

**Title:**                   **Attracting Pollinators to the Meadow Garden**  
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**Date:**                   **April 2010**

**Abstract:**

The Meadow Garden at the Morris Arboretum was planted in 2002 and was in need of a make-over by 2010. Invasive grasses had become dominant in the landscape and did not provide an aesthetically pleasing or welcoming atmosphere for visitors. The new design for the Meadow Garden has three goals. The first is to attract pollinators to the garden with attractive perennials, woody plants, grasses and bulbs that are native to the United States. Attracting pollinators and educating visitors about the role they have in the environment is important because the number of pollinators worldwide has been declining in recent history due to urbanization, farming and global warming.

The second goal is to focus the Meadow Garden around the paved garden loop road so anyone who walks along the road, including people with strollers and wheelchairs, will have the feeling of walking through the Meadow Garden. The final goal is to make the Meadow Garden easy to maintain by using plants that do not need much care and are non-invasive. These goals will make the area an attractive destination in the Arboretum as well as a valuable place to educate visitors about pollination.

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## **INTRODUCTION**

National and international studies and surveys have shown global urbanization, agriculture and climate change are severely threatening populations of pollinators by removing natural habitats, increasing the use of pesticides and changing the growing season. To mitigate this drastic situation it is important that the global community make a huge effort to restore and maintain pollinator species and the plants that depend upon them for pollination. The Arboretum is already a prime example of an oasis for pollinators in an urban environment and should strive to teach the community about the importance of pollinators and how to create pollinator friendly habitats. Creating a garden within the Arboretum designed to attract pollinators is a perfect way to do this and the Meadow Garden is a prime location. Hopefully, visitors will find the flowers, grasses, and shrubs within the newly designed Meadow Garden attractive and bring home ideas for their own gardens.

## **IMPORTANACE OF POLLINATORS**

Plants rely on pollinators to fertilize them by carrying pollen from one plant to another. This relationship is imperative for the survival of future generations of plants as well as the survival of a majority of the food crops the human population depends on for survival. Planting an area with plants that attract all sorts of organisms is very beneficial to the entire ecosystem. Even if an organism is a carnivore and doesn't eat plant material itself its prey probably is an herbivore. Thus, both predator and prey rely on plants for survival. Reliance on plants continues up the food web. It is important to plant a diversity of plant species in order to attract and maintain a diversity of animal species.

Pollinator species and the overall number of pollinators are decreasing in the United States. Urbanization and agriculture are the top two culprits responsible for this decline. As the human population expands, natural areas succumb to houses, schools, malls and other structures required for civilization. Many of these buildings are designed with little to no regard for the plants and animals that once lived there. Landscaping in developments, both commercial and residential, are often just a few ill planted species that are area fillers; nothing ascetically appealing or designed to attracted native fauna. Or landscapes are vast expanses of non-descript lawn drenched in pesticides and fertilizers. Changing the ideas of landscapers and the general public in order to change developed landscapes is important to making urban areas better habitats for pollinators.

The decline of pollinators has been more strongly addressed within the agricultural world because many crops depend on pollinators for fertilization and eventual fruit set. Such dependency results in pollinators being responsible for three bites in every four a person takes. Without pollinators humans, as well as all other herbivorous species would be reduced to eating only wind pollinated crops; mainly corn, wheat and rice. This would be a very dull diet indeed. Pollination by hand, already practiced in areas where pollinating species have become extinct due to over use of pesticides, is a painstaking process that require lots of human labor.

Honey bees are the most important pollinator for crop plants. Bee hives and their keepers travel all around the nation pollinating crops as they come into flower. Such a huge influx of pollinators at the exact flowering time enables huge crop yields that would not be possible otherwise. Frighteningly, in 2006 and 2007 beekeepers in the United States, Europe and South America found hives empty of adult bees yet full of food and brood. This devastating phenomenon called Colony Collapse Disorder (CCD) caused farmers, beekeepers and scientists to frantically search for the reason and a solution. CCD is not fully understood but is most likely the result of multiple factors including mites, viruses, pesticide use and malnutrition in bees.

The decline in pollinators has lead to the establishment of organizations to promote pollinators welfare and educate the general public about the actions they can take at home. Promotion of pollinators is happening at all levels. In the community groups organize events like 'Pollinator Week,' which is in its fourth year as a national event. Money for studying pollinators, especially CCD was clearly defined in the most recent U.S. Farm Bill. Authors like Doug Tallamy, who wrote Bringing Nature Home, are advocating for people to install native plants into their home gardens in order to make them hospitable for pollinators.

Pollinators can be classified into two large groups: specialized pollinators and generalized pollinators. Specialized pollinators are species that have evolved in tandem with a particular plant and

pollinate only that species. Plant and pollinator relationships like this are usually found between tropical species where there is a long growing period. An example of specialized pollinators is long

tongue wasps, which are the only type of pollinators with the ability to reach the nectar in flowers with extremely long tubes. If a specialized pollinator were to become extinct it would be extremely difficult to restore ecological balance. However many plant species that rely on specialized pollinators have alternate methods of reproduction including cloning or self pollination so they would hopefully survive an extinction of their pollinator. Generalized pollinators will feed from many flower types and species. Nearly all pollinators in North America and Europe are generalized pollinators. Bees, wasps, beetles, hummingbirds, moths and butterflies are the main types of generalized pollinators. If one pollinator species were to disappear the plant would most likely survive. If all the generalized pollinators were to disappear the impact on flora would be drastic.

Bees may be the most well known of the pollinators. There are over 400 native bee species in the United States. Native bees are much better at pollinating native plants because they evolved together. Native bees can be divided into wood dwelling bees like mason, carpenter and leaf cutter bees, and soil dwelling bees like bumble, sweat and digger bees. Mason bees do not sting and so are a perfect species to promote in a public garden. Furthermore, their houses are attractive and add a permanent structure to the garden. Pollination bees have a short life span and spend many months of the year hibernation. Thus bees like houses in branch piles and bamboo where they will not be disturbed. Bees pollinate by ‘buzz pollination’. When on a flower, a bee can disengage its wing muscles, causing them to vibrate. The vibrations cause pollen to stick to the bee. When the bee flies to a new flower the pollen stuck to it will fertilize the new flower. This method of pollination is important for flowers with hard-to-reach stamens like blueberries.

Butterflies and moths are important in the ecosystem as pollinators and as a food source. It is easy to tell the two apart: moths have plume-like antennae whereas a butterfly’s antenna is knobby at the end. Butterflies are thought to prefer bright yellow or purple flowers like *Solidago*, *Helianthus* and *Asters*. Flowers pollinated by butterflies and moths typically have a landing platform and a narrow tube that allow only insects with long tongues to reach the nectar. Butterflies and moths frequent similar species of flowers, just at different times of day. In the larval caterpillar stage butterflies and moths are an important food source for birds, lizards, wasps and spiders.

Flowers and the nectar they contain are a plant’s way of advertising. Flower color, scent, nectar and flower morphology all have a part in attracting pollinators to flowers. Plants important for pollinators can be divided into three categories according to an article called “Pollination and Restoration” by Kingsley Dixon in *Science* (2009). Framework species are major sources of nectar and pollen. Bridging species provide nectar in times when it is otherwise scarce. Magnet species pair plants with attractive flowers with plants that have unattractive small flowers. In the future it is thought that pollinators will need to migrate between natural areas fragmented by urban development, thus having plants from each of these groups will be important for creating natural islands for pollinators. Plant species pollinated by generalized pollinators would be best for introduction or reintroduction into the urban landscape.

## **GARDEN DESIGN**

The Morris Arboretum's Meadow Garden was planted eight years ago and is in dire need of a makeover making it the perfect site for a garden to attract pollinators. Since its installation, the area has become overgrown and dominated by a few species. It is generally unattractive and uninviting to the visitor. The Meadow Garden is found between the Rose Garden and the Garden Railway along a well traveled part of the main garden loop road. Large plants on either side of the road have made the area a tight place for visitors and Arboretum vehicles to pass. Furthermore, the garden was hard to maintain. Large bed size made it hard to reach the center where inevitably a pokeweed was tauntingly out of reach. Canada thistle and creeping Charlie ran rampant over the paths. Weeding and herbicide spraying were unable to control these two weeds.

The new design for the Meadow Garden focuses on plants native to the Eastern United States that provide dietary interest for pollinators and visual interest for visitors. Plants used in the design will be a source of nectar, pollen, seeds and plant material for the birds, hummingbirds, bees, butterflies and beneficial insects like parasitic wasps.

Besides plant choice a few things will be done to make the area as hospitable as possible to pollinators. The garden will be covered in layers of leaf mold, not woodchips. This organic mulch will provide nutrients for plants and organisms who live underground like arthropods. In the fall when plants are finished flowering and begin to die back, all plant material will be left standing until spring when it will be mowed and left to further mulch the garden. Doing this provides habitat for pollinators and allows many insect species to overwinter successfully without disturbance.

The Meadow Garden is in a very sunny location, especially in the summer months. Soil testing done in 2001 by the Pennsylvania State University found the Meadow Garden had optimum to above-optimum phosphate, potash, magnesium and calcium levels. The pH level was 6.8, which is slightly acidic. The soil is defined a sandy clay-loam.

The hardscape design for the Meadow Garden focuses on making the garden loop road the central path through the garden. This path is used heavily by visitors as they go from the Rose Garden to the Garden Railway or visa versa. It is also a path used heavily by Arboretum vehicles and the intersection of vehicle and pedestrian traffic can lead to tricky situations. To help alleviate this problem, a pullout area will be created where there is currently a bench. The area will be enlarged so a stroller could easily fit and allow an Arboretum vehicle to pass by. In this area there will be a sign offering information on why pollinators are important and pictures of pollinator species you might see in the garden. The bench that had been in this pullout will be moved across the driveway and be set further back from traffic.

Through the largest section of the garden there will be a narrow footpath made of schist and red rock. Using rocks to make this pathway will hopefully clearly delineate the pathway from the garden bed and keep weeds from being as persistent as they were with wood chip pathways. This path will allow visitors to get a closer view of many of the plants and pollinators without harming anything. It will also make the garden easier to maintain. Along the path a bench will offer visitors somewhere to sit and watch the ecosystem around them. It may also offer cold blooded insects a place to land and warm up in the sun.

The new Meadow Garden design features perennials and bulbs with a few woody plants and grasses to provide structure to the garden. Many of these plants are found on the list of "20 most valuable

woody and perennial native plant genera in terms of supporting biodiversity in the Mid Atlantic region” compiled by Doug Tallamy, a professor at Delaware University. Because the area is so small it would be impossible to plant large trees like *Quercus*, *Malus*, *Acer* and *Prunus* as Tallamy suggests, even though they support many more pollinator species than perennials are able to. Luckily, many species of these trees are found around the Meadow Garden, specifically *Malus*, since the crabapple slope is directly adjacent. This genera supports over 310 species of Lepidoptera alone and flower at the same time that mason bees emerge from their hives for the year. A few smaller woody plants will be planted in the Meadow Garden including *Hydrangea abervences*, *Symphoricarpos albus*, and *Cyrilla racemiflora*. These three shrubs support both nectar feeding pollinators and berry eating vectors. A few woody plants currently planted in the garden will remain including three *Cornus sercia* to provide winter interest, two *Caryopteris clandonensis* since they are loved by pollinators and a *Lespedeza bicolor*.

The perennials chosen for the new design are a variety of colors, shapes, and sizes to entice all kinds of pollinators. The design and layout of the garden is an attempt to create a natural looking area where one mass of plants runs seamlessly into the next. Along the slope by the steps there is an abundance of red flowers designed to attract hummingbirds including *Lobelia cardinalis*, *Monarda dydima* ‘Jacob Cline,’ *Salvia greggii* ‘Autumn sage,’ *Silene virginica* and continue with the reddish grass *Eragrostis spectabilis*. The abundance of red is punctuated by bright white *Phlox* ‘minnie pearl’ and pale lavender *Ruellia humillis*. Across the steps pink and lavender *Geranium sanguine* ‘Straiatum,’ *Boltonia asteroides* ‘Pink beauty,’ *Penstemon digitalis* ‘Sunburst amethyst’ and *Kalimeris* ‘blue star’ are accented by two *Cornus sericea* ‘Cardinal’ and tufts of *Muhlenbergia capillaries*.

In the main part of the Meadow Garden there will be a riot of different colors. Yellow *Helianthus augustifolia*, *Solidago rugosa x little lemon*, and *Heliopsis helianthoides* will contrast with *Veronica spicata* ‘Royal candles,’ *Asclepius purpurascens* and *Phlox paniculata* ‘blue paridise.’ *Achillea* ‘fireland,’ *Achillea* ‘terra cotta’ and *Asclepius tuberosa* add bright flashes of bright orange to the garden. Around the sign *Eryngium planum* will be prominent to display its color and texture. Finally, two grasses that stay clumped, *Pennisetum alopecuroides* ‘foxtrot’ and *Schizachyrium scoparium* ‘The Blues’ will be used to break up the design as well as offering winter interest.

Alliums are the main type of bulb chosen because they attract the most pollinators and bloom throughout the spring. A mixture of *Crocus* species along with *Galianthus nivalis* will provide cheerful color in the very early spring. Three *Narcissus* ‘Arctic gold,’ ‘Pacific coast’ and ‘Sailboat’ were chosen because of the variety of heights, sizes and flower types that they provide. *Hyacinthoides hispanica* ‘Queen of pinks’ and *Ipheion uniflorum* ‘Rolf Fiedle’ are chosen to provide blue contrast to the yellow narcissus.

Between the Meadow Garden and Baxter’s Memorial Plaza grass will be planted. A small garden bed right in front of the plaza will be planted with three white-out roses and the ground cover *Rubus calycinoides*. White roses would look particularly nice against the red brick of Baxter’s Memorial Plaza and the white-out rose would be especially low maintenance. *Rubus calycinoides* is a ground cover and will hopefully keep the weeds down under the roses.

## **CONCLUSION**

The installment of the Meadow Garden should make the area more appealing and a destination in the Arboretum for visitors. The variety of plant types, shapes and colors in the new design ensure year round interest and beauty. Using plants that are native to the United States and are important for the survival of pollinators gives the garden a focal point as well as providing the Arboretum with a fabulous opportunity to educate visitors of all ages about the significance of pollinators in the landscape. Hopefully, the new design will inspire visitors to bring pollinator friendly planting ideas home with them thus increasing pollinator habit.



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## PLANT LISTS

Perennials and woody plants

Scientific name	Common name	Color	Height (feet)
<i>Achillea 'fireland'</i>	Yarrow	Brick red	3
<i>Achillea 'terra cotta'</i>	Yarrow	Orange	2
<i>Agastache 'black adder'</i>		Dark blue	2.5
<i>Aquilegia canadensis</i>	Wild Columbine	Red	2
<i>Asclepius purpurascens</i>	Purple milkweed	rose, purple	3
<i>Asclepius tuberosa</i>	Butterfly weed	orange	2
<i>Aster novae-angliae</i>	New England aster	purple-rose	4
<i>Bostonian asteroides 'Pink beauty'</i>		pink	4
<i>Chelone lyonii 'Hotlips'</i>	Turtle head	pink	2
<i>Coreopsis v. moonbeam</i>	Tickseed	yellow	1
<i>Cyrilla racemiflora</i>	Titi	white	7
<i>Echinacea purpurea 'White swan'</i>	Coneflower		3
<i>Eragrostis spectabilis</i>	Purple love grass	pink	2
<i>Eryngium planum</i>	Sea holly	silver blue	4
<i>Geranium sanguineum 'Striatum'</i>	Geranium	pink	1
<i>Eupatorium dubium 'Little Joe'</i>	Joe-pye-weed	pink	4
<i>Helenium 'Mardi gras'</i>	Sneezeweed	yellow	3
<i>Helianthus angustifolius gold lace</i>		yellow	5
<i>Heliopsis belianthoides 'summer nights'</i>		yellow	4
<i>Hydrangea arborescence</i>	Smooth hydrangea	white	4
<i>Kalimeris incisa 'blue star'</i>		light blue	1
<i>Knautia macedonica</i>		red	2
<i>Liatris spicata</i>		Purple	4
<i>Lobelia cardinalis</i>	Cardinal flower	red	3
<i>Monarda didyma 'Jacob cline'</i>	Bee balm	red	4
<i>Monarda didyma 'raspberry wine'</i>	Bee balm	purple red	4
<i>Muhlenbergia capillaris</i>	Muhly grass	pink	3
<i>Pennisetum alopecuroides 'foxtrot'</i>		tan	4
<i>Penstemon digitalis 'Sunburst amethyst'</i>	Beard tongue	purple	3
<i>Phlox 'minnie pearl'</i>	Phlox	white	1
<i>Phlox paniculata 'blue paradise'</i>	Garden phlox	blue	2
<i>Rubus calycinooides</i>	Creeping raspberry	green	0.5
<i>Rudbeckia fulgida 'goldsturm'</i>	Brown eyed Susan	yellow	2
<i>Ruellia humilis</i>	Wild petunia	light purple	2
<i>Salvia gregii 'autumn sage'</i>	Autumn sage	red	3
<i>Scutellaria incana</i>	Hyssop skullcap	purple	3
<i>Silene virginica</i>	Fire pinks	red	1

<i>Solidago rugosa</i> × <i>little lemon</i>	Goldenrod	yellow	3
<i>Symphoricarpos</i> × <i>doorenbosii</i> <i>Amethyst</i> ('Kordes')	Snowberry		
<i>Veronica noveboracensis</i>	New York Ironweed	purple	6
<i>Veronica spicata</i> 'Royal candles'		purple	1
<i>Rosa white out</i>		white	4

#### Bulbs

Scientific name	Common Name	color	height
<i>Allium atropurpureum</i>	onion	dark purple	1'-2'
<i>Allium ceruleum</i>	onion	flax blue	12"-18"
<i>Allium neapolitanum</i>	onion	white	12-14"
<i>Allium unifolium</i>	onion	lavender	12"-18"
<i>Anemone coronaria</i>	anemone	red	8-10"
<i>Crocus chrysanthus</i> 'Cream beauty'	crocus	creamy white	3-6"
<i>Crocus species mixture</i>	crocus	lots	3-6"
<i>Crocus tommasinianus</i>	crocus	light purple	3-6"
<i>Ermurus</i> 'Cleopatra'	Foxtail lily	burnt orange	4-5'
<i>Galianthus nivalis</i>	snowdrop	white	4"-5"
<i>Hyacinthoides hispanica</i> 'Queen of pinks'	blue bells	soft lavender	8-12"
<i>Ipheion uniflorum</i> 'Rolf Fiedle'	star flower	deep blue	3-6"
<i>Leucojum aestivum</i>	summer snowflake	white	12-18"
<i>Narcissus</i> 'Arctic gold'	daffodil	goldenrod yellow	12"-16"
<i>Narcissus</i> 'Pacific coast'	daffodil- miniature	yellow	5"-6"
<i>Narcissus</i> 'Sailboat'	daffodil- jonquil	creamy white	10"-12"
<i>Triteleia ixioides</i> 'Starlight'		light yellow	20-24"

## PLANT BUDGET

### Perennials and woody plants

<b>Plant name</b>	<b>Quantity</b>	<b>Vendor</b>	<b>Price</b>	<b>Total</b>
<i>Achillea 'fireland'</i>	15	Clearview	4	60
<i>Achillea 'terra cotta'</i>	15	Clearview	3.65	54.75
<i>Agastache 'black adder'</i>	10	Russell	2.9	29
<i>Aquilegia canadensis</i>	20	Clearview	3.65	73
<i>Asclepius purpurascens</i>	12	Rudbud	5	60
<i>Asclepius tuberosa</i>	15	Clearview	4	60
<i>Aster novae-angliae</i>	15	Clearview	3.65	54.75
<i>Boltonia asteroides 'Pink beauty'</i>	12	Clearview	3.65	43.8
<i>Chelone lyonii 'Hotlips'</i>	15	Clearview	3.65	54.75
<i>Coreopsis v. moonbeam</i>	15	Clearview	3.65	54.75
<i>Cyrilla racemiflora</i>	1			0
<i>Echinacea purpurea 'White swan'</i>	15	Clearview	3.65	54.75
<i>Eragrostis spectabilis</i>	15	Russell	4.95	74.25
<i>Eryngium planum</i>	10	Clearview	4	40
<i>Eupatorium dubium 'Little joe'</i>	10	Clearview	3.65	36.5
<i>Geranium sanguineum 'Striatum'</i>	15	Clearview	4	60
<i>Helenium 'Mardi gras'</i>	10	Kurt Blumel	3.95	39.5
<i>Helianthus angustifolia gold lace</i>	10	Kurt Blumel	3.6	36
<i>Heliopsis helianthoides 'summer nights'</i>	15	Clearview	3.65	54.75
<i>Hydrangea arborescens</i>	1			0
<i>Kalimeris 'blue star'</i>	12	Clearview	4	48
<i>Knautia macedonica</i>	15	Clearview	3.65	54.75
<i>Liatris spicata</i>	10	Clearview	3.65	36.5
<i>Lobelia cardinalis</i>	15	Clearview	3.65	54.75
<i>Monarda didyma 'Jacob cline'</i>	15	Clearview	3.65	54.75
<i>Monarda didyma 'raspberry wine'</i>	15	Clearview	3.65	54.75
<i>Muhlenbergia capillaris</i>	10	Clearview	3.65	36.5
<i>Pennisetum alopecuroides 'foxtrot'</i>	12	Kurt Blumel	3.9	46.8
<i>Penstemon digitalis 'Sunburst amethyst'</i>	15	Clearview	3.65	54.75
<i>Phlox 'minnie pearl'</i>	15	Russell	3	45
<i>Phlox paniculata 'blue paradise'</i>	15	Russell	2.9	43.5
<i>Rubus calycinoides</i>	10	Northcreek	4	40
<i>Rudbeckia fulgida 'goldsturm'</i>	15	Clearview	3.65	54.75
<i>Ruellia humilis</i>	15	Russell	2.9	43.5
<i>Salvia gregii 'autumn sage'</i>	15	Kurt Blumel	3.6	54
<i>Scutellaria incana</i>	10	Redbud	7	70
<i>Silene virginica</i>	15	Russell	4	60

<i>Solidago rugosa</i> × <i>little lemon</i>	15	Russell	4	60
<i>Symphoricarpos</i> × <i>doorenbosii</i> <i>Amethyst</i> ( <i>Kordes</i> )	1			0
<i>Veronica noveboracensis</i>	15	Russell	3	45
<i>Veronica spicata</i> ' <i>Royal candles</i> '	15	Clearview	3.65	54.75
<i>Rosa white-out</i>	3	Conard- pyle	15	45
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Total				1997.6

#### Bulbs

<b>Scientific name</b>	<b>Number</b>	<b>Vendor</b>	<b>Price</b>
<i>Crocus chrysanthus</i> ' <i>Cream beauty</i> '	100	Brent and Becky's Bulbs	17
<i>Crocus species mixture</i>	100	Brent and Becky's Bulbs	25
<i>Crocus tommasinianus</i>	100	Brent and Becky's Bulbs	17
<i>Galanthus nivalis</i>	100	Brent and Becky's Bulbs	36
<i>Anemone coronaria</i>	100	Brent and Becky's Bulbs	25
<i>Hyacinthoides hispanica</i> ' <i>Queen of pinks</i> '	100	Brent and Becky's Bulbs	30
<i>Ipheion uniflorum</i> ' <i>Rolf Fiedle</i> '	100	Brent and Becky's Bulbs	17
<i>Narcissus</i> ' <i>Arctic gold</i> '	100	Brent and Becky's Bulbs	62
<i>Narcissus</i> ' <i>Pacific coast</i> '	100	Brent and Becky's Bulbs	30
<i>Narcissus</i> ' <i>Sailboat</i> '	100	Brent and Becky's Bulbs	43
<i>Leucojum aestivum</i>	100	Brent and Becky's Bulbs	56
<i>Allium atropurpureum</i>	100	Brent and Becky's Bulbs	43
<i>Allium neopolitanum</i>	100	Brent and Becky's Bulbs	17
<i>Allium ceruleum</i>	100	Brent and Becky's Bulbs	17
<i>Allium unifolium</i>	100	Brent and Becky's Bulbs	17
<i>Ermurus</i> ' <i>Cleopatra</i> '	50	Brent and Becky's Bulbs	113
<i>Triteleia ixioides</i> ' <i>Starlight</i> '	100	Brent and Becky's Bulbs	30
<hr/>			
Total			595

#### Interpretation