restoration and plant propagation. They provide regional seeds available in small quantities, plant identification, and workshops on: 1) Plant propagation from seeds, 2) Gardening with native plants, 3) Streambank and forest restoration

**Contact:** Krissy Boys, [kbf3@cornell.edu](mailto:kbf3@cornell.edu)

**Website:** <https://cornellbotanicgardens.org/location/mundy-wildflower-garden/>

#### **Finger Lakes Native Plant Society (FLNPS)**

The website lists nearby sources for native plants and cultivation conditions for garden worthy species. They provide workshops on plant propagation, help with plant identification; provide regional seeds available in small quantities; conduct plant sales at the annual Cooperative Extension Plant Fair

**Website:** <https://flnps.org/>

#### **Greenbelt Native Plant Center**

Plant material is available for city parks, including volunteer groups who are restoring parks. It is NOT a general resource for plants. Call Ed Toth to learn a whole lot about NY regional seed!

**Contact:** Ed Toth, Director of the Native Plant Center on Staten Island: [Edward.Toth@parks.nyc.gov](mailto:Edward.Toth@parks.nyc.gov)

**Website:** <https://www.nycgovparks.org/greening/greenbelt-native-plant-center>

#### **Niagara Frontier Botanic Society**

Coordinates a semi-annual plant sale mid-spring on even years at Harlem Road Community Center.

**Location:** 4255 Harlem Road Amherst, NY 14226

**Website:** <https://sites.google.com/a/niagarafontierbotanicalsociety.org/niagara-frontier-botanical-society/>



### **The Long Island Native Plant Initiative (LINPI)**

Local genotype plant material that is adapted to Long Island's unique environmental. LINPI provides commercial sources of genetically appropriate local (ecotypic) plant materials for use in nursery, landscaping and habitat restoration activities.

**Location:** Hampton Bays, NY

**Phone:** 631-525-1690

**Email:** [info@linpi.org](mailto:info@linpi.org)

**Website:** <http://www.linpi.org/>

### **The Native Plant Center at Westchester Community College**

Affiliated with the Lady Bird Johnson Wildflower Center. An active group with many workshops, a plant sale, and a demonstration garden.

**Address:** 75 Grasslands Road, Valhalla, NY 10595

**Phone:** (914) 606-7870

**Website:** [wccnativeplant@sunywcc.edu](mailto:wccnativeplant@sunywcc.edu)

### **Amanda's Garden**

Mail and retail nursery; consultations, site assessments, and habitat histories; classes; shade plants.

**Address:** 8030 Story Road, Dansville, NY 14437

**Phone:** 585-750-6288

**Email:** [ellen@amandasnativeplants.com](mailto:ellen@amandasnativeplants.com)

**Website:** <https://www.amandasnativeplants.com/>

### **White Oak Nursery**

Consultations, invasive plant control, treatments for HWA, plant installations and landscaping, specializing in native shrubs and trees.

**Jim Engel (owner):** [jengel53@rochester.rr.com](mailto:jengel53@rochester.rr.com)

**Nursery location:** 4350 Kipp Road, Canandaigua, NY

**Mailing address:** 801 W. Washington St., Geneva, NY 14456

**Phone:** 315-789-3509

**Website:** <http://www.whiteoaknursery.biz/>

### **Twisted Tree Farm:**

Organically grown nut trees, fruit trees, berry bushes, and perennials. Twisted Tree Farm grows virtually all of their own plants and collects most of their seed from local sources. Roughly half of the plants are native. Creating food and habitat for people and wildlife is the primary focus.

**Akiva Silver (owner):** [ttfarm279@gmail.com](mailto:ttfarm279@gmail.com)

**Address:** 279 Washburn Road, Spencer, NY, 14883,

### **Fiddlehead Creek Native Plant Nursery**

They carry shrubs and perennials that are native to New York state, including plants that are more specifically native to the Adirondacks. Additionally, they provide education materials about the benefits of native plants for biodiversity, wildlife, and water quality.

**Nursery location:** 7381 State Route 40, Hartford, NY 12838

**Mailing address:** 7381 State Route 40, Fort Ann, NY 12827

**Phone:** 518-632-5505 , [info@fiddleheadcreek.com](mailto:info@fiddleheadcreek.com)

**Website:** <http://fiddleheadcreek.com/>

### **Plantsmen Nursery**

A native plant nursery providing native seeds, and container plants at various stages of development. They also have a landscaping business that provides design, installation, and maintenance.

**Location:** 482 Peruville Rd. (Route 34B), Groton, NY 13073

**Phone:** 607-533-7193

**Nursery and Inventory:** [info@plantsmen.com](mailto:info@plantsmen.com)

**Design and Landscape questions:** [landscaping@plantsmen.com](mailto:landscaping@plantsmen.com)

**Website:** <http://www.plantsmen.com/plants-for-your-site>

### **Useful websites for propagating native plants**

Plants can be propagated either by seed or by vegetative parts. The internet is a great resource for learning which propagation method works best for each plant species. A simple search for the Latin name of the plant and the word 'propagation' will usually lead you to a page that describes the propagation method needed for the specific species. Below are the main internet resources that share information on how to propagate species.

- <https://www.prairiemoon.com/>
- <https://hort.ifas.ufl.edu/database/lppi/index.shtml>
- <https://www.izelplants.com/>
- <https://www.wildflower.org/> (listed under seed sources)

If you cannot find the information you seek or would like to speak to a person about these methods, contact the Cornell Botanical Gardens or any of the resources listed above to ask questions.

### **Out-of-State Native Plant Seed Companies selling regional seed**

- **Ernst Conservation Seeds (PA)**

Ernst Conservation Seeds has great seed mixes, and full descriptions of how to prepare the area you plan to convert into wildlife or pollinator habitat. They provide seed mixes for riparian areas, meadows, pastures, and specifically for birds and pollinators as well as planting details.

**Phone:** 814-336-2404

**Email:** [sales@ernstseed.com](mailto:sales@ernstseed.com)

**Website:** <http://www.ernstseed.com/>

- **Roundstone Native Seed, LLC** (located in KY but have NY Region Seed Mix)

They provide native seeds and specialize in large restorations.

**Phone:** 888-981-7417 / 270-531-3034,

**Email:** [sales@roundstoneseed.com](mailto:sales@roundstoneseed.com)

**Website:** [www.roundstoneseed.com](http://www.roundstoneseed.com)

**Link to NE regional plant list:** <http://roundstoneseed.com/pollinators-honey-bee-mix/1064-pollinator-conservation-mix.html>

- **Sylvia Native Plant & Seed Nursery (PA)**

They provide seeds and seedlings of native plants species.

\*They are a great resource for willow species which provide early spring floral resources for bees.

*Salix purpurea* (Banker's Dwarf Willow) \*non-native\* Medium shrub. Riverbanks.

*Salix cottetii* (Streamco Willow) Large shrub. Riverbanks.

*Salix discolor* (Pussy Willow) Large shrub, velvety flowers. Wet soils. All zones.

*Salix nigra* (Black Willow) Most common willow, medium tree. Wet soils-flood plains. All zones.

**Phone:** 717-227-0486

**Website:** <http://www.sylvanative.com/>

### **Non-regional seed sources (Midwestern genotype only)**

- **Prairie Moon Nursery (MN)** - <https://www.prairiemoon.com/>  
Excellent source for cultural and propagation information. Retail, mail source for *Midwestern genotype* seeds and plants, straight species.  
**Address:** 32115 Prairie Lane, Winona, MN 55987 US  
**Phone:** 866-417-8156
- **Prairie Nursery (WI)** - <http://www.prairienursery.com/>  
Prairie Nursery provides custom seed mixes and is committed to native plant restoration. They also provide consulting services and a variety of resource guides.  
**Phone:** 800-476-9453
- **Prairie Restorations (MN)** - <http://www.praieresto.com/>  
Prairie Restorations is committed to native plant community restoration. They provide native seed and plant materials, planning and educational resources, and installation services.  
**Phone:** 763-389-4342,  
**Email:** [info@prairieresto.com](mailto:info@prairieresto.com)

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