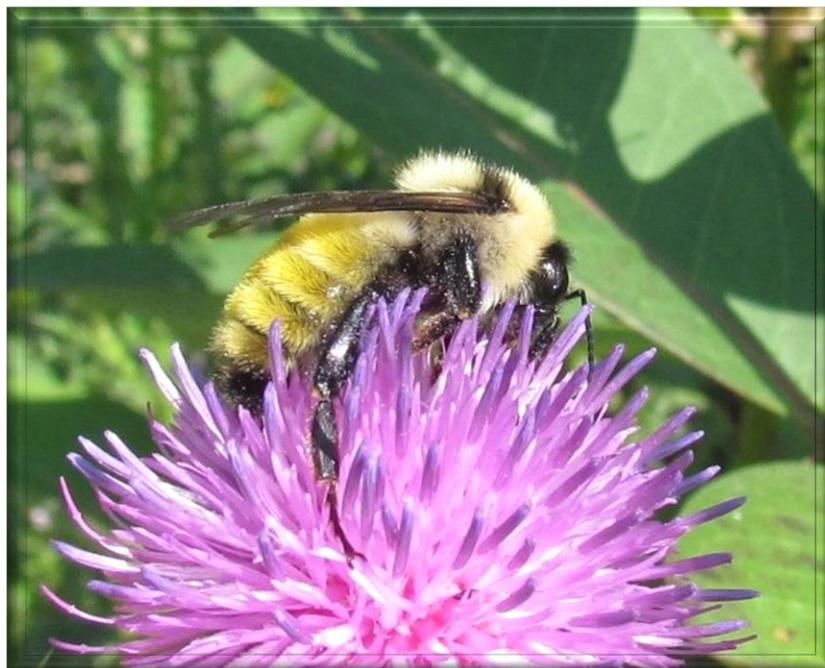


**PENNSYLVANIA NATURAL HERITAGE PROGRAM
HABITAT MANAGEMENT FOR POLLINATORS**



Baltimore Checkerspot (*Euphydryas phaeton*)



Golden Northern Bumble Bee (*Bombus fervidus*)

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Figure 1. Milkweeds like this swamp milkweed (*Asclepias incarnata*) are a favorite nectar plant for many pollinators.

On the cover: A Baltimore checkerspot nectars on common milkweed (*Asclepias syriaca*), a native Pennsylvania plant. A golden northern bumble bee nectars on spiny plumel thistle (*Carduus acanthoides*), which is not native to Pennsylvania and should not be planted. However, Table 5 lists three native thistles (*Cirsium* species) that are recommended as valuable additions to meadow habitats.

Introduction

The Pennsylvania Natural Heritage Program gathers and provides information on the location and status of important ecological resources. Pollinators are a research and conservation priority for our program as scientists seek to understand and reduce the threats that are contributing to the decline of pollinators, from honey bees and wild bees to butterflies and moths. Pollinators provide valuable ecosystem services that benefit humans directly and maintain the plant communities that support all wildlife. This document is intended to help PNHP staff and land managers evaluate how pollinator friendly a site is, and to identify management actions that will enhance a site for a variety of pollinators.

Pollinator habitats provide flowers where adult insects can gather food; they also grow food for the young. Caterpillars of different kinds of butterflies and moths may feed on a group of plants, such as grasses, blueberries, pines, or oaks. Others specialize on one or a few kinds of plants. Specialists include the monarch, bog copper, and Baltimore checkerspot butterflies, whose caterpillars feed on milkweeds, cranberries, and turtlehead, respectively. A similar trend is seen in native bees. The larvae of bees cannot seek food for themselves, so the adults must gather it for them. Adult bees gather nectar and pollen from specific kinds of plants to meet their nutritional needs. Some species of bees feed from a broad variety of plants. Others are specialists that feed from a very limited number of native plants. Some bees become active in early spring and are dependent upon ephemeral wildflowers that grow under trees in woodland settings and bloom before the tree canopy closes. Pollinator habitats also provide safe places for nesting and overwintering insects in burrows in soils, snags and fallen logs, grassy tussocks, abandoned rodent tunnels, and other sheltered sites.

Good pollinator habitats come in many shapes and sizes, including backyard gardens, old fields, wetland complexes, forest glades, shady woodlands, and floodplains. Each habitat supports a unique combination of flowering plants that appeal to different pollinators. Right-of-ways, roadsides, field edges, hedgerows, ditches, and other infrequently mowed areas can support nectar plants and nesting sites. These areas are often degraded by herbicides, road treatments, vehicle traffic, and poorly timed mowing, but under ideal management conditions they can provide excellent pollinator habitat.



Figure 2. A silver-bordered fritillary (*Boloria selene*) feeds on grass-leaved goldenrod (*Euthamia graminifolia*) on a pipeline right-of-way.

Management Priorities

The first step in developing a habitat management plan is to think about what you want to achieve with your property. List all of your wildlife, recreation, economic, and aesthetic goals. Ordering and reviewing priorities will help you decide how and when to conduct different management activities. It will also help identify where certain activities may conflict and serve at cross purposes to each other.

Inventory Habitats and Plants

The next step in developing a habitat management plan is to describe the current conditions of the site. List the types and approximate size of natural habitats on the property, including woodlands, meadows, streams, springs, and wetlands, as well as heavily managed landscapes such as farm fields, yards, and gardens. Describe the basic environmental conditions within each habitat, such as slope, soil, light, and moisture conditions.

Once you have determined your habitat types, visit each habitat every couple of weeks throughout the growing season. Note the type, abundance, and distribution of flowering trees, shrubs, grasses, and herbaceous plants. You will get a sense of how many different kinds of plants are available to pollinators. Look for invasive plants that should be removed. Consider the quality and availability of nesting and overwintering sites. Most of our native bees are ground nesters and need easy access to soil that isn't densely vegetated, driven over, or plowed. Look for patches of bare or sparsely vegetated soils which may be located on eroding banks beside trails and dirt roads, along watercourses, in poor or rocky soils, and other disturbed areas. We also have many wood nesting bees that live in tunnels in decaying wood. Others chew little cavities inside old dead woody plant stems. Bumble bees nest in un-manicured grassy habitats where they find empty rodent tunnels and other protected spaces under dense tussocks of grass.

If you need assistance identifying species and habitats, contact your [County Master Gardener Program](#) or [County Conservation District](#). The Pennsylvania Game Commission also has a great [Private Landowner Assistance Program](#) which helps landowners of eligible properties develop habitat management plans for game and non-game wildlife. They can also connect landowners to grant programs that support habitat restoration projects on private lands.

Pollinator friendly habitats are great insect-feeding wildlife, such as dragonflies, spiders, birds, bats, turtles, and salamanders. This fawn darner at right (*Boyeria vinosa*) catches its fill of small insects flying in little wet meadow opening in the forest, next to a stream.



Figure 3. A fawn darner dragonfly rests on a cardinal flower (*Lobelia cardinalis*), a lovely wildflower of riparian areas and wet meadows.

Promote Habitat Variety to Support All Life Stages of Pollinators

To remember key features of pollinator habitat, think about these three 'Bs': blooms, beds, and bassinets. Blooms are flowering plants that provide nectar and pollen for adult insects. Beds are places for pollinators to rest and overwinter. Bassinets represent the food and nests needed by the developing young (caterpillars or larvae) of pollinator insects.

Pollinators need a continuous progression of blooms throughout the spring, summer, and fall. They also need a variety of flower colors and shapes within each season. If you have a gap in blooms on your property, you can look for trees, shrubs, and plants that will flower during the lulls and are suitable to your site conditions. Recommendations for pollinator plants are provided in the sections '*Find Native Plants*', '*Find Local Plants*', and Table 5 '*Native Plant Recommendations*'.

During the property inventory you may discover that you have few beds and bassinets. Different kinds of bees, moths, and butterflies have different nesting and overwintering needs, so habitat diversity is the key. When property size and conditions permit, aim to have scattered sunlit patches of bare or lightly vegetated soil in both forested and open habitats, allow leaf litter to accumulate under trees, leave standing snags and fallen logs, and maintain areas of infrequently mowed vegetation. These features are often in short supply in residential communities and agricultural areas, so even very small patches of these specific habitats will be helpful. Owners of smaller properties can artfully arrange brush piles or driftwood. Bird baths and ornamental water features can provide water for birds and insects alike. Bare dirt can be created in a low visibility section of a garden by clearing away mulch and ground cover so that patches of soil become exposed. It may be necessary to scrape and till an area first, but once the bare soil site is established it should not be disturbed other than to control vegetation on the surface by mowing and raking.

Other habitat improvements will take more effort but can make a big difference. Landowners can dedicate a portion of their yard or property to creating or enhancing meadow habitat. This may involve removing turf grass or clearing a patch of trees a half acre or larger to create a place for an upland or wet meadow planted with a mix of native grasses, sedges, and flowering plants. Reseeding soils that were disturbed during a construction project is another opportunity to create habitat for pollinators. Native seed mixes can be used that incorporate plants appropriate to the region and site conditions. Planting recommendations specific to pollinators are provided in the 'Find Native and Local Plants' section of this document. The Pennsylvania Bureau of Forestry [Planting and Seeding Guidelines](#) also provide detailed recommendations for planting or seeding a site with native grasses, sedges, rushes, flowering plants, shrubs, deciduous trees, and conifers. Landowners interested in gardening and farming can read the [Organic Farming for Bees](#) factsheets by the Xerces Society for recommendations on how to minimize the negative and maximize the positive effects of farming practices on pollinators.

Other common problems in pollinator habitats include encroachment by invasive plants, heavy deer browse, and succession of open fields into shrub thickets and young forest. In the next section we will discuss mowing to maintain open habitats and control invasive plants. There are also many resources available online provide in-depth information on habitat management for pollinators. Two excellent

guides are the Xerces Societies' [Pollinators in Natural Areas: A Primer on Habitat Management](#), and the USDA Natural Resource Conservation Service's [Pollinator Biology and Habitat](#).

Protecting pollinator plants from excessive deer browse is another difficult challenge in many regions of Pennsylvania. Fencing and tree tubes are good ways to protect your investment in native plantings. Good overviews of how white-tailed deer shape their environment are available at the Pennsylvania Department of Conservation and Natural Resources (DCNR) webpage on [Conserving Pennsylvania's Forests and Native Plants through Deep Management](#), in Penn State Extensions' [White-Tailed Deer](#), and in the USDA Forest Service Northeastern Area's [Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview](#). Two publications that provide more detailed deer management recommendations include The Natural Lands Trust's [Deer Management Options](#) and the Cornell Cooperative Extension's [White-tailed Deer Wildlife Damage Management Fact Sheet](#).

Deer like to eat many of the same flowering plants needed by adult and larval insects. In Figure 1, the native thin-leaved sunflower (*Helianthus decapetalus*) grows to twice the height and flowers more vigorously than browsed plants outside of the fenced area.



Figure 4. Thin-leaved sunflower growing and flowering more vigorously inside a deer enclosure compared with plants outside of it. Photo by Rodger Waldman.

Maintain Open Habitats

Existing old fields and meadows need periodic maintenance to remove woody shrubs and tree seedlings that will eventually shade out the flowering plants. Mowing can also maintain the vegetation's overall vigor and helps control invasive plants. It is important not to mow pollinator habitats during the growing season when flowers are in bloom. Generally the best time to mow is in the fall after the first frost or in early spring. Waiting until after the first frost to mow ensures that grassland birds have completed their nesting season, insects have stopped feeding on plant blooms and foliage, and desirable native plants have had time to develop and disperse their mature seeds. Soils are typically drier in the fall and less likely to get damaged by tractor tires. The vegetation is still upright before the winter snows beat it down, so it is easier to cut. Waiting until after snow melt is the best option if the site is dry enough to mow in the spring, as this leaves standing vegetation over the winter to provide shelter for insects, small birds, and mammals.

Cutting an entire field at one time is the simplest technique, but is least effective in creating habitat diversity and may not adequately provide both food and cover habitat for wildlife. The mowing options shown below are preferable because they create a variety of vegetation heights and types. In both mowing scenarios, no more than 1/3 of the field is mowed in a given year. The remaining 2/3 of the habitat is uncut that year, which leaves areas of more substantial winter cover. If wildlife is directly or indirectly disturbed by the mowing, there will be portions of the field left untouched where animals can find refuge. If the field is relatively uniform in plants, soils, and moisture, it does not matter much which blocks or strips are mowed in a year. However, if a portion of the field is different from the rest, e.g., is wetter or supports different types of plants, then design the blocks or strips so that not more than 1/3 to 1/2 of the unique area is mowed in a year. Note that a rotational approach is also recommended when using prescribed fire for habitat management, but allowing a minimum of three years recovery time in a habitat patch before reburning.

Decide upon a mowing schedule based on management goals for the site. Mowing every 1-3 years will maintain a relatively open meadow, while mowing every 3-5 years will allow shrubs to develop. The mower blade should be set to 6 inches or higher (8 inches is ideal) so that a tall layer of stubble is left behind as vegetative cover. Cleaning up the cuttings to prevent accumulation of plant litter will also help encourage a more meadow-like setting.

Block Method: Divide the field into three or more blocks and decide upon a mowing schedule based on management goals for the site. In this example, a field was divided into six blocks and placed on a three year mowing cycle. A particular block is mowed once every three years.

MOW YEARS 1, 4, 7...	MOW YEARS 2, 5, 8...	MOW YEARS 3, 6, 9...
MOW YEARS 3, 6, 9...	MOW YEARS 1, 4, 7...	MOW YEARS 2, 5, 8...

Strip Method: Conceptualize the field as a series of narrow strips. Decide upon a mowing schedule based on management goals for the site. No more than 1/3 of the strips should be mowed in a given year, with unmowed strips left between mowed ones. Strips do not have to be straight lines. Curving strips produce more edge and, when cut to follow the contour of the land, provide more erosion control. In this example, a 180 foot field is divided into nine 20-foot strips with each strip mowed at two year intervals.

MOW YEARS 1, 4	MOW YEARS 2, 5	MOW YEARS 3, 6	MOW YEARS 1, 4	MOW YEARS 2, 5	MOW YEARS 3, 6	MOW YEARS 1, 4	MOW YEARS 2, 5	MOW YEARS 3, 6
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Control Invasive Plants

Invasive plants can provide flowers for adult pollinators, but in the long term do more harm than good. Invasive plants are marching into Pennsylvania woodlands, fields and wetlands, crowding out native plants and breaking the intricate links between native plants and wildlife. For a list of plants that are not native to the state, grow aggressively, and spread and displace native vegetation, see the [DCNR Invasive Plants List](#). Fact sheets with information on how to identify and control invasive plants are available at the [DCNR Invasive Plants Website](#). A few common and/or particularly problematic invasive plants are listed in Table 1. Each name contains a link to a factsheet developed by the Pennsylvania Department of Conservation and Natural Resources (PA-DCNR).

Table 1. Common invasive plants of Pennsylvania with links to the PA-DCNR factsheet providing information on identification and control of that plant.

Grasses	Herbs	Shrubs	Vines	Trees	Aquatic Plants
Bamboo	Bull Thistle	Burning Bush	Oriental Bittersweet	Callery or Bradford Pear	Hybrid Cattail
Cheatgrass & Poverty Brome	Black, Brown & Spotted Knapweed	Common Buckthorn	English Ivy	Japanese Angelica Tree	Narrow-leaved Cattail
Common Reed	Canada Thistle	Glossy Buckthorn	Japanese Honeysuckle	Amur Maple	Didymo
Japanese Stilt Grass	Garlic Mustard	European & Japanese Barberry	Japanese Hops	Norway Maple	Hydrilla
Reed Canary Grass	Japanese & Giant Knotweed	Multiflora Rose	Kudzu	Mimosa	Curly Pondweed
Shattercane & Johnsongrass	Moneywort	Privets	Mile-a-Minute	White Mulberry	Eurasian Watermilfoil
Wavyleaf Basketgrass	Narrowleaf Bittercress	Russian & Autumn Olive	Porcelain Berry	Princess Tree	Parrot Feather Watermilfoil
Zebra Grass / Miscanthus	Purple Loosestrife	Shrub Honeysuckles	Pale and Black Swallowworts	Tree of Heaven	Brazilian Waterweed

Invasive plants are typically controlled by mechanical or chemical means. Regularly mowing invasives can control them without the use of chemicals. Plants that spread via seeds should be mowed before they go to seed. Hand pulling can be an effective control method for certain invasive plants. For example, garlic mustard is a serious invader of woodland habitats, displacing spring ephemeral wildflowers. Garlic mustard is easily hand-pulled before the plants flower and go to seed. If the plants are beginning to produce seed they should be bagged and removed from the site.

Herbicides are best reserved for treating larger stands of invasive plants where there are few natives mixed in, or for concentrated clumps that can be treated without also spraying many desirable native plants. When spraying is necessary, avoid spraying plants when they are in bloom, or when wind could cause drift. Avoid spraying during periods of high pollinator activity. Pollinators are generally less active during cool mornings and evenings in spring and fall, but in the heat of summer they often become more active in the cooler bookends of the day and less active during the hottest midday hours. Choose the most specific herbicide for the plants being targeted, and do not exceed the recommended concentration. Invasive grasses such as Japanese stiltgrass can be treated with a grass-specific herbicide which limits damage to non-target plants. In situations where mowing is not possible due to chronically wet soils, invasive shrubs and sapling trees can be manually removed with a tool like a weed wrench. Herbicide use should be avoided in or near wet areas, but when they are necessary, only use wetland-approved formulations.

Protect Pollinator Diversity and Rare Species

European honey bees were imported to the United States to pollinate crops, but long before that pollination of our native flowering trees, shrubs, and plants was accomplished by native pollinators, particularly insects in the orders Lepidoptera (butterflies and moths) and Hymenoptera (ants, bees, and wasps). The importance of pollinators was recognized in the recently updated [Pennsylvania State Wildlife Action Plan](#). As part of this plan, the conservation status was determined for 82 (out of 154) Pennsylvania butterflies, 147 (out of ~1,500) moths, and 4 (out of 357) native bees. No species of ants or wasps were evaluated. Critical habitats for rare and declining pollinators include grasslands, old fields, shrubby barrens, wet meadows, and woodland glades. Many pollinators utilize little pockets of unique habitat, and they need many of these habitat pockets scattered across the landscape. Loss and fragmentation of habitat is problematic but can be alleviated by protecting remaining habitat patches, restoring degraded habitats or creating new ones, and connecting the habitats with green corridors.

Variations in environmental conditions and natural fluctuations in population sizes can make it difficult to assess the condition of an insect population. Monitoring populations of species of concern over time is necessary to know if they are persisting at a site, and if habitat conditions are remaining favorable for that species. Populations of species of special concern, as well as key habitat features (e.g. nectar and larval food plants) should be monitored on a regular basis (every 3-5 years), and immediately before and after any management activity that may alter the habitat. Delineate the known occupied habitat for insects of conservation concern, and map locations of important nectar and host plants. Review species life history requirements when planning management activities.

Bees

There are 437 species of bees known from Pennsylvania (Table 2) according to a 2020 paper by Kilpatrick et al. Of these, 414 species are thought to be native to Pennsylvania; the remaining 23 were introduced to North America. The first Pennsylvania bee checklist was published in 2010 by Donovall and VanEngelsdorp, who documented 371 species of bees. The 2020 paper documented an additional 80 species, and shows that our knowledge of Pennsylvania bee diversity is still growing. Table 3 provides a summary of bee families known from Pennsylvania and some basic life history information. Most of the life history information in the table was obtained from the [University of Minnesota Bee Lab](#).

Bees make up a portion of a much larger group of insects in the order Hymenoptera, which includes bees, ants, hornets, wasps, and parasitoid wasps. More research is needed to determine how many species of Hymenoptera are in the state. There are nearly 18,000 species of Hymenoptera known from North America, so we expect our diversity in this group to exceed 1,000 for Pennsylvania (PA Biological Survey 2013). Our understanding of the conservation status of many bees is another area where more research is needed. The 2015 State Wildlife Action plan includes conservation status assessments for four species of bees in the state, but hundreds more species remain to be evaluated. In 2016 the US Fish and Wildlife Service proposed to list the rusty-patched bumble bee (*Bombus affinis*) as an endangered species under the Endangered Species Act. Other species of bumble bee that appear to be declining in the state, include the yellow-belted bumble bee (*Bombus terricola*), the American bumble bee (*Bombus pennsylvanicus*), and Ashton's cuckoo Bee (*Bombus ashtoni*).

Table 2. Bee diversity in Pennsylvania by family; number of species (# spp) is listed for each genus.

Melittid Bees (Melittidae)		Sweat Bees (Halictidae)		Mason, Leaf Cutter and Carder Bees (Megachilidae)		Carpenter, Cuckoo, Bumble, Digger, etc. (Apidae)	
Genera	# spp	Genera	# spp	Genera	# spp	Genera	# spp
<i>Macropis</i>	3	<i>Agapostemon</i>	4	<i>Anthidiellum</i>	1	<i>Anthophora</i>	5
<i>Melitta</i>	1	<i>Augochlora</i>	1	<i>Anthidium</i>	2	<i>Apis</i>	1
Total	4	<i>Augochlorella</i>	2	<i>Chelostoma</i>	2	<i>Bombus</i>	18
		<i>Augochloropsis</i>	2	<i>Coelioxys</i>	12	<i>Ceratina</i>	5
		<i>Dieunomia</i>	1	<i>Heriades</i>	3	<i>Epeoloides</i>	1
		<i>Halictus</i>	5	<i>Hoplitis</i>	7	<i>Epeolus</i>	6
		<i>Lasioglossum</i>	72	<i>Lithurgus</i>	1	<i>Eucera</i>	6
		<i>Nomia</i>	1	<i>Megachile</i>	25	<i>Habropoda</i>	1
		<i>Sphecodes</i>	22	<i>Osmia</i>	21	<i>Holcopasites</i>	2
		Total	110	<i>Paranthidium</i>	1	<i>Melecta</i>	1
				<i>Pseudoanthidium</i>	5	<i>Melissodes</i>	16
				<i>Stelis</i>	5	<i>Melitoma</i>	1
				Total	81	<i>Nomada</i>	39
						<i>Ptilothrix</i>	1
						<i>Svastra</i>	2
						<i>Triepeolus</i>	12
						<i>Xylocopa</i>	1
						Total	118

Cellophane Bees (Colletidae)		Mining Bees (Andrenidae)	
Genera	# spp	Genera	# spp
<i>Colletes</i>	12	<i>Andrena</i>	91
<i>Hylaeus</i>	12	<i>Calliopsis</i>	1
Total	24	<i>Perdita</i>	2
		<i>Protandrena</i>	6
		Total	100

Table 3. Families of bees in Pennsylvania with number of documented species and nesting habits. Life history information was obtained from the [University of Minnesota Bee Lab](#).

Common Name	Family	Nesting Habits	Comments
Cellophane and Masked Bees	Colletidae (20 species)	Solitary but may nest in aggregations; mostly nest underground but some in wood cavities	Cellophane bees make their own plastic-like plaster to smooth and line the walls of their nest cells.
Mining Bees and other Andrenids	Andrenidae (98 species)	Solitary, ground-nesting	Medium bees with shiny (usually hairless) black abdomens; among the first bees seen in the spring.
Sweat Bees, Green Sweat Bees, and other Halictids	Halictidae (80 species)	Social habits range from solitary to colonial; mostly ground-nesting	Small bees, some are bee-patterned but many are dark brown or black; some with metallic green or blue highlights; among the first bees seen in spring.
Melittid Bees	Melittidae (4 species)	Solitary, ground-nesting	Small to medium black bees; family contains many specialists that feed on a limited number of plants.
Mason, Leafcutter, and Carder Bees	Megachilidae (70 species)	Solitary; nesting locations include underground burrows, hollow plant stems, wood cavities, and rock crevices. Construct nests with leaf cuttings, leaf pulp, plant fibers, wood pulp, resin, soil and gravel.	Medium, stout bees, with large heads and mandibles for cutting and chewing nesting materials. Carry pollen under their abdomen instead of on their legs. Important pollinators, several species are used commercially.
Cuckoo, Carpenter, Digger, Bumble, Orchard, Long-Horned, and Honey Bees	Apidae (99 species)	Social habits range from solitary to colonial; nesting locations include underground burrows and wood cavities. Cuckoo bees lay their eggs in the nests of other bees.	A diverse group that contains familiar bees such as honey bees and bumble bees.

Butterflies and Moths

Another large group of pollinator insects are in the order Lepidoptera. Pennsylvania has over 150 species of butterflies and 1500 species of moths. Most butterflies are pollinators and many moths are as well. Hawk and sphinx moths are known to be important pollinators, but more research is needed to identify which moths are effective pollinators, and what kinds of plants they typically select for nectar. While adult pollinators benefit plants by helping them reproduce, the larval stage of pollinators such as butterflies and moths eat plant leaves, flowers, and fruits. Virtually every native plant in Pennsylvania has a caterpillar that will feed upon it. Caterpillars usually don't kill their hosts by feeding on them, but plants are continually evolving chemical and physical defenses to protect themselves from herbivory. Caterpillars must also continue to evolve to overcome plants' defenses, and sometimes even turn them to their own advantage. The monarch caterpillar is a classic example. Milkweed plants contain chemicals that make them distasteful and unpalatable to most insect and mammal herbivores. Monarch caterpillars evolved to tolerate these toxins, and can even sequester them in their own bodies, which makes them distasteful to predators.

The woody trees and shrubs that blanket our forested landscapes are an integral part of any wildlife habitat. Woodlands create the woody debris, leafy carpets, and rich organic soils that nurture woodland wildflowers. They surround and protect special habitats like woodland openings (glades),

shale and serpentine barrens, seeps and springs, bogs, swamps, and other wetlands. They provide food and shelter for all the birds, mammals, and insects in the forest. Great numbers of caterpillars develop on woody plants, and in turn become food for other wildlife. Baby songbirds especially depend upon caterpillars because they are easy to eat and energy rich morsels of food. Woody trees and shrubs that support high species diversity and abundance of Lepidoptera include oaks, willows, cherries, plums, birches, poplars, crabapples, blueberries and huckleberries, cranberries, maples, elms, pines, hickories, hawthorns, alders, spruces, ashes, basswood, linden, hazelnut, walnut, butternut, beech, and chestnuts (Tallamy 2009).

Some native plants support rare and/or specialized pollinators, like the two illustrated in Figure 2: New Jersey Tea (*Ceanothus americanus*) and yellow wild indigo (*Baptisia tinctoria*). Table 4 '*Rare butterflies of Pennsylvania and their caterpillar host plants*' lists butterflies of conservation concern found in Pennsylvania based upon the State Wildlife Action Plan (2015). The species are organized by habitat and caterpillar host plants.

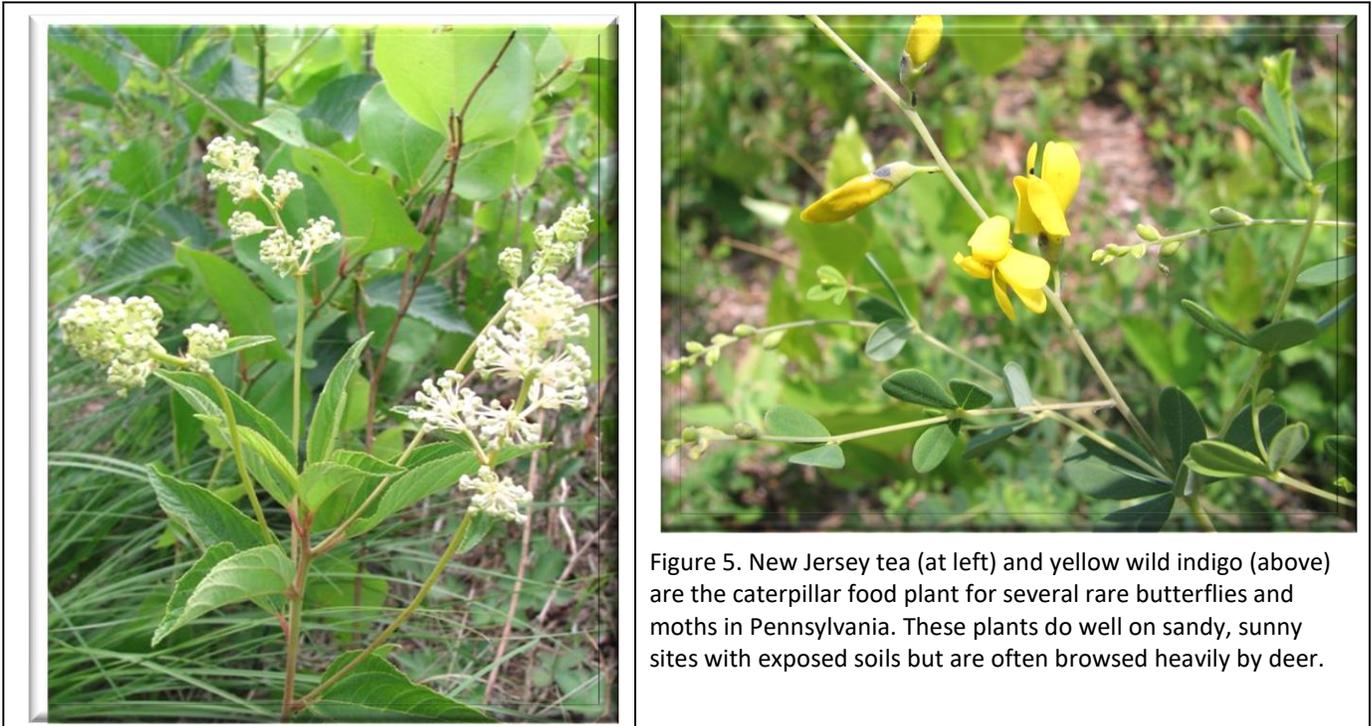


Table 4. Rare butterflies of Pennsylvania and their caterpillar host plant.

Barrens and Grassy Openings, caterpillars feed on grasses or flowering plants			
Common Name	Caterpillar Food Plant	Common Name	Host Plant
Cobweb Skipper	bluestem grasses	Frosted Elfin	wild indigo
Common Roadside Skipper	grasses	Grizzled Skipper	dwarf cinquefoil
Dusted Skipper	bluestem grasses	Mottled Duskywing	New Jersey tea
Indian Skipper	grasses	Olympia Marble	rock cresses
Leonard's Skipper	grasses	Persius Duskywing	wild indigo
Swarthy Skipper	bluestem grasses	Regal Fritillary	violets
		Southern Cloudywing	legumes, esp. tick trefoils
Woodlands and Glades, caterpillars feed on flowering plants			
Common Name	Caterpillar Food Plant	Common Name	Host Plant
Falcate Orangetip	bitter & rock cresses, toothworts	Appalachian Azure	black cohosh
West Virginia White	toothworts	Columbine Duskywing	wild columbine
Northern Crescent	asters	Dusky Azure	goatsbeard
Northern Metalmark	round-leaved ragwort	Golden-banded Skipper	thicket bean
Silvery Checkerspot	wingstem, other composites	Silvery Blue	legumes, esp. Carolina vetch
		Monarch	milkweeds
Woodlands, Shrublands and Glades, caterpillars feed on woody shrubs and trees			
Common Name	Caterpillar Food Plant	Common Name	Host Plant
Brown Elfin	blueberries	Acadian Hairstreak	willows
Pink-edged Sulphur	blueberries	Compton Tortoiseshell	Birches, willows, elm
Henry's Elfin	redbud	Green Comma	birches and willows
Hoary Elfin	trailing arbutus	Coral Hairstreak	wild cherry
Juniper Hairstreak	red cedar	Early Hairstreak	beech and beaked hazelnut
Gray Comma	currants	Edward's Hairstreak	scrub oak
Pipevine Swallowtail	pipevines	Oak Hairstreak	oaks
Zebra Swallowtail	pawpaw		
Wet meadows and wetlands, caterpillars feed on flowering plants or shrubs			
Common Name	Caterpillar Food Plant	Common Name	Host Plant
Atlantis Fritillary	violets	Baltimore Checkerspot*	turtlehead*
Silver-bordered Fritillary	violets	Harris' Checkerspot	flat-topped white aster
Bronze Copper	docks	Bog Copper	cranberries
Harvester	caterpillars feed on wooly aphids, typically those on alders or beech	<i>*Some populations of Baltimores have caterpillars feeding in uplands on narrowleaf plantain or yellow false foxglove. Mature caterpillars will feed on additional plants.</i>	
Wet meadows and wetlands, caterpillars feed on wetland grasses or sedges			
Common Name	Caterpillar Food Plant	Common Name	Host Plant
Arctic Skipper	grasses, esp. blue joint grass	Eyed Brown	sedges
Black Dash	sedges	Long Dash	grasses
Broad-winged Skipper	sedges and common reed	Mulberry Wing	sedges
Dion Skipper	sedges	Two-spotted Skipper	sedges

Find Native and Local Plants

Native Plants

The best plants for pollinators are native to the local region and appropriate for site conditions. The U.S. Forest Service's [Attracting Pollinators to Your Garden Using Native Plants](#) provides a good introduction and overview to gardening for pollinators, from plant selection to providing artificial nest sites. Helpful guides for selecting plants include the Xerces Societies' [Pollinator Plants for the Great Lakes Region](#) (covers the northwest half of the state) and [Pollinator Plants for the Mid-Atlantic Region](#) (covers the southeast half of the state). This guide to the [Pollinator-Friendly Plants for the Northeast United States](#) by the USDA Natural Resource Conservation Service (NRCS) includes large photos that showcase some beautiful native plant options for gardening enthusiasts. DCNR provides great tools for picking plants including their Landscaping with Native Plants [webpage](#) and [brochure](#) and these [Native Garden Templates](#).

Many garden centers have native plants for sale, but the term 'native' covers a lot of territory if it means that the plant is native to the United States. A plant that is native to Florida or even a closer state like New Jersey may not occur naturally in the wild in Pennsylvania. It is also common to find cultivars of native plants which are bred to be showy but may be less beneficial for wildlife. There are nurseries that specialize in native plants, and they can help landowners find the best native plants for their property. DCNR maintains a list of resources for finding a [Native Plant Nursery](#) throughout the state. Knowledgeable nursery staff will also be able to provide information on the 'provenance' of the plant. Provenance refers to where an individual plant and the previous generations that produced it came from. Stock grown from the seeds of plants that originated in Pennsylvania is preferred over stock grown from plants that originated elsewhere in the U.S. or abroad. Please see the section '[Find Local Plants](#)' for more information related to picking plants that are best suited to your location.

If you are interested in a specific plant and want to know if it is native to Pennsylvania, the [North American Plant Atlas \(NAPA\)](#) through the Biota of North America project is one way to get this information. The Pennsylvania Flora Project used to be an excellent source of plant information and county level range maps, but this website is no longer maintained. To look up a plant in NAPA, click on 'BONAP Maps by States and Provinces' under [U.S. County Maps](#). Click on Pennsylvania (PA) in the country map, or select it from the list of state names. A list of genera known from PA will be listed at the bottom of the window. Click on a genus (e.g. *Asclepias*), and range maps for all the species of milkweed (*Asclepias* spp.) known from PA will appear. Click on the map for a species to get a larger scale image to inspect known distribution of a plant at the state and county level.

There is a [NAPA map color key](#) for interpreting range maps. The word 'exotic' is used to indicate a plant that is not native to PA. Exotic species are blue (e.g. [Japanese stiltgrass](#)); noxious weeds are hot pink (e.g. [Canadian thistle](#)). The ranges of native species are shown in dark green. Even if a particular plant is only found in one county in PA, the whole state will be colored dark green to indicate the plant is native at the state level. Counties highlighted in bright green coloring show counties where a plant species occurs AND it is not rare in that county (e.g. [common milkweed](#)). The distribution maps can be used to determine how common the plant is known from your region of PA. This [Physiographic](#)

[Provinces of Pennsylvania](#) map shows all the unique regions of the state. If you live in the Ridge and Valley Section of PA and want to grow a bee balm, for example, you might select [scarlet beebalm](#) which grows naturally in the Ridge and Valley, over [spotted bee balm](#) which does not. Counties with only a few known records for a particular plant are highlighted in bright yellow. ‘Adventive’ plants are those that are historically native to the U.S. but not to PA, like [Purple Coneflower](#). If any PA counties show a plant as being adventive, it is probably safe to assume it is adventive wherever it occurs in PA.

Local Plants

After you come up with a list of plants that are found in nature in Pennsylvania, you can go a step further and look for plants that were grown from stock originating in Pennsylvania. There are many reasons to look for plants whose provenance is from a location as close to your site as possible. Local plants are best prepared to thrive in local climate, soils, and precipitation conditions. This leads to better overall plant health, including germination, survivorship, flowering, and seed set. For example, a red maple seedling whose ancestors originated in the Ridge and Valley of Pennsylvania will carry with it adaptations in its genetic blueprint that help it thrive in that region of Pennsylvania. You could plant a red maple seedling whose ancestors originated in the Everglades of Florida, but that seedling will carry adaptations to very different soil and climatic conditions.

Finding seed or plants grown from parent plants with local provenance will require some detective work, but as more people request plant material grown from local plants, the more available they will become. Try to find plants with a provenance as close to your location as possible, preferably within Pennsylvania, or at a minimum from within the [Northeastern US or mid-Atlantic region](#). You can talk to a nursery about growing stock for you from seeds collected locally. There are rules governing plant collection, especially if you want to gather material from state lands. Please be sure to obtain permission from the landowner before gathering any plant material, including seeds or stem cuttings.

Table 5 ‘*Native Plant Recommendations*’ lists native plants that provide nectar and pollen for adults and/or serve as food plants for the young. This is not an exhaustive list of all the important pollinator plants in Pennsylvania. It provides a representative selection of Pennsylvania native species across a range of flower shapes and colors, habitats, and blooming seasons. Regional pollinator planting guides and other pollinator research and literature was consulted. Only plants that occur naturally in the wild in Pennsylvania were included on this list. Species that naturally occur statewide were preferentially selected. Species with extremely limited distributions in Pennsylvania were generally avoided unless they are known to serve as a host plant for a rare pollinator species.



Figure 6. A bumble bee crawls into a turtlehead flower (*Chelone glabra*). The foliage of turtlehead is the preferred host plant for Baltimore checkerspot, a butterfly of conservation concern in Pennsylvania.

Table 5. Recommendations of native flowering plants, shrubs, and trees in Pennsylvania.

SRING	SUMMER	FALL
The first pollinators appear early in the spring and need to quickly find energy rich nectar. Foundress bumble bee queens emerge from hibernation and seek nectar and pollen to begin the work of building their colony.	As spring progresses into summer, new species of butterflies and bees become active. Long lived insects need a variety of native plants that provide a continuous progression flowers	Flowers remain a critical resource in the fall. Bees must build up their energy reserves before winter. Migratory hummingbirds and monarchs visit flowers to refuel as they fly long distances to wintering grounds.

Table 5. Herbaceous Plants

Scientific Name	Common Name	Habitat	Spring Mar-May	Summer Jun-Aug	Fall Sep-Nov
<i>Agastache scrophulariifolia</i>	purple giant hyssop	Wetland		X	X
<i>Amianthium muscaetoxicum</i>	fly-poison	Upland	X	X	
<i>Anemone virginiana</i>	tall anemone	Upland		X	
<i>Apocynum cannabinum</i>	common dogbane	Upland		X	
<i>Arabis canadensis</i>	sicklepod	Upland	X	X	
<i>Arabis laevigata</i>	smooth rockcress	Upland	X	X	
<i>Arabis lyrata</i>	lyre-leaved rockcress	Upland	X	X	
<i>Aristolochia macrophylla</i>	Dutchman's pipe	Upland	X	X	
<i>Aristolochia serpentaria</i>	Virginia snakeroot	Upland	X	X	
<i>Aruncus dioicus</i>	goat's beard	Upland	X		
<i>Asclepias incarnata</i>	swamp milkweed	Wetland		X	
<i>Asclepias syriaca</i>	common milkweed	Upland		X	
<i>Asclepias tuberosa</i>	butterfly milkweed	Upland		X	
<i>Aureolaria flava</i>	smooth yellow false foxglove	Upland		X	X
<i>Aureolaria pedicularia</i>	cut-leaf false foxglove	Upland		X	X
<i>Baptisia tinctoria</i>	wild indigo	Upland	X	X	
<i>Caltha palustris</i>	marsh-marigold	Wetland	X	X	
<i>Cardamine concatenata</i>	cutleaf toothwort	Upland	X		
<i>Cardamine diphylla</i>	two-leaved toothwort	Upland	X	X	
<i>Cardamine pensylvanica</i>	Pennsylvania bittercress	Wetland	X	X	
<i>Cerastium nutans</i>	nodding chickweed	Upland	X	X	
<i>Chamaecrista fasciculata</i>	partridge pea	Upland		X	
<i>Chelone glabra</i>	white turtlehead	Transition		X	X
<i>Cirsium discolor</i>	field thistle	Upland		X	X
<i>Cirsium muticum</i>	swamp thistle	Wetland		X	X
<i>Cirsium pumilum</i>	pasture thistle	Upland		X	
<i>Claytonia virginica</i>	spring-beauty	Upland	X		
<i>Collinsonia canadensis</i>	horse balm	Upland		X	X
<i>Coreopsis tripteris</i>	tall tickseed	Upland		X	X
<i>Dicentra canadensis</i>	squirrel-corn	Upland	X		

Table 5. Herbaceous Plants Continued

Scientific Name	Common Name	Habitat	Spring Mar-May	Summer Jun-Aug	Fall Sep-Nov
Dicentra cucullaria	dutchman's-breeches	Upland	X		
Doellingeria umbellata	flat top white aster	Wetland		X	X
Erigeron pulchellus	Robin's plantain	Upland	X	X	
Erythronium americanum	yellow trout-lily	Upland	X		
Eupatorium perfoliatum	boneset	Wetland		X	X
Eurybia divaricata	white wood aster	Upland		X	X
Eurybia macrophylla	big leaf aster	Upland		X	X
Euthamia graminifolia	grass-leaved goldenrod	Upland		X	X
Eutrochium fistulosum	hollow joe-pye weed	Wetland		X	X
Eutrochium purpureum	sweet-scented joe-pye weed	Transition		X	X
Gentiana andrewsii	bottle gentian	Transition		X	X
Helenium autumnale	common sneezeweed	Wetland		X	X
Helianthus decapetalus	thin-leaved sunflower	Upland		X	X
Heliopsis helianthoides	ox-eye sunflower	Upland		X	
Hibiscus moscheutos	rose-mallow	Wetland		X	X
Houstonia caerulea	bluets	Upland	X		
Liatris spicata	blazing-star	Upland		X	
Lobelia cardinalis	cardinal flower	Wetland		X	X
Lobelia siphilitica	great blue lobelia	Wetland		X	X
Lupinus perennis	blue lupine	Upland	X	X	
Lysimachia ciliata	fringed loosestrife	Wetland		X	X
Lysimachia terrestris	swamp-candles	Wetland		X	
Mertensia virginica	Virginia bluebells	Upland	X		
Mimulus ringens	monkey flower	Wetland		X	X
Monarda didyma	scarlet beebalm	Wetland		X	
Monarda fistulosa	wild bergamot	Upland		X	X
Monarda media	purple bergamot	Transition		X	X
Oenothera biennis	common evening primrose	Upland		X	X
Packera aurea	golden ragwort	Transition	X		
Packera obovata	roundleaf ragwort	Upland	X		
Penstemon digitalis	tall white beardtongue	Upland	X	X	
Penstemon hirsutus	hairy beardtongue	Upland	X	X	
Phaseolus polystachios	thicket bean	Upland		X	X
Phlox maculata	meadow phlox	Transition		X	X
Phlox paniculata	summer phlox	Upland		X	
Phlox subulata	moss-pink	Upland	X		
Physalis heterophylla	clammy ground cherry	Upland		X	
Podophyllum peltatum	Mayapple	Upland	X		
Pontederia cordata	pickerel-weed	Wetland		X	X
Potentilla canadensis	common cinquefoil	Upland	X	X	

Table 5. Herbaceous Plants Continued

<i>Pycnanthemum incanum</i>	hoary mountainmint	Upland		X	X
<i>Pycnanthemum muticum</i>	clustered mountainmint	Upland		X	X
<i>Pycnanthemum tenuifolium</i>	narrowleaf mountainmint	Transition		X	X
<i>Rubus allegheniensis</i>	common blackberry	Upland	X	X	
<i>Rubus flagellaris</i>	prickly dewberry	Upland	X	X	
<i>Rubus hispidus</i>	swamp dewberry	Wetland		X	
<i>Rubus occidentalis</i>	black raspberry	Upland	X		
<i>Rubus odoratus</i>	purple-flowering raspberry	Upland		X	
<i>Rubus pensilvanicus</i>	Pennsylvania blackberry	Upland	X		
<i>Rudbeckia hirta</i>	black-eyed susan	Upland		X	X
<i>Rudbeckia laciniata</i>	cutleaf coneflower	Transition		X	X
<i>Salvia lyrata</i>	lyre-leaved sage	Upland	X	X	
<i>Scutellaria incana</i>	downy skullcap	Upland		X	
<i>Scutellaria lateriflora</i>	mad-dog skullcap	Upland		X	X
<i>Sedum ternatum</i>	wild stonecrop	Upland	X	X	
<i>Senna hebecarpa</i>	northern wild senna	Upland		X	
<i>Solidago caesia</i>	bluestem goldenrod	Upland		X	X
<i>Solidago juncea</i>	early goldenrod	Upland		X	X
<i>Solidago nemoralis</i>	gray goldenrod	Upland		X	X
<i>Solidago patula</i>	rough-leaved goldenrod	Wetland			X
<i>Solidago speciosa</i>	showy goldenrod	Upland		X	X
<i>Symphotrichum laeve</i>	smooth blue aster	Upland		X	X
<i>Symphotrichum lateriflorum</i>	calico aster	Upland		X	X
<i>Symphotrichum novae-angliae</i>	New England aster	Upland		X	X
<i>Symphotrichum prenanthoides</i>	zigzag aster	Upland		X	X
<i>Thalictrum pubescens</i>	tall meadow-rue	Wetland		X	
<i>Thalictrum thalictroides</i>	rue anemone	Upland	X		
<i>Tiarella cordifolia</i>	foamflower	Upland	X		
<i>Tradescantia virginiana</i>	Virginia spiderwort	Upland	X	X	
<i>Trillium erectum</i>	red or purple trillium	Upland	X		
<i>Trillium undulatum</i>	painted trillium	Transition	X		
<i>Verbena hastata</i>	blue vervain	Wetland		X	
<i>Verbesina alternifolia</i>	wingstem	Transition		X	X
<i>Vernonia noveboracensis</i>	New York ironweed	Wetland		X	X
<i>Veronicastrum virginicum</i>	Culver's root	Upland	X	X	
<i>Viola blanda</i>	sweet white violet	Transition	X		
<i>Viola cucullata</i>	blue marsh violet	Wetland	X	X	
<i>Viola eriocarpa</i>	smooth yellow violet	Upland	X		
<i>Viola sagittata</i>	arrow-leaved violet	Upland	X	X	
<i>Viola sororia</i>	common blue violet	Upland	X		
<i>Zizia aptera</i>	meadow zizia	Upland	X		
<i>Zizia aurea</i>	golden alexanders	Upland	X	X	

Table 5. Shrubs and Trees

Scientific Name	Common Name	Category	Spring Mar-May	Summer Jun-Aug	Fall Sep- Nov
<i>Alnus serrulata</i>	smooth alder	Wetland tall shrub	X		
<i>Amelanchier arborea</i>	downy serviceberry	Upland understory tree	X		
<i>Amelanchier laevis</i>	smooth serviceberry	Upland understory tree	X		
<i>Amorpha fruticosa</i>	false indigo	Transition medium shrub	X	X	
<i>Asimina triloba</i>	pawpaw	Upland understory tree	X		
<i>Photinia melanocarpa</i>	black chokeberry	Upland small shrub	X		
<i>Photinia pyrifolia</i>	red chokeberry	Wetland medium shrub	X		
<i>Ceanothus americanus</i>	New Jersey tea	Upland small shrub		X	
<i>Cephalanthus occidentalis</i>	buttonbush	Wetland medium shrub		X	
<i>Cercis canadensis</i>	redbud	Upland understory tree	X		
<i>Cornus alternifolia</i>	alternate-leaved dogwood	Upland understory tree	X	X	
<i>Cornus racemosa</i>	gray dogwood	Transition medium shrub	X	X	
<i>Corylus cornuta</i>	beaked hazelnut	Upland medium shrub	X		
<i>Crataegus crus-galli</i>	cockspur hawthorn	Upland tree	X		
<i>Epigaea repens</i>	trailing arbutus	Upland low shrub	X		
<i>Gaylussacia baccata</i>	black huckleberry	Upland low shrub	X	X	
<i>Hamamelis virginiana</i>	witch hazel	Upland tall shrub			X
<i>Kalmia latifolia</i>	mountain laurel	Shrub, medium	X		
<i>Lyonia ligustrina</i>	maleberry	Transition medium shrub		X	
<i>Physocarpus opulifolius</i>	ninebark	Transition shrub medium	X	X	
<i>Prunus americana</i>	wild plum	Upland small tree	X		
<i>Prunus pensylvanica</i>	pin cherry	Upland small tree	X		
<i>Prunus serotina</i>	wild black cherry	Upland tree	X	X	
<i>Prunus virginiana</i>	choke cherry	Upland small tree	X		
<i>Rhododendron maximum</i>	rosebay	Upland tall shrub		X	
<i>Rhododendron periclymenoides</i>	pink azalea	Upland medium shrub	X	X	
<i>Ribes americanum</i>	black currant	Upland medium shrub	X		
<i>Salix discolor</i>	pussy willow	Transition medium shrub	X		
<i>Salix nigra</i>	black willow	Wetland tree	X		
<i>Spiraea alba</i>	narrow-leaved meadow-sweet	Wetland low shrub		X	X
<i>Tilia americana</i>	basswood	Upland tree		X	
<i>Vaccinium angustifolium</i>	low sweet blueberry	Upland low shrub	X	X	
<i>Vaccinium corymbosum</i>	highbush blueberry	Wetland medium shrub	X		
<i>Vaccinium macrocarpon</i>	large cranberry	Wetland low shrub		X	
<i>Vaccinium pallidum</i>	lowbush blueberry	Upland low shrub	X	X	
<i>Vaccinium stamineum</i>	deerberry	Upland low shrub	X	X	
<i>Viburnum acerifolium</i>	maple-leaved viburnum	Upland low shrub		X	
<i>Viburnum lentago</i>	nannyberry	Transition medium shrub	X	X	
<i>Viburnum prunifolium</i>	black haw	Upland tall shrub	X	X	
<i>Viburnum recognitum</i>	northern arrowwood	Wetland medium shrub	X	X	

Books and Other Publications

- Allen, T. 1997. The Butterflies of West Virginia and Their Caterpillars. University of Pittsburgh Press, Pittsburgh.
- Donovall, L. and D. VanEngelsdorp. 2010. A Checklist of the Bees (Hymenoptera: Apoidea) of Pennsylvania. Journal of the Kansas Entomological Society 83(1):7-24.
- Holm, H. 2014. Pollinators of Native Plants: Attract, Observe and Identify Pollinators and Beneficial Insects with Native Plants. Pollination Press LLC, Minnetonka, MN.
- Leppo, B., D. Lieb, M. Walsh, N. Welte, P. Woods. 2015. Invertebrate Assessment for the 2015 Pennsylvania Wildlife Action Plan Revision. Final report for State Wildlife Grant F14AF00255 to the Pennsylvania Fish and Boat Commission.
- Monroe, J. and D. Wright. 2017. Butterflies of Pennsylvania: A Field Guide. University of Pittsburgh Press, Pittsburgh, PA. 33pp. [Publication date:28Apr2017].
- Tallamy, D. W. 2009. Bringing Nature Home: How You Can Sustain Wildlife with Native Plants. Timber Press, Portland, Oregon.
- Wagner, David. 2005. Caterpillars of Eastern North America. Princeton University Press, Princeton, New Jersey.

Online Resources

Pollinator Conservation and Habitat Management

- Attracting Pollinators to Your Garden Using Native Plants
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd548063.pdf
- Benefitting Pollinators on Pennsylvania State Forest Lands
http://elibrary.dcnr.pa.gov/PDFProvider.ashx?action=PDFStream&docID=1742684&chksum=&revision=0&docName=sf-Native_Plants_PollinatorHabitat&nativeExt=pdf&PromptToSave=False&Size=482607&ViewerMode=2&overlay=0
- Conservation and Management of North American Bumble Bees
<https://www.natureserve.org/sites/default/files/publications/files/cons-mgmt-na-bumblebees-web-rev.pdf>
- Conservation and Management of North American Mason Bees
http://www.natureserve.org/sites/default/files/web_-_natureserve_osmia_report_brochure.pdf
- Conserving Wild Bees in Pennsylvania
<https://extension.psu.edu/conserving-wild-bees-in-pennsylvania#:~:text=Ways%20to%20Enhance%20Wild%20Bees,reducing%20bee%20exposure%20to%20pesticides>
- Illinois Wildflowers - Insect Visitors of Wildflowers
http://www.illinoiswildflowers.info/flower_insects/index.htm
- Illinois Wildflowers - Plant Feeding Insect Database
http://www.illinoiswildflowers.info/plant_insects/database.html

- Organic Farming Practices – Reducing Harm to Pollinators from Farming
https://xerces.org/sites/default/files/2018-05/13-052_02_XercesSoc_Organic-Farming-Practices_web.pdf
- Pollinator Biology and Habitat
https://efotg.sc.egov.usda.gov/references/public/MI/Biol_TN_20_Pollinator-Biology-and-Habitat_v1-1_honey_bee_preferences.pdf
- Pollinators in Natural Areas: A Primer on Habitat Management
https://xerces.org/sites/default/files/2018-05/13-003_02_XercesSoc_Pollinators-in-Natural-Areas_web.pdf
- Pollinator Plants for the Northeast United States
<https://www.nrcs.usda.gov/plantmaterials/nypmctn11164.pdf>
- Pollinator Plants for the Great Lakes Region (includes NW half of Pennsylvania)
<https://xerces.org/publications/plant-lists/pollinator-plants-great-lakes-region>
- Pollinator Plants for the Mid-Atlantic Region (includes SE half of Pennsylvania)
<https://xerces.org/publications/plant-lists/pollinator-plants-mid-atlantic-region>

Invasive Plants

- Pennsylvania Invasive Species Website
<https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx>
- Pennsylvania Invasive Plant List
https://elibrary.dcnr.pa.gov/GetDocument?docId=2700788&DocName=dcnr_20033786.pdf
- Pennsylvania Invasive Plant Factsheets
<http://www.dcnr.state.pa.us/forestry/plants/invasiveplants/>
- Pennsylvania Invasive Plants of Riparian Areas
<https://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/streamreleaf/Docs/Invasive%20Plants.pdf>
- Plant Conservation Alliance Alien Plant Fact Sheets
<https://www.invasive.org/alien/factmain.htm>
- Safe Herbicide Handling in Natural Areas: A Guide for Land and Volunteer Stewards
<http://www.invasive.org/gist/products/library/herbsafe.pdf>
- Upkeep and Maintenance of Herbicide Equipment: A Guide for Natural Area Stewards
<http://www.invasive.org/gist/products/library/herbupkeep.pdf>
- Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas
<http://www.invasive.org/gist/products/handbook/methods-handbook.pdf>

Native Plants

- Illinois Wildflowers – plant descriptions, cultivation notes, and faunal associations, group by habitat type (woodland, wetland, weedy, prairie, savanna and thicket)
<http://www.illinoiswildflowers.info/index.htm>
- DCNR Landscaping with Native Plants in Pennsylvania Brochure
http://elibrary.dcnr.pa.gov/GetDocument?docId=1742582&DocName=sf-Native_Plants_Landscaping-brochure.pdf

- DCNR Landscaping with Native Plants in Pennsylvania Website
<https://www.dcnr.pa.gov/Conservation/WildPlants/LandscapingwithNativePlants/Pages/default.aspx>
- DCNR Native Garden Templates
<https://www.dcnr.pa.gov/Conservation/WildPlants/LandscapingwithNativePlants/Pages/default.aspx>
- Native Plant Nurseries
<https://www.dcnr.pa.gov/Conservation/WildPlants/LandscapingwithNativePlants/BuyNativePlants/Pages/default.aspx>
- North American Plant Atlas through the Biota of North America Pennsylvania Flora Project
<http://bonap.net/napa>
- Pennsylvania Native Plant Society
www.pawildflower.org
- Planting and Seeding Guidelines, Pennsylvania Bureau of Forestry
http://elibrary.dcnr.pa.gov/GetDocument?docId=1742696&DocName=sf-BOF_Planting-Seeding_Guidelines.pdf

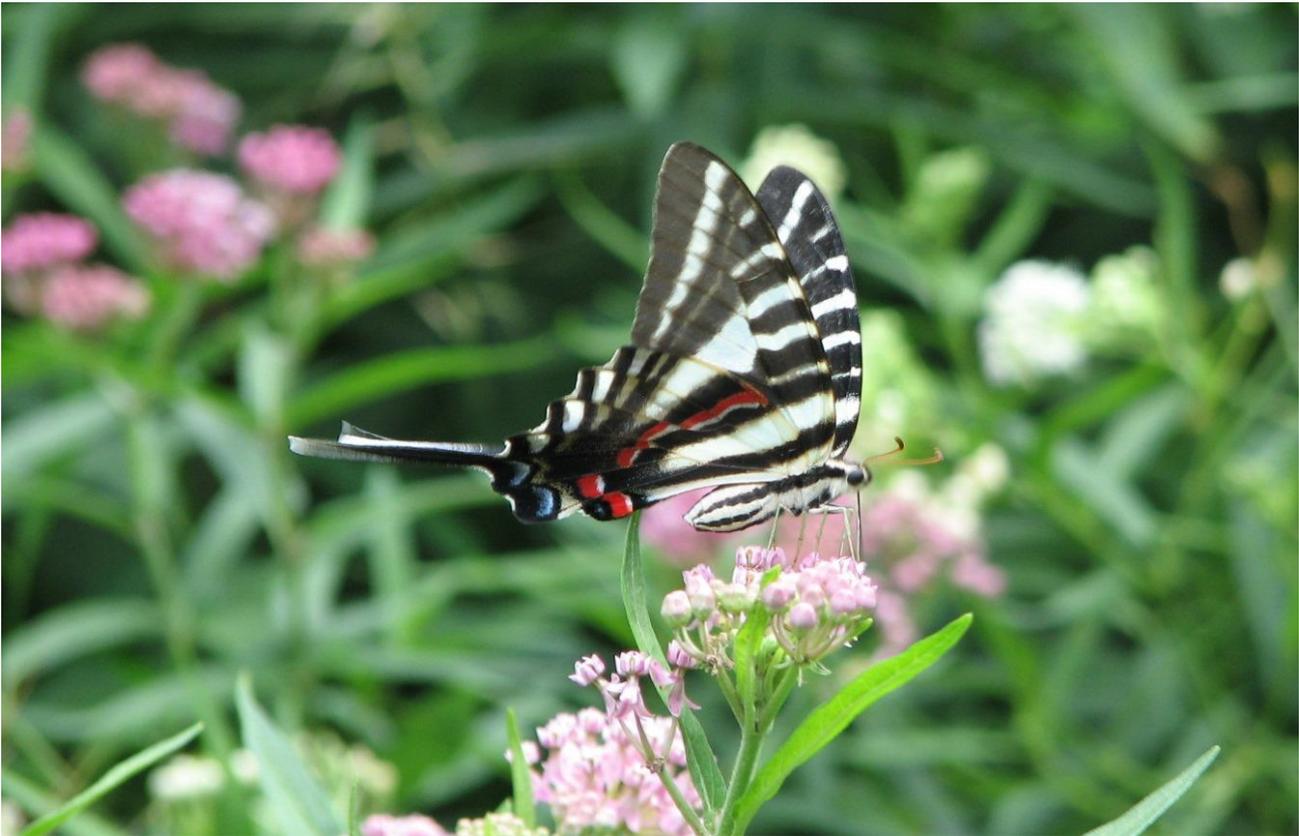


Figure 7. Zebra swallowtail (*Eurytides marcellus*) adults love to nectar on a variety of flowers, but their caterpillars can only feed on the leaves of pawpaw trees (*Asimina triloba*).

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