On The Fringe

Journal of the Native Plant Society of Northeastern Ohio

Program Schedule – Spring 2018

Wednesday, March 7, 7:00 – 8:30 pm – Beech Leaf Disease Update. The West Woods Nature Center of Geauga County. What's happening with our native Beech trees? Constance Hausmen, PhD., Plant and Restoration Ecologist with Cleveland Metroparks, will give an update on Beech Leaf Disease and how it is affecting Northeast Ohio woodlands. Presented in conjunction with the Geauga Park District. **Directions:** take St. Rt. 87 east from Rt. 306 in Russell Township approx. 2 miles to the park entrance on south side of the road. 9465 Kinsman road, Novelty, Ohio 44072. **No registration** required.

Saturday, May 26, 9:00 am – Noon – Padanarum Woods. Padanarum Woods is in Ashtabula County and is also known as State Line Woods. Jim Bissell, Curator of Botany at the Cleveland Museum of Natural History, leads this joint trip with NEON. This cold-woods on the eastern shoreline of Pymatuning Lake, harbors several rare plants, Jim expects to find more. **Directions**: Take US Rt. 6 to Andover Square. From Andover, travel north on US Rt. 6 (OH Rt. 7) 3.2 miles to the Padanarum Rd. intersection. Turn right (east) onto Padanarum Road and travel 2.4 miles to the boat launch. The parking area is on the north side of the road. The swamp is just north of the parking area. Padanarum Road intersects with Pymatuning Lake Road before it ends at the boat launch. Another way to access the swamp is to go east on Ohio Rt. 85 to the traffic light at the intersection of Pymatuning Lake Road, then north to Padanarum Road. **Registration:** email Judy at judysbarnhart@gmail.com.

Spring Weekly Wildflower Walks – Wednesdays at 6:30 pm
No registration is required for these walks. All walks will take place rain or shine.
These easy walks will explore the parade of spring blooming woodland flowers from the first skunk cabbage to the final waterleaf and wild geranium. **Guests are always welcome.**

April 11 – Veterans Park, Lake County. Explore the trails for signs of spring on this discovery walk led by Ohio Certified Volunteer Naturalist and board member Lisa Schlag. Managed by Lake Metroparks, Veterans Park protects the largest inland pond in Lake County and a remnant of original Ohio swamp forest. The asphalt, gravel, and natural trails are relatively flat. Be prepared for unpredictable Spring weather conditions. **Directions:** From I-90 take Exit 195 (Route 615, Center St) and head North on Center St. approximately 5 miles. Cross over SR 84 (Johnnycake Ridge Rd), US Route 20 (Mentor Ave), and Tyler Blvd. Then pass Mentor High School. Continue straight on Center St. Cross over Munson Rd intersection. (Do **not** follow 615 North signs bearing left.) At second stop sign, Center St. becomes Hopkins Rd. Veterans Park will be on west side of road, 5730 Hopkins Rd.

2018 Membership Renewal

You should have already received your 2018 renewal form. Please renew at the highest level you can. If you wish a printed copy of *On The Fringe* mailed to you, simply check the box to receive the printed journal and add $10 to your total.

Please also consider making a contribution to our endowment fund. This is the source of our Annual Grant and is a lasting tribute to our founder, Ann Malmquist.; with the low interest rates, we need to increase the principal.

☛ PLEASE RENEW NOW ☚

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On The Fringe

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The Mission of the Native Plant Society of Northeastern Ohio is to promote the study, appreciation and conservation of the native plants and plant communities of Ohio.

April 18 – Eagle Creek State Nature Preserve. See up to 70 species of spring wildflowers with Chuck Fletcher of the ODNR staff. **Directions:** The Preserve is at 11027 Hopkins Rd., Garrettsville OH, 44231. From Garrettsville go east on State Route 82 for two blocks to the flashing light. Turn left (north) at the light onto Center St., which becomes Center Road. Travel for 2.3 miles to Hopkins Road and turn right (south).

April 25 – Affelder property, The West Woods Geauga County. With Judy Barnhart see diverse spring flowers and, if it has rained recently, possibly a waterfall. **Directions:** The property is at 15139 Chillicothe Rd, Novelty, OH, on the east side a half mile south of St Rt 87. Drive all the way back from the road.

May 2 – North Chagrin Reservation, Cuyahoga County. Fred Losi leads us on the updated Sylvan Trail through the A.B. Williams Memorial Woods past the site of the first trailside museum. **Directions:** Meet at the A.B Williams Memorial Woods forest picnic area.

May 9 – Cleveland Metropark Hinckley Reservation, Medina County. Not only do the buzzards return in the spring, but so do the beautiful wildflowers. Ellen Armstrong Brown leads us on the bridle and buckeye trails along Johnson Creek then into the woods to discover early spring ephemerals. **Directions:** Meet at the Hinckley boathouse in Hinckley Reservation. 1 West Drive, Hinckley OH 44233, located between Bellus and State roads.

May 16 – Cleveland Lakefront Nature Preserve, Cuyahoga County. Wendy Weirich, Director of Outdoor Experiences with Cleveland Metroparks, leads this hike to see how nature has reclaimed this former disposal site for Cuyahoga River dredgings. Plenty of migrating birds. **Directions:** Exit I-90 at MLK Blvd. and go north toward Lake Erie. Follow Lakeshore Drive around (sign says to Bratenahl), take the first driveway on the left. 8701 Lakeshore Boulevard, N.E. Cleveland, OH 44108-1069, The sign out front says the Cleveland Lakefront Administration.

May 23 – Private Newbury Township Preserve, Geauga County. Meet at the front Horse Trailer parking of The West Woods 9465 Kinsman Road, Newbury, OH 44065. Carpool to a local property to see late spring flowers, the terrain is varied, with a trickling brook and sandstone ledges. The owner actively removes invasives.

May 30 – Headlands Beach State Nature Preserve, Lake County. Chuck Fletcher of the ODNR staff leads us along the sand dunes to look for beach pea and other dune plants. **Directions:** Located in Lake County west of Fairport Harbor at the north end of State Route 44 and the extreme east end of Headlands Beach State Park. 9601 Headlands Road, Mentor, OH 44060. Meet in the far east parking lot.



Perry Peskin
Winner of the First The Gentian Award in 2012



Upon the recent passing of Perry Peskin, the Journal editors thought it appropriate to reprint the citation accompanying the presentation of the Gentian award to Perry at the 2012 Annual Dinner:

We are proud to give Perry Peskin our first Gentian award. Our Society created the award to honor those in the community who have made a "significant contribution" to the mission and goals of the Society. The Society's mission is the study, appreciation, and conservation of the native plants and plant communities of Ohio.

Perry Peskin exemplifies our mission in a special way. There are many who through their occupation do much to foster that mission, but Perry's life shows that this mission can be pursued with dedication even by those who are not employed in the field of conservation, botany, or similar areas.

Perry was a teacher of English for many years in Cleveland-area schools. Nevertheless, he pursued the love of botany that he developed while wandering the hills of Cumberland, Maryland, where he grew up, and while he minored in biology at Case Western Reserve University.

Perry went on many nature walks over the years, and he turned what he learned and experienced on those walks into many articles and talks, sharing his knowledge and experience. He wrote more than a half-dozen articles for our Society's journal, *On The Fringe*. He also wrote for *Wildflower Magazine* and *Explorer*. Perry's botanical travels have taken him worldwide, and he wrote articles about many of his trips. He created a book from the portion of his articles that were about Ohio and the Midwest. The book is called *The Search for Lost Habitats*.

Perry shared his love of nature with others, not only through his own writing, but also through the writing assignments he gave his students. Often, he assigned his English students to take a walk and write about it. We are sure that he prompted many to see things in nature they never saw before.

So, for a lifetime of interest in native plants and for sharing his knowledge with others, we are delighted to honor Perry with this first Gentian Award.

Ohio Phenology Calendar, Ohio State University

Phenology is the study of recurring biological phenomena and their relationship to weather. Bird migration, hunting and gathering seasons, blooming of wildflowers and trees, and the seasonal appearance of insects are examples of phenological events that have been recorded for centuries. We have all observed that plants bloom earlier in warm springs. Insects also emerge earlier when a season is warm than when it is cool. Because the development of both plants and insects is temperature dependent, plants can accurately track the environmental factors that determine when insects are active. For this reason, plant phenology can be used to predict insect emergence. Indeed, the use of plant phenology to predict insect activity is an old practice, with recorded observations dating back at least 300 years. In fact, research at The Ohio State University has shown that plants bloom and insects emerge in virtually the same order every year, no matter what kind of weather occurred that winter or spring. For this reason, the flowering sequence of plants can be used as a biological calendar to predict insect activity and to time other gardening practices that are dependent on a particular stage of plant development, such as propagation or weed control.

The website (www.oardc.ohio-state.edu/gdd) is simple to use, just enter your Ohio zip code and the date. A daily calendar of all the phenologic events occurring in your area will pop up. It may be a plant, insect, or chemical. You will find out what is in bloom, and if you change the date to a future date, you see when flowers will be in bloom.

Native Groundcovers: Low-Growing Herbaceous Plants for Sun and Shade Gardens

By Claire Sawyers



Foam flower, Tiarella cordifolia, blooms in a naturalized setting. Picture taken from https://gnps.org/

Groundcovers are important elements in the designed garden. They fill the blank spaces of our beds and borders, knit together trees and shrubs, provide a "picture frame" for sculpture and other structures, and unify our plantings. We all know the big three: Japanese pachysandra, English ivy, and periwinkle. These are the most commonly used groundcovers in the American garden, and they fit the bill so well: They are easy to grow, rapidly spreading, inexpensive, readily available, and they create dense, low carpets of attractive foliage that persist throughout the year and keep out most weeds.

However, there's a problem: Two of these plants are major invasive species. English ivy, *Hedera helix*, rapidly invades forests in the East and Northwest, creating "ivy deserts" that smother and displace native understory flora. Periwinkle, *Vinca minor*, is also a common and harmful invader of U.S. forests. At the Scott Arboretum in Swarthmore, Pennsylvania, where I work, we have "blacklisted" both these plants and no longer recommend them to our visitors. What we do recommend is that gardeners replace their invasive exotic groundcovers with one or more of our very fine native groundcovers. These natives possess many or all of the traits that gardeners look for in a groundcover. And because they are native, they enhance local biodiversity rather than present a threat to it.

I should say that by "native" I mean indigenous to specific geographical regions. The plants discussed here are native to the eastern U.S. and generally hardy from USDA Zones 4 to 8. But they shouldn't be considered native plants in the South or West. What's more, just because they are eastern natives doesn't mean they will perform well in all situations there. Soil, moisture, and light all play key parts in determining a plant's success in the garden, whether it's a native or not.

Following is a selection of my favorite native herbaceous groundcovers, organized according to light requirements. There are many others I would profile if space allowed, including *Arex plantaginea* and native *Asarum* species, wild gingers. And of course, there are excellent native woody groundcovers worth consideration, such as the petite *Paxistima* species. But the point is to highlight the fact that many wonderful native groundcovers are out there, waiting for you to discover them.

Shade Plants

A good plant to start with is

Allegheny pachysandra, *Pachysandra procumbens.* Like its popular Japanese cousin, *Pachysandra terminalis,* this native produces rounded, coarsely toothed foliage on low fleshy stems, but it has a much greater flair for the dramatic, changing its look as the season progresses. In early spring, short spikes of small, fragrant white flowers appear amid the previous year's foliage and last for a week or two. Shortly after, new upright shoots the color of celery emerge. These grow about a foot tall and bear medium-green leaves that expand and darken over the course of the spring and summer. In the late summer to early fall, silver-gray mottling appears on the dark green leaves, adding another dimension to the color palette. Over the winter, the stems and leaves sink to the ground but generally remain evergreen. (In Zones 6 and lower, the foliage may die back completely.) In the spring, the cycle repeats. Allegheny pachysandra is a clumping plant and thus spreads more slowly than the stoloniferous Japanese species. Nonetheless, it spreads well: Several clusters in my home garden have doubled or tripled in breadth in a handful of years to give good cover. This native is easy to propagate from root divisions. Grow it in dry soil and full or dappled shade.

The genus *Phlox* is quintessentially North American: All but one of its more than 60 species are native to this continent. Quite a number of these have been grown and cherished as flowering perennials and rock garden plants, but there are several eastern species that also fit our expectations for groundcovers very well. *Phlox stolinifera,* creeping phlox, comes immediately to mind.

This plant's somewhat lax, six-inch-tall stems spread rapidly by stolons, creating a mat of delicate, rounded, dime-size dark green leaves that remain evergreen in all but the harshest winters. In May, dense, eight-inch-tall spikes of pale to deep purple flowers appear atop the foliage, forming a patch of solid color. Because of the showy blossoms, many gardeners regard creeping phlox primarily as a spring wildflower, but it also makes an excellent groundcover. Small plugs of this phlox planted half a foot apart will provide effective, lasting cover within a growing season or two. The plant performs best in partial shade and humus-rich, moist but well-drained soil.

A number of cultivars are available, including 'Bruce's White', which has bright white flowers. To see the plant used on a grand scale and to great effect, visit Peirce's Woods, a section of Longwood Gardens, in Kennett Square, Pennsylvania, where carpets of *P. stolonifera* spread out over great distances between majestic old trees. When the plant is in bloom, the effect is pure garden magic.

A great groundcover companion for *Phlox stolonifera* is foam flower, *Tiarella cordifolia.* Foam flower blooms at the same time as this phlox species, producing an abundance of small, creamy-white flowers on upright stems that rise above the plant's maple-shaped leaves at the same height—about one foot—as the phlox. The combination is used to great effect in the same woods at Longwood Gardens: The cream flowers of the foam flower are woven together with pale blue phlox flowers in a beautiful abstract tapestry. Like the phlox, the foam flower is stoloniferous and forms a consistent expanse of leaves. The milder the winter, the more evergreen it remains. New selections of foam flower with colored leaves and showier flowers seem to be popping up each year, giving gardeners a broad palette to paint the ground with. However, don't buy the clump-forming selections, such as *Tiarella cordifolia* var. *collina T. wherryi,* because they don't have a good covering habit.

Heuchera americana, or alum root, is amenable to sun or shade, given sufficient moisture. While it's not a spreading plant, it does form strong rosettes of persistent leaves, which, if grown en masse about a foot apart, function effectively as a groundcover. In the last decade or so, scores of cultivars and hybrids have appeared, and gardeners now have the option of carpeting the ground with everything from silver-tinged, dark emerald-green leaves (Emerald Veil) to frilly purple leaves (Purple Petticoats). Alum root flowers are tiny and greenish and appear on tall, airy stems in early summer. Unless the light hits the flowers just right though, the flowers can obscure the effect of the foliage without adding much in the bargain. I advise cutting the flower stalks off after they finish blooming to restore the full impact of the decorative layer of foliage beneath.

Sun Lovers

Two native phloxes that make great groundcovers in sunny situations are *Phlox pilosa* and *P. subulata.* Some gardeners label *P. pilosa* a garden thug, but I think that's because they mistakenly expect it to behave like a classic garden phlox. If you're looking for year-round cover for open areas, this vigorous plant will provide it, and also throw in the bonus of dramatic pink flowers in late spring and summer. *Phlox pilosa* grows a little taller than *P. stolonifera,* about one foot, producing softly hairy stems and three-inch-long leaves. It prefers a medium to dry, well-



Foam flower, *Tiarella cordifolia*. Picture taken from https://www.pinterest.com



Phlox pilosa blankets a field with color. Picture taken from https://jayjaysfavorites.wordpress.com/



Goldenstar, Chrysogonum virginianum, produces a low, dense carpet of leaves and bright yellow flowers. Picture taken from https://www.usbg.gov

drained soil. A full-sun plant, it works well as a groundcover under shrubs. At Ashland Hollow, William and Nancy Frederick's Delaware garden, this phlox is planted under a border of mixed shrub roses. In early summer, the various mauve, pink, and red flowers of the roses are united by a billowing layer of pink phlox flowers as everything blooms together in great floral exuberance. In the winter, the foliage of the phlox persists, providing something to look at other than thorny rose canes. At the Mt. Cuba Center, in Greenville, Delaware, *Phlox pilosa* battles it out with hay-scented fern, *Dennstaedtia punctilobula,* at the edge of a meadow, providing a lovely transition groundcover planting for a woodland garden.

The other sun-loving phlox, *Phlox subulata,* or moss pink, produces dense six-inch-tall cushions of needlelike evergreen foliage. Easy to grow even in tough spots and readily available, it certainly qualifies as a good groundcover. But the plant's use between rocks on steep slopes has perhaps become a garden cliche. It also shouts when it blooms in late spring and early summer: The flowers are almost too vivid to enjoy, especially in the bright, midday sun. Restrict yourself to one color to avoid the patchwork effect that comes from mixing the dozen or so cultivars available (the spectrum runs from purple to pink to white), and the plant snobs may forgive you.

If the moss pink is not for you, then try *Sibbaldiopsis tridentata* (formerly *Potentilla tridentata),* three-toothed cinquefoil, which is a good candidate for moss-pink-type situations. With its three-part leaves and ground-hugging habit, it resembles a strawberry plant. The white, early-summer flowers are also similar to those of the strawberry. A few of the cinquefoil's shiny evergreen leaves turn orange or red in the fall and winter. Years ago I admired and watched this native growing in full sun on a steep south-facing slope in the rock garden at Mt. Cuba. It seemed to have all the virtues of a handsome groundcover plant, and I've wondered ever since why I don't encounter it more often in gardens. Grow it in moderately fertile, well-drained soil.

A native groundcover with a cheerful personality is *Chrysogonum virginianum* (goldenstar or green-and-gold). I say this because it features bright yellow daisy flowers that bloom over an extended period of time. I've seen a few flowers occur as early as March and as late as October, although peak bloom is May and June. There is considerable variation in the habit of this species: Some plants form mounds reaching a foot tall, while others form dense, spreading layers of leaves only inches above the earth. Before purchasing one, make sure to read the catalog description of the particular cultivar closely, or study it in its pot to make sure you are getting the habit you're after. Some years ago I visited a private garden in Connecticut that had an extensive hillside garden full of choice native plants, with vast expanses of *Chrysogonum* used as a groundcover. The plant was dotted with many yellow flowers and made a lasting impression.

Claire Sawyers is the director of the Scott Arboretum of Swarthmore College, Swarthmore, Pennsylvania.

Reprinted from the *Plants and Gardens News*, a newsletter of the Brooklyn Botanic Garden, Fall 2005/Winter 2006, Vol 20, No 3.

Springville Marsh State Nature Preserve
Seneca County



Visitors to Springville Marsh State Nature Preserve have a unique opportunity to observe and study the beauty of nature and to reflect on the past. Three factors have had a marked effect on this resource. First, abundant groundwater, which has surfaced as many cool, calcium-rich springs, continues to nourish the special plant life found here. Also, many Ice Age plant species and others that are newcomers, provide this preserve with a remarkable and diverse inventory of flowering plants. Third, the uniqueness of the marsh has survived despite past agricultural and industrial disruption.

Springville Marsh is an unequaled nature preserve in northwestern Ohio. It is the largest inland wetland in this part of the state. The preserve is notable for several reasons. Growing within the preserve are several Canadian and Atlantic coastal plain species, which became established here shortly after the Ice Age. Some of these plants are threatened and endangered species in Ohio. Fen orchids, bottle gentian, Kalm's lobelia, and little yellow sedge can be seen along the boardwalk. One of Ohio's largest populations of twig-rush, a typical Atlantic coastal plain species, is located throughout the preserve. There are also smaller areas of more northern plants, such as Ohio goldenrod, grass-of-Parnassus, and shrubby cinquefoil. The sedge meadows, shrubby thickets, and vast areas of cattail marsh provide excellent opportunities to observe wildlife.

The Springville Marsh State Nature Preserve is 201 acres and is wheelchair accessible. There is a boardwalk trail system which connects to an observation tower and a wildlife blind.

Located in Seneca County 3.5 miles north of Carey on US-23 and OH-199; proceed one mile west on Township Road 24 (Muck Road) to the preserve parking lot.

Information for this article was taken from www.naturepreserves.ohiodnr.gov and www.ohioebirdhotspots.wikispaces.com. Picture taken from www.naturepreserves.ohiodnr.gov.

Surprises in a Native Plant Garden

By Deborah Chute

Butterflies are possessive of my garden. Last July, a feisty little question mark chased a monarch from the swamp milkweed patch, *Asclepias incarnata*. It then landed on top of the redbud tree, *Cercis canadensis*, and stayed there for some time as if keeping watch over its domain. When I tried to take photographs, it twice landed on my head apparently warning me away as well!

A few years ago, my husband and I built a new home and opted for native plant gardens instead of the monoculture of mowed lawns. To our surprise and delight, wildlife heartily approved our choice! And the Richmond Hill Garden and Horticultural Society did too, posting a Front Garden Recognition 2011 sign in our front yard.

Because we made the usual mistake of planting too many trees, we ended up enjoying four years of white spruce, *Picea glauca*, Christmas Trees that we culled from our backyard. This year the highlight among our native trees was the first-time flowering of both the redbud and the tulip tree, *Liriodendron tulipifera*. The tulips were particularly breathtaking.

Paul Heydon and his local native plant nursery, Grow Wild!, guided our choices. Since it was a new yard with only small trees, the plants needed to fit a hot, sunny and dry environment. I'd help them out the first year with watering, but otherwise these plants were to be on their own. That has worked out well. We are saving on water and watering time.

Fortunately, there is one rather wet area near the landscape swales at the back of the yard that supports the much welcome mid-and late-summer blooms of marsh hibiscus, *Hibiscus moscheutos*, and the Beautiful blue bottle gentian, *Gentiana andrewsii*.



Goldfinches enjoy an early season snack from *Echinacea pallida,* next to a Wild Bee Condo.

Over 50 species of native plants are now thriving in the front and back gardens. The goal is to provide lots of color and texture contrast at all times. Native plants are particularly challenging in this regard due to their smaller flowers and often short blooming time. Larger groupings in many places around the yard seem to be working for me. This is especially true for the small but vibrant flowers of early blooming blue-eyed grass, *Sisyrinchium montanum*. Color groupings have also served to highlight blooms, for example, blue harebells, *Campanula rotundifolia*, alongside orange butterfly milkweed, *Asclepias tuberosa*. Plants with differing leaf structures or shades of green also help: the lacy leaf structure of prairie smoke, *Geum triflorum*, near the grass-like and lighter green leaves of nodding wild onion, *Allium cernuum*.

A favorite all-season native plant of mine is foxglove beardtongue, *Penstemon digitalis*. If two or three are planted together, it produces a nice fountain-like display. It revives its green base leaves quickly in the spring, blooms with hundreds of white blossoms on long stems in June, produces rusty red to bright red leaves in the fall, and pokes its seed heads out of the snow in winter.

In the beginning, I was diligent about deadheading, hoping to get the neighbors with their manicured lawns on my side. I was rewarded for this extra work when a neighbor told me that their son had moved his bedroom to the back of their house so that he could overlook our garden!

Pedestrians passing by the front garden are often attracted to the bright

red and yellow wild columbine flowers, *Aquilegia canadensis*, or the sparkling seed heads of prairie smoke… and they go home with pots for their gardens.

I definitely wanted a garden rich in biodiversity, and that's what I got. The sunlight often catches the wings of dragonflies hovering around the backyard. A bright yellow calico pennant stopped to do some fly catching from its chosen perch of cylindric blazing star, *Liatris cylindracea*, in the front yard last summer. Robins and other birds enjoy the wild strawberries, *Fragaria virginiana*, and serviceberries, *Amelanchier* spp., before I get to them. Hummingbirds often arrive early in the morning to large patches of tasty wild columbine, ready for the sipping. This spring, I was delighted to spot a male cardinal feeding his mate sunflower seeds. He would then stand guard while she flew down to the ground to break off dried stems from last year's heath aster, A*ster ericoides*, for their nest. They repeated this routine several times over the next few days.

The comical antics of goldfinches provide a daily chuckle. They have discovered how to leap up from the ground to retrieve seeds from the feathery seedpods of prairie smoke. They do the same with the black-eyed Susans, *Rudbeckia hirta*. Gray-headed coneflowers, *Ratibida pinnata*, pale purple coneflowers, *Echinacea pallida*, and round-headed bush clover, *Lespedeza capitate*, will hold the goldfinches' weight, and they can pick away at the seedheads while swaying wildly in the wind. They always seem to perch on the highest and slimmest top leader of our tamarack, *Larix laricina*, where they are buffeted ferociously to and fro.

Bunnies come to nibble here and there with no major damage so far. Squirrels beat me to the hazelnuts, *Corylus* spp. I've even had an early morning face-to-face encounter with a skunk with no disastrous results.

The American lady butterfly tends to visit the garden early in the season. She will fly directly to her host plants, pussytoes, *Antennaria plantagnifolia*, and pearly everlasting, *Anaphalis margaritacea*, laying bright green, striped eggs. The first year I noticed this, the caterpillars did a fine job eating up the pussytoes, and I began to wonder if I would have any left. However, by the end of the summer the plants had rebounded and looked almost unscathed. Nature knows what she's doing.

Wild bees (and other interesting insects) have sent me to the books and to knowledgeable people to uncover how they fit into the total ecosystem of this small yard. As a result, I've learned a great deal about the wild bees that inhabit the ground in my garden and sleep in native flowers, including black-eyed Susans, nodding wild onion and meadow sundrops, *Oenothera pilosella*. As I took photographs, I discovered that bees do not wake up easily. At first I thought they might be dead until I saw a lazy stretching of a leg or a slight movement as they circled the stamens of the flowers they had been clutching in their sleep.

I also learned that the little halfmoon-shaped cutouts starting to decorate the leaves of the redbud were the work of the leaf-cutting bee. It rolls the leaves and uses them to make tunnel homes for laying eggs. Members of this species congregate around pale purple coneflower for nectar and even take a slice or two from the leaves of both beardtongues, *Penstemon digitalis* and *hirsutus*.



Leaf-cutter bee on *Campanula rotundifolia*

Every native plant is swarming with a variety of pollinating bees when in full bloom. There are red-belted bumble bees and tri-coloured bumble bees on the harebells; two-spotted bumble bees on purple-flowering raspberry, *Rubus odoratus*, and smooth rose, *Rosa blanda*; big black-bodied carpenter bees on wild bergamot, *Monarda fistulosa*, and obedient plant, *Physostegia virginiana*; and smaller sweat bees on meadowsweet, *Spirea alba*, and tall cinquefoil, *Potentilla arguta*—to name just a few!

I'm pleased to say that my yard now sports a white bee condo. Scott MacIvor, a Ph.D. student at York University, installed the condo and is maintaining it. His research goal is to discover which bees will use nest boxes and to examine how landscape and urbanization influence bee diversity and foraging. This is critical work since bees are losing their traditional meadow and farm edge habitat to development. As Douglas Tallamy states in his book *Bringing Nature Home*, if urban gardeners start

to include more native plant species, it may be the city gardens of North America that will help provide this much-needed habitat for bees, other insects and birds.

Some days, when the weeds are overwhelming and the heat is too much, I begin to wonder if this is better than mowing a lawn. Then I hear the goldfinches twittering or witness the bees pollinating or see a magnificent tiger swallowtail seek out a bright wood lily, *Lilium philadelphicum,* and I am renewed. I am renewed by the variety of life forms attracted to this space. I am renewed by what I have learned from this small patch of native urban landscape.



Allium cernuum; Penstemon digitalis; and *Potentilla fruticosa*, shrubby cinquefoil, in the foreground. At the back, spikes of pink *Liatris spicate,* with *Spirea alba* behind the gate.

Deb Chute is a self-taught naturalist who says she will never tire of exploring nature in all its intriguing forms. In October 2007, Deb's garden received the NANPS Native Plant Garden Award in the category "Suburban Ground Breaker." For more photographs of Deb's garden including a garden key, visit www.nanps.org.

Reprinted with permission from *The Blazing Star*, the quarterly publication of the North American Native Plant Society, nanps.org, Summer 2012, Vol 13, No 3.



New OIPC Brochure Available Now!

Alternatives for Invasive Plants in Ohio
A Guide for Landscaping and Habitat Restoration

This exciting new brochure on alternatives to invasive plants is now available from the Ohio Invasive Plants Council (OIPC). The brochure was completed with funding from The Columbus Foundation in cooperation with The Dawes Arboretum and the Ohio Nursery & Landscape Association. The brochure includes information about 15 invasive plants and recommends 3-4 alternatives for each species for use in landscaping and habitat restoration. For more information see the OIPC website at www.oipc.info.

Some Plants Grow Bigger—and Meaner—When Clipped

By Diana Yates

Some plants behave like the mythical monster Hydra: Cut off their heads and they grow back, bigger and better than before. A new study finds that these "over-compensators," as they are called, also augment their defensive chemistry—think plant venom—when they are clipped.

Clipping removes the primary stem and simulates what browsing mammals do when they eat plants in the wild.

The study, reported in the journal Ecology, is the first to find this link and to trace it to three interconnected molecular pathways. The discovery could lead to the development of new methods for boosting plant growth while reducing the need for insecticides, the researchers said.

"You would think that a plant would either produce a lot of defensive chemicals to prevent it from being eaten or that it would put its energy into regrowing after being eaten—but not both, given its limited energy," said graduate student Miles Mesa, who led the research with University of Illinois animal biology professor Ken Paige.

"But we found that the plants that overcompensated—with higher reproductive success after having been damaged—also produced more defensive chemicals in their tissues."

About 90 percent of herbaceous flowering plants engage in a process called endoreduplication—duplicating all of the genetic material in their cells without cell division, the researchers said. This process increases cell size, allowing the plants to quickly rebound from damage.

Each round of endoreduplication doubles a cell's output. Having twice as many active genes means the cell can pump out more proteins needed to perform cellular tasks.

Some plants multiply their genomes again and again in response to being browsed. One example is scarlet gilia, a red-flowered plant that grows in western North America and is browsed by elk and mule deer. Paige is studying its responses to being eaten.

"We're seeing two- and three-fold increases in yield after it has been cut—in the same season," he said.

Paige discovered overcompensation and reported on it in 1987, but he said almost none of his peers in plant biology believed it. The idea that being browsed can increase some plants' reproductive success is counterintuitive, Paige said. It took more than a decade for the research community to accept the science; even today, almost no one else in plant biology studies the molecular biology of overcompensation.

The new study focused on *Arabidopsis thaliana*, a member of the mustard family that is often used in research. Paige and his colleagues had already identified the molecular pathway that promotes endoreduplication in this plant, along with an important regulator of the endoreduplication pathway, a molecule called ILP1.

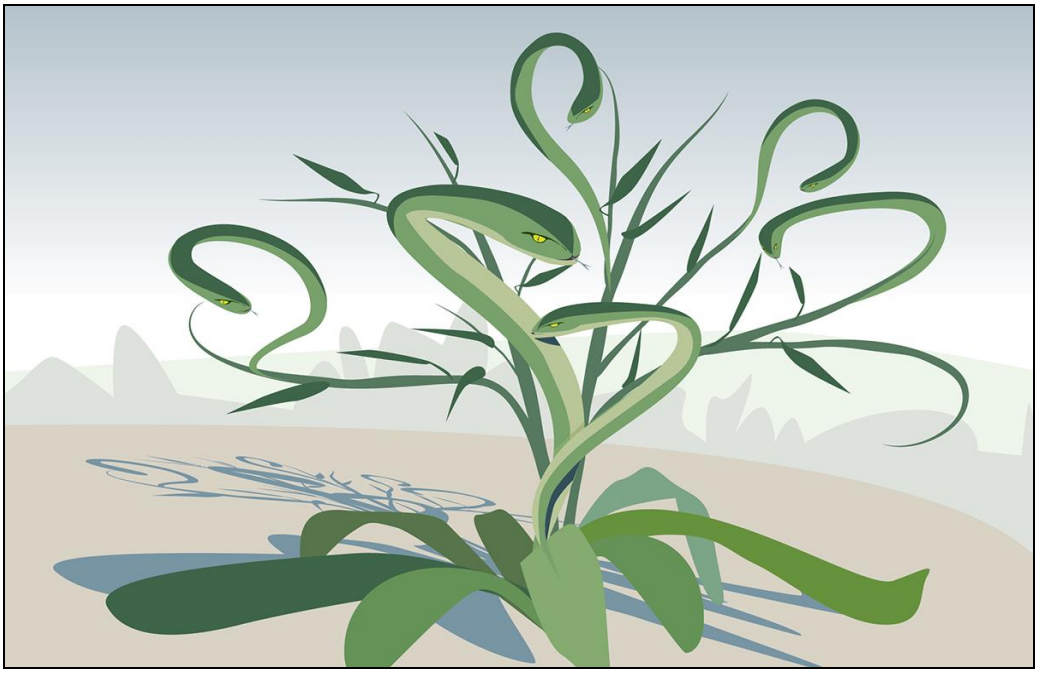
The researchers discovered that by increasing the expression of the ILP1 gene, they could increase endoreduplication in genetic varieties of *A. thaliana* that don't normally overcompensate. This led to greater seed production in the altered plants and increased expression of defensive compounds in plant tissues, the researchers said.

This is possible because the molecular pathway that induces endoreduplication also feeds into two other pathways: the oxidative pentose phosphate pathway, for primary metabolism, and the shikimate pathway, which boosts plant chemical defenses, Paige said.

"There's a positive feedback loop," he said. "When you increase the number of chromosomes through endoreduplication, you increase gene expression, which increases the plant's ability to produce more defensive compounds and nucleotides for DNA production to endoreduplicate again."

The new findings may lead to advances in agricultural yields and reductions in pesticide use, Paige said.

The National Science Foundation supports this research.



Like a Hydra, some plants grow bigger and boost their chemical defenses after being clipped.
Illustration by Julie McMahon

This article was reprinted from the website: https://news.illinois.edu/blog/view/.

Folklore:

Mayapple Lore

By Val Ross



Fig. 1: Early shoots. Picture taken from http://www.davesgarden.com.

The shoots of one of our most interesting native plants begin to poke up soon after the snow melts in the spring (Fig. 1). *Podophyllum peltatum* is variously known as Mayapple, Indian Apple, Umbrella Plant, American Mandrake, and Duck's Foot. The Greek name is descriptive, *Podophyllum* meaning "foot-leaf" and *Peltatum* meaning "shield-shaped." One section of the leaf resembles the long, narrow footprint of a duck (hence "Duck's Foot"), and the flower and umbrella-like shape of the leaves resemble the small round convex shield (*Pelta*) carried by ancient Greek foot-soldiers. "May-apple" is a misnomer, because it's the flower that appears in May, with the edible "apple" (technically a *berry*) ripening in late summer. The plant is in the Berberidaceae and is native to deciduous forests of the entire eastern half of the U. S. and Canada.

Plants sprout before the full canopy of the forest unfurls, reaching 12-18 inches in height. The single 3-to 5-cm-diameter flower, which blooms in May, is usually creamy white, though pinkish or purplish-tinged ones are sometimes found (Fig. 2). It has a skunky, nauseating odor. It is a nectarless flower, which makes pollination difficult, because insects aren't rewarded for visiting. You'll rarely see an insect on the Mayapple flower. The plant usually can't fertilize itself, so its ability to get its pollen distributed is a bit of a mystery. According to James E. Crants, in his unpublished University of Michigan doctoral dissertation on *Pollination and Pollen Limitation in Mayapple, Podophyllum peltatum L., A Nectarless Spring Ephemeral*, Mayapples probably rely on nearby flowers to attract insects. The Mayapple plant has two means of reproduction. Some of the plants are reproductive individuals with flower and fruit, and usually two palmate leaves with 5-9 deeply cut lobes (Fig. 3). Other Mayapple plants are sterile, with asexual reproduction by rhizomes. Those have one umbrella-like leaf and no flower (Fig. 4). It is common to find clonal rhizome colonies covering the forest floor (Fig. 5). Mayapples like partly to fully shaded forests, and grow under deciduous hardwoods, but do not like the proximity of pine trees. The plant is obligately dependent on mycorrhizae in the root system, which help to gather nutrients from the soil. It is often host to *Puccinia podophylli*, the parasitic Mayapple Rust Fungus, which causes yellow spots on the underside of the leaves, but doesn't seem to hurt the plant very much.

Mayapple makes a wonderful ground cover, but its limitations for use in gardening are that the leaves wither and die in late summer, it needs shade, and it doesn't like to share space with any other plant. It is best propagated by division of its roots, which somewhat resemble the roots of the Old World Mandrake, *Mandragora officinarum, Solanaceae* (hence the name "American Mandrake," though it is not related to real Mandrake). Every part of the root will grow. It is preferable to divide them in spring, just before the roots begin to shoot, or in the fall when the leaves decay. *P. peltatum* is the only species of *Podophyllum* native to the U. S., but there are four other species native to eastern Asia. These are now imported as ornamentals for southern and western U. S. gardens, but require hardiness zones 6-9.

The Mayapple's fruit is produced in June and ripens



Fig. 5: A clonal rhizome colony

in late summer. It turns yellow when ripe and is quite edible. The taste is not unpleasant, like a slightly lemony, unripe strawberry. You can eat the ripe apples by themselves as a trail snack, and there are lots of ways to use them in jams, jellies, and drinks. In harvesting them, you have to be quick about your business to beat the squirrels, deer, and box turtles. *Don't eat the seeds, and don't eat them green. The apples will be impressively cathartic if you eat too many* (personal childhood experience). You can collect nearly ripe fruits and finish the ripening at home. *The rest of the plant is inedible and toxic. Native Americans used to commit suicide by eating the roots.*

The toxicity of the plant is also the source of important medicines. *Podophyllum* species are incredibly important medicinal plants, with a long history of varied usage. Native Americans and early settlers used *P. peltatum* roots and leaves for all kinds of treatments, mostly along the purging, anti-helminthic, and cathartic line. It was thought that its effects on the gastrointestinal tract (vomiting, diarrhea) were helpful for getting rid of "whatever ailed ya," and it was one of the active ingredients in "Carter's Little Liver Pills" in the late 1800s. Tinctures of the roots are still used in homeopathic preparations, and there appears to be brisk trade on eBay for dried Mayapple roots as ingredients for Wiccan elixirs and potions. (It is mistaken for Old World Mandrake in many of the descriptions.) The ground-up leaves and roots have long been recognized as skin irritants, with poultices applied to warts and sores in the old days. Podophyllin is the impure resin that is obtained from plant rhizomes, and it is still used medically as a treatment for warts, particularly the genital kind. As a doctor, I have painted podophyllin on dozens of crotches. My impression is that its mode of action, as with most wart treatments, is to irritate the lesion to the point of blistering, then it scabs and falls off. There is supposedly some anti-viral property at work as well. (Nowadays I don't see it used as much as freezing and lasering of the warts.)

The active material in the crude podophyllin resin is a lignan called *podophyllotoxin* (Fig. 6). This organic molecule has been studied for its cytotoxic properties. Two derivatives of podophyllotoxin are actively used for various cancer treatments (etoposide or VP-16, and teniposide or VM-26), and there is ongoing investigation into using it in autoimmune disorders like rheumatoid arthritis. Podophyllotoxin acts by binding to DNA topoisomerase II complexes, with resultant DNA strand breakages. This leads to inhibition of cell division, and kills off bad, rapidly dividing cells. There is a high demand for podophyllotoxin. Because it was originally isolated from the leaves and roots of Asian *Podophyllum* plants, they have been hunted to near extinction in the Himalayas (particularly *Podophyllum emodi* and *Podophyllum hexandrum*). *Podophyllum* is gaining popularity as a cash crop in Europe and Russia. Because importation of the refined podophyllotoxin is so expensive, and demand out-strips supply, efforts have been made to extract it from native U. S. Mayapple plants. It's a hard plant to grow in massive quantities, so other options are being explored. Chemists have synthesized the molecule in the lab, but so far that method of obtaining podophyllotoxin has proved too difficult and expensive to be practical on a commercial basis. Biotechnologists are figuring out ways to grow the podophyllotoxin-producing plant cells and organs in lab cultures. One fascinating discovery was reported in 2006: Some of the endophytic *fungi* that inhabit the root system of the plant—those mycorrhizae mentioned previously in this article that help the plant absorb nutrients from the soil—were also found to produce podophyllotoxin (A. L. Eyberger, R. Dondapati, & J. R. Porter, Aug. 2006, *Journal of Natural Products* 69(8):1621-1624). The fungi might be grown in a lab more easily than plant cells and organelles, and they could eventually be used to produce podophyllotoxin.

In summary, our unassuming native Mayapple plant provides us lessons in beauty, botany, Greek, mycology, gastronomy, reproduction, Native American medicine and culture, warts, cancer treatments, chemistry, and the ingenuity of modern scientists in the pharmaceutical industry. We look forward to its arrival this spring!


Fig. 2: Flower under leaves.


Fig. 3: Flower and two leaves on a reproductive plant.


Fig. 4: Sterile plant.

Reprinted from *Solidago*, The Newsletter of the Finger Lakes Native Plant Society, March 2014, Vol 15, No 1.

Invasive Plant:

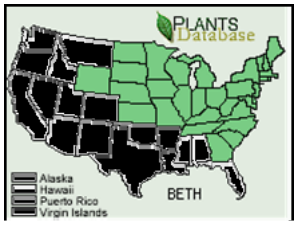
Japanese Barberry, *Berberis thunbergii DC*



Native Range:
Japan

Description:
Japanese barberry is a compact, spiny, deciduous shrub in the barberry family (Berberidaceae) that commonly grows from 2 to 3 feet tall (although it can grow up to six feet in height). Roots are shallow but tough. The smooth-edged leaves range from oval to spoon-shaped and are clustered in tight bunches close to the branches. The single spines bear small leaves in their axils. Yellow flowers bloom in May, are about one third of an inch wide, and are solitary or in small clusters of 2-4 blossoms. The bright-red fruits mature in mid-summer and hang from the bush during autumn and into winter. The berries are small, oblong, and found singly or in clusters. The plant regenerates by seed and creeping roots. Birds and rabbits are known to eat the seeds and distribute the species. Branches root freely when they touch the ground; thus allowing single plants to become quite large.

Habitat:
Japanese barberry prefers well-drained soils, although it has been found in wet, calcareous situations (specifically in a black ash swamp). It is typically found in locations of partial sunlight such as a woodland's edge; it can survive well under the shade of an oak canopy. It is also found along roadsides, fences, old fields, forest edges, and open woods. Japanese barberry can be found invading oak woodlands and oak savannas; it is widespread in Wisconsin woodlands south of the tension zone. A related non-native species, B. vulgaris, was widely planted for similar ornamental purposes, but has been exterminated because it is the alternate host of black rust, a disease that affects wheat crops. Japanese barberry competes poorly with grasses and may succumb to drought conditions.



Distribution:
Japanese barberry was introduced from Japan around 1875. It is commonly planted for ornamental reasons. Its scarlet fruit and autumnal foliage in shades of orange, red, and crimson make it an attractive hedge. However, it is reported invasive in CT, DC, DE, IN, KY, MA, MD, ME, MO, NC, NH, NJ, NY, OH, PA, RI, TN, VA, VT, WI, and WV.

Environmental Impact:
It often escapes cultivation. Plants shade out other understory species. Recent research studies in New Jersey indicated that Japanese barberry changes the soil chemistry in the environment it inhabits.

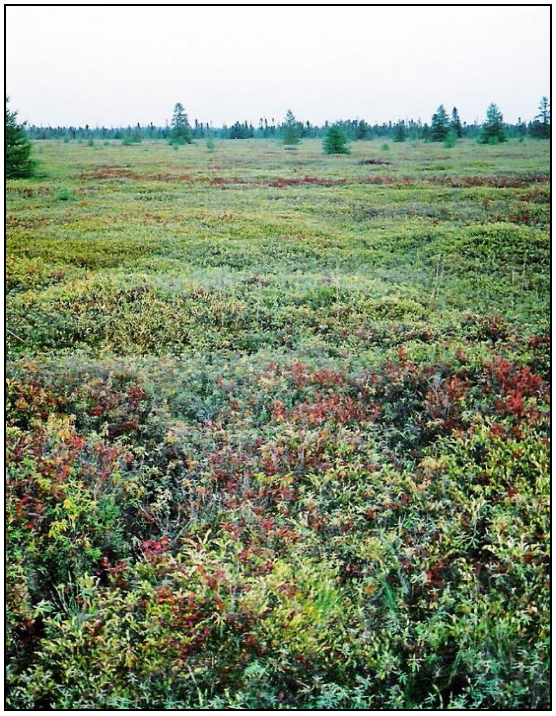
Information taken from Invasive Plants website (www.na.fs.fed.us), which is a product of the USDA Forest Service, Forest Health Staff, Newtown Square, PA.



Picture taken from
https://saglikdogada.wordpress.com

Questioning Peat Moss: The Environmental Costs of Using Peat Moss

By Ken Druse



Mer Bleue Conservation Area, a large, protected *Sphagnum* bog near Ottawa, Ontario, Canada

Before the mid-1900s, peat moss was largely unavailable and unused by gardeners and farmers in the United States. In the decades since then, peat's popularity has increased dramatically. And with it, an unanswered question: Is peat moss a responsible and sustainable choice for gardeners?

Peat is the partially decomposed remains of plants, most commonly sphagnum moss. It forms over many millennia in bogs, marshes, and swamps—known as peatlands or peat bogs—often gaining less than a millimeter in depth every year. The process is simple but very slow.

As sphagnum moss grows on the surface of a bog, the older parts of the plant are submerged in oxygen-poor water. The lack of oxygen slows decomposition dramatically, preserving the moss and anything else that falls into the bog. Given enough time, submerged sphagnum moss forms the dense, absorbent material known as peat moss. Left alone, the process won't stop there. Although the transformation requires eons, undisturbed peat will eventually form coal. Peat is essentially young coal—a baby fossil fuel. And, like all fossil fuels, it is rich in carbon.

A 2009 article in the journal *Science* makes the claim that, "meter for meter, peatlands store more carbon than any other terrestrial ecosystem." All told, the world's peat bogs store approximately 562 billion tons of carbon—more than all the trees in the world, and roughly equivalent to half the carbon currently in the atmosphere as carbon dioxide, or CO2. Healthy peat bogs accumulate an additional 110 million tons of carbon every year, more or less. All this despite the fact that peat bogs cover only 3 percent of Earth's land and freshwater surface.

When peat is mined, this stored carbon is vulnerable to release into the atmosphere, where it contributes to the problem of global climate change. Whether used as a soil amendment or a fuel source, peat releases its stored carbon when it decays or burns. Additionally, because peatlands must be drained of their water before the peat can be mined, the bogs also release carbon during the mining process. The International Peat Society reports that some mined bogs continue to exhale carbon into the atmosphere long after the completion of mining, often despite habitat-restoration attempts.



Sphagnum flexuosum

Climate change and carbon emissions are not the only issues here. There is also the question of sustainability. Almost all horticultural peat sold in the United States is imported from Canada, which has a wealth of peatlands and other wetlands. More than 11

percent of Canada is covered by peatlands, which account for more than 279 million acres of the nation's total land and freshwater area. "Canadian Peat Harvesting and the Environment," a report sponsored in part by the Canadian Sphagnum Peat Moss Association, claims that Canada accumulates more than 77 million tons of peat every year. This is approximately 60 times the industry's estimated annual harvest of 1.3 million tons of peat. A comparison of these two numbers indicates that the Canadian peat industry mines just 1.7 percent of the peat produced naturally every year—arguably a responsible quantity. However, the situation is not that simple.

Only a fraction of Canada's peatlands are suitable for commercial extraction. Most Canadian peat-mining operations are located in the southern provinces, where ready access to roads and population centers reduces the costs of transportation and ensures the availability of a work force, electricity, and other resources. A large percentage of peat bogs may simply be too remote to support peat extraction on a commercial scale.

In addition to geographic accessibility, a commercially viable peat bog must supply enough high-quality peat to justify the expense of mining. In most cases, the horticultural-quality peat deposit must have an average depth of at least 2 meters to be considered worth the effort. The bog must drain readily—an essential step in the mining process—and be located in a region where occasional dry spells facilitate the peat-drying process.

These limitations raise a question: Of Canada's 279 million acres of peat bogs, how many are actually suitable for mining? This unanswered question is key, because only those bogs that can be developed should be included in any sustainability calculation.



Peat moss soil amendment, made of partly decayed, dried sphagnum moss

Sphagnum moss grows so slowly that management for sustainable use is a significant challenge. At the average rate of 0.6 to 0.7 millimeter per year, Canadian peat bogs add 6 to 7 centimeters in depth (less than 3 inches) over the course of a century. It will require 3,000 years to amass the 2-meter depth needed to justify the costs of extraction. Under these conditions, a fully mined peat bog will not be able to support a second "harvest" for at least 3,000 years.

Can a resource that renews itself this slowly ever be considered sustainable? If we balk at cutting down 500-year-old trees in old-growth forests, should we accept the extraction of 3,000-year-old sphagnum moss from peat bogs?

Content for this article taken from www.organicgardening.com. Pictures taken from www.wikipedia.org.

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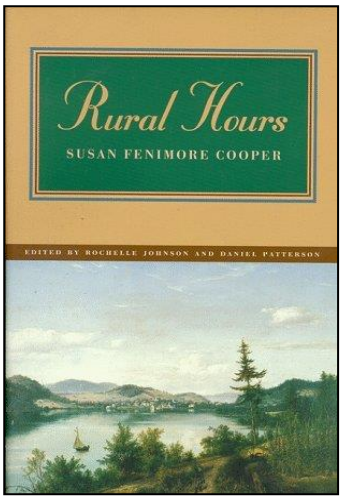
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Book Review:

Rural Hours

By Susan Fenimore Cooper



Publisher: University of Georgia Press (1998)
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Hardcover, Paperback and Kindle
Price: $44.76 hardcover, $21.99 paperback, and $1.99 Kindle; used copies are available at a lower cost.

The classic book, Rural Hours, by Susan Fenimore Cooper is a personal journal that contemporaneously describes her life in Cooperstown, New York and surrounding Oswego County in the mid-1800, which only 50 years earlier was the edge of the American frontier. By the time Miss Cooper lived there, the area was rapidly changing as settlers moved Westward.

First published in 1850 when she was 37, and updated and condensed in 1887, it is a sophisticated narrative concerning the native plants, birds, and other wildlife that she encounters on her almost daily peregrinations, and the changing face of the land. She laments the rapid and wasteful clearing of the old first-growth trees and sets forth an elegant argument for saving stands of old-growth timber that is practical, inspirational, and timeless.

Although she touches on many subjects, her true love and inspiration were the wildflowers, and her beautiful writing style and passion made her an instant commercial success, despite the initial doubts of her famous father, James Fenimore Cooper, who did not see the public demand for anything other than frontier action stories. In the following passage she describes why wild flowers are superior to garden flowers:

> How beautiful is this exquisite native grace of the flowers, seen in all their habits and positions! They know nothing of vanity, its trivial toils and triumphs! In unconscious, spontaneous beauty, they live their joy-giving lives, and yet how all but impossible for man to add to their perfection in a single point!

Her sense of humor and wide-ranging knowledge shine through in her objection to the recently embraced practice of creating plant names using Latinized science, instead of the colorful and descriptive appellations created by country people. She asks, "Why should a strange tongue sputter its uncouth, compound syllables upon the simple weeds by the wayside?" She follows with an interesting and amusing history, explanation, and defense of the old way of naming flowers such as bachelor's buttons, cowslip, monkshood, and morning glory, to name a few.

Rural Hours is highly recommended to anyone with an interest in ecological history, social history, and the flora and fauna of the vast Eastern wilderness that once dominated our landscape.

Reprinted from *The Turk's Cap*, a newsletter of the Delaware Native Plant Society, Spring 2015, Vol 18 No 1.

Interesting Factoid:

Flowers Use "Blue Halo" to Attract Bees

Bees are drawn to the color blue, but it's hard for flowers to make that color in their petals.

Instead, some flowers use a trick of physics. They produce a blue halo when sunlight strikes a series of tiny ridges in their thin waxy surfaces. The ridges alter how the light bounces back, which affects the color that one sees.

The halos appear over pigmented areas of a flower, and people can see them over darkly colored areas if they look from certain angles.

While the effect is not always visible to humans, it can be spotted by bees—suggesting the optical effect might help to attract the pollinators.

"The exciting thing is that it is a new optical trick—we didn't know that flowers could use disorder to generate a specific color, and that is quite clever," said Professor Beverley Glover, co-author of the research from the University of Cambridge.

The discovery has its roots in previous work from Glover's team which revealed that tiny ridges on the petals of certain plants could diffract, or bend, light, giving them an iridescent sheen.

Writing in the journal *Nature*, the team reveals how they sought to explore the effect further to see if it occurred in other species with similar big, flat petals.

Using a variety of microscopy techniques, they examined the petals of 12 species from across the flowering plant family tree, ranging from golden bartonia, *Mentzelia lindleyi*, to the dark tulip known as "Queen of the Night." For the 11 species for which fresh flowers were available, the team also looked at how they scatter and diffract light.

The results show that the architecture of the nanostructures differed from species to species, with some showing variations in the spacing of their ridges while others showed variations in their height.

Despite these differences, all the flowers were found to have a weak iridescent sheen. But the team stumbled upon an additional quirk: the ridges also scattered blue and ultraviolet light. The upshot is that all the flowers appeared to have a "blue halo"—an effect that can be seen by the human eye for flowers with dark pigments.

Interesting Factoids:

- Many flowers lack the genetic and biochemical capability to manipulate pigment chemistry into the blue-to-ultraviolent spectrum, so arranging the molecules in petals so that reflected sunlight will produce a blue halo emerged as an alternative evolutionary strategy to attract pollinators.
- Previous studies have shown that bees in search of nectar-giving plants are attracted to odors, but take most of their cues from colors and petal shapes. Bees are especially sensitive to the band of colors on the light spectrum where blue graduates into ultraviolent.
- Hundreds of flower species have evolved the ability to project ethereal halos of blue light invisible to humans in order to lure pollinating bees.



Further work using computer models revealed that the blue halo depends not on the specific architecture of the tiny ridges, but on their level of disorder—in other words the degree of variation in their height or spacing.

To explore the impact of the phenomenon, the team constructed a series of small squares with different colored pigments and surface textures—while one type had a smooth surface, another had ridges that gave rise to an iridescent sheen, and a third type had ridges that produced a blue halo.

The researchers then let bumblebees lose on these "artificial flowers", with each bee in turn presented with two types of black square, one of which was coupled with a sweet solution and the other with a bitter-tasting one.

The bees were able to learn which square to visit for a tasty treat even though the squares were rearranged after each drink, suggesting bees can see the optical effects generated by the surface textures—and can spot the blue halo even without the presence of an iridescent sheen.

Information for this article taken from *The Guardian* (https://www.theguardian.com/science/2017/oct/18/flower-nanostructures-optical-trick-attract-bees-pollinators-blue-halo); *LiveMint* e-newspaper (*www.livemint.com); and* www.thehindu.com.

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