



Block Fellows Describe Their Summer Research

As I stated in my last *Plant Press* article, it has been very gratifying to be able to collaborate with my former students on my sabbatical research and to be able to have our Herbarium Fellows participate in this collaboration this summer. I am working with Ashley Morris, C'97, at Furman on a number of spatial genetic studies of plant populations on the Domain, including the mystery of *Phacelia* morphotypes that JT describes below. I am also working with Sarah McCarthy-Neumann, C'99, at Tennessee State University to examine long-term dynamics in Plateau forests, and this is the work that Rob and Keegan describe in their pieces. —Jon Evans

From JT Michel, C'24

This summer, while being funded by The Garden Club of America's Joan K. Hunt and Rachel M. Hunt Summer Scholarship in Field Botany, I was able to conduct both ecological and genetic research on *Phacelia bipinnatifida*. In Shakerag Hollow, just inside the gates of the Domain, lies a rare phenomenon of spatial segregation between morphotypes occurring among the same species. This means that *P. bipinnatifida* in Shakerag Hollow demonstrates two different

expressions within the same species, and these plants that exhibit different traits—such as different flower color, stamen length, spotted leaves, and more—are situated within the landscape in distinct patterns. What we have been calling the blue vs. purple *Phacelia* do not intersect, but rather stand their ground so as to make any given location in Shakerag Hollow either an ocean of blue or purple, but never both.

Dr. Evans and I wanted to determine if this phenomenon occurred in other parts of the species' range, so we chose a park heavily populated with *Phacelia* in Frankfort, Kentucky, to ask this question. Preliminary phenotypic observations told us that, at least in this Kentucky population, *Phacelia bipinnatifida* does not fall into these different expressions, or morphotypes, as they do in Shakerag Hollow. The results of two weeks of DNA extractions and analyses working with our collaborator, Dr. Ashley Morris at her plant genetics lab at Furman University, seemed to support this preliminary observation as well. Something is afoot in Shakerag Hollow, but it will take some more time ... and maybe a few more trips into our serene old-growth cove forest to figure it out.

From Rob Phillips, C'25

I spent eight weeks this summer as a Sewanee undergraduate research fellow working under Dr. Evans. Most of my time was spent conducting fieldwork in Franklin State Forest as part of a long-term study of forest dynamics on the Cumberland Plateau. The fieldwork primarily consisted of identifying and mapping all woody plants down to sapling height in five 100m x 100m plots. Throughout this experience I became incredibly proficient at species identification and gained an understanding of the ecology and life cycles of many of the trees.

The highlight of my summer was taking a break from fieldwork and shadowing Tennessee state botanist Todd Crabtree when he came to Sewanee to monitor populations of the endangered *Clematis*

morefieldii on the Domain. In order to get to the *Clematis*, we hiked to remote parts of the Domain, where we also saw a rare cedar glade ecosystem and many other obscure and uncommon plant species that I had not seen before. It was incredible seeing a federally endangered species first hand and even more wonderful that we were able to see it while it was flowering. The experiences I had during my internship this summer were incredibly memorable and meaningful and I am looking forward to continuing my involvement with plants and plant-related research in the future.

From Keegan Congleton, C'25

I also worked at Franklin State Forest for four weeks this summer with the other fellows and the team from TSU. I was engaged in spatial mapping of trees using iPads, gathered diameter measurements, identified trees, and determined relative abundance of seedling species. Over the course of the summer the team did 500 10x10, plots gathering data on thousands of trees. During the comparatively short time I was able to assist, I learned about tree identification and fieldwork. Working in the forest was the best part though. The history and the diversity of the forest were incredible. There were multiple species of hickory that were challenging to identify in the sapling stage but made the plots with them all the more exciting.

My favorite tree was a hybrid chestnut x white oak in one of the plots, which are pretty rare and had interesting leaves. There was also a species of fuzzy blueberry bush (*Vaccinium hirsutum*) that produced berries that were also fuzzy and delicious. It is a rare species of blueberry, and it was interesting to see it grow clonally as a perfect circle in the forest understory. It was nice to work with people that were willing to spend hours obsessing over plants instead of walking right by them!



Why Are We Seeing Red?



We are heading into fall when one talks about brilliant colors as the leaves on the trees form their abscission layer and prepare to drop to the ground in shades of yellow, oranges, red and purples. Although the xanthophylls give us the majority of

the yellows, as the carotenoids do with the oranges, it is the anthocyanins that provide predominantly the red to purple pigments that we're looking at today—and we're not waiting for the cooler temperatures of fall. Just as a note, though the first two are present through the growing season, simply hidden by the greens of chlorophyll in the leaves of our trees, the anthocyanins are more actively produced in the leaves towards the summer's end, encouraged by the weakening of the foliage as well as the cooler temperatures. But in the tropics they are more consistently present and visible, sometimes on the top side of the leaves, sometimes on the bottom, and often on the new growth of many trees and shrubs as well as understory herbs, ferns, and fern allies.

When I first started reading about these water-soluble pigments, there were relatively few articles on them. This is not the case today, and I suspect largely due to the presence of antioxidants as part of the chemistry and the increased awareness of the value of this for us and our health. But those more familiar with chemistry may possibly note a lack of chemical accuracy in this statement, which speaks in

part to my training in philosophy rather than biology. The plethora of more recent articles read largely like Greek to me, so I will sidestep the chemical analysis and simply speak to observations.

My first awareness of anthocyanin pigments included the abaxial (lower) surface of leaves predominantly in the *Marantaceae*, the arrowroot or prayer plant family, as well as on the tops of the leaves in many *Coleus* species (mint family) and hybrids as well as Crotons, *Codiaeum variegatum* cultivars, (Euphorbia family). Though generally persistent in the former, in the latter where the pigments are on the upper leaf surfaces, the coloring would fade on older leaves and not be present on newer leaves grown in lower light levels.

The first article I read (1979) spoke to the anthocyanin pigments in the abaxial epidermal layers of tropical understory plants reflecting back some of the light wavelengths that had passed through the chloroplasts upon initially hitting the leaves, providing more useful light for the photosynthetically active parts of the leaves. Though not being completely clear on how this worked, it made sense to me not only in terms of what was presented in the article but also in for plants with anthocyanins located in the upper epidermal layers of the leaves, where by similar reflectivity these pigments could protect the leaves from too much light potentially damaging leaf tissues. This also explained why these colorful surface pigments would gradually fade in lower light conditions and not be present in new growth—until the plant was put back into higher light.

I have discovered several additional bits of information on these pigments from reading

through more recent articles. One aspect of these pigments is that they can be abundant in new leaf growth but also in older leaves, such that anthocyanins can in some cases suggest some measure of stress on the growth. This stress may be environmental but it can also simply be nutrient related. It is also interesting that the accumulations of different anthocyanin pigments in fruit ripening can lead to the fruits being more visible to one group of seed dispersers or another, i.e. , red and purple/black being more visible to birds and actually less visible to mammals and insects. (2009) Finally, these pigments can render the foliage less palatable to would-be herbivores, as well as in some cases providing camouflage while in others providing an antifungal property which not only protects against fungal pathogens attacking young leaves but also prevents collection by leaf-cutter ants. (1989)

The bottom line is that as with almost any aspect of the plants that we so enjoy seeing and exploring, the purposes of their different structures and pigments goes far beyond our viewing enjoyment and can quickly lead us into a greater understanding of the intricate functioning of ecosystems and how all these things are interconnected in ways that we continue to study and try to understand.

—Jonathan Ertelt

1979. *Biotropica* 11(1): 70-77. Lee, Lowry, and Stone.

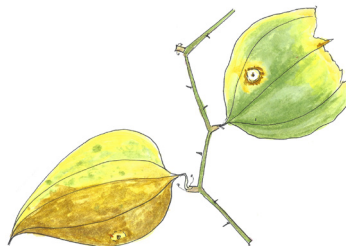
1989. *Journal of Tropical Ecology* 5:293-300. Coley, Phyllis D., and T. Mitchell Aide.

2009. *Anthocyanins*. W. J. Steyn. ISBN : 978-0-387-77334-6.

Weeding the Woods

When we bought our 20-some acres, we were looking for woods we could walk in and some water feature. We nearly didn't look further into buying the property because when we started to walk the land all we could see was greenbrier, perhaps from past use of the land for cattle forage and/or the openness of the young woods. Further inspection led us to decide to buy it after all, since the woods were in good shape and there was a house site that didn't involve cutting down a lot of those trees. A lot of the appeal was the presence of seasonal streams on the property. However, we have found those stream beds to be heavily infested with Nepal grass, about the only non-native plant in our woods. Greenbrier, while annoying, is at least a native plant. We really wanted to eliminate the Nepal

grass. Besides crowding out the lovely ferns and other natives, it alters the nutrient cycling in the soil and disrupts the native plant and insect communities. We spent a lot of time pulling it



up and even went to the extreme of putting on a backpack sprayer and hitting it with Roundup multiple times, even though we are generally opposed to Roundup. It eventually became

apparent that that battle would never be won, especially since there was a constant source of seed washing down from a neighboring field. It still pains us to see our stream sides and fern hollows drowned in Nepal grass each year.

More recently, we have been in battle with another unwelcome plant, *Perilla frutescens*, known as perilla mint or beefsteak plant, which has invaded our woods. Like the Nepal grass, it is washing down from the same neighboring field and likes the same locations—semishaded, damp woodlands. It is native in the mountains of eastern Asia and has been cultivated in Asia for centuries. The cultivated variety has many culinary uses, some due to its red color, but also due to its flavor. The wild

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Calendar of Events

MEADOW TRAIL

South Cumberland State Park Visitor's Center, Saturday, Sept. 23, 10 a.m. and Sunday, Sept. 24, 2 p.m., Yolande Gottfried.

The Herbarium is offering two opportunities to celebrate the first weekend of fall and catch the end of the summer wildflower display on the Meadow Trail behind the South Cumberland State Park Visitor's Center. One-hour easy walk. Meet at the kiosk to the right of the Visitor's Center that marks the trailhead.



Quercus alba L.

BOTANICAL ART

Saturday, Oct. 28, 9:30–11:30 a.m., Mary Priestley

Produce botanically correct artwork without drawing: transfer a careful rubbing of a leaf to watercolor paper. Then use any of a variety of materials to create an image suitable for framing or notecards. Tree leaves and art materials will be provided, but bring your own if you wish. This activity is suitable for all ages. Spencer Hall, room 169.



The Herbarium sponsors a nature journaling group that meets Thursdays, 9–11 a.m., led by Mary Priestley. All are welcome. Email Mary for more information.

Wear appropriate shoes on all walks. Risks involved in hiking include physical exertion, rough terrain, forces of nature, and other hazards not present in everyday life. Picking flowers and digging plants are prohibited in all natural areas.

THE SEWANEE PLANT PRESS

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HERBARIUM PUBLICATIONS

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What If Trees Could Walk?

Trail Guide to Shakerag Hollow

Sewanee Wildflowers in Watercolor

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Weeding the Woods, continued from page 2

variety, however, is high in perilla ketone, potentially toxic, and it is not as flavorful. The strong, somewhat unpleasant smell might indicate its unpalatability. The name, beefsteak plant, comes not from a culinary use but from the reddish-purple color of the leaves, looking somewhat like raw beefsteak. The name perilla mint is accurate in that it is in the mint family. Unlike the Nepal grass, we have some hope of keeping it from becoming established. Last year we pulled several large garbage bags of the weed and are on our way to pulling several more this year, trying to catch it before it blooms and sets seed.

Nepal grass and perilla mint are bad enough, but thank heavens we don't have some of the invasive woody plants like wisteria or bittersweet or honeysuckle. When patrolling the woods, I will come upon the occasional privet or burning bush and pull that up. The deer probably eat anything woody they come across—they do at least eat greenbrier—and the forest floor looks unnaturally bare. The deer probably have also eaten the delightful things we used to find—gentians, fairy wand, grass-of-parnassus, and, often, cardinal flower. It would be great to put up an enclosure and see what might return if protected from deer predation.

We also weed our pond! Another attractive feature of the property was an advertised pond site, which turned out to be a wet hole with a failed dam. We did decide to seal the hole, repair the dam, and greatly enjoy our pond. We are keeping a close eye on the plants that get established in it. The edges are largely a tall sedge, wool grass, but in the last two to three years three-way sedge has gotten

established. When I saw the first patch I tried hard to eradicate it but it has quickly spread. We just hope it won't become a problem.

I also found one patch of cattails and did eliminate that—it is a small pond and we don't want it filling quickly with vegetation. One researcher found that a single cattail seed can grow a rhizome system 10 feet in diameter in a single season and send up 100 clonal shoots! One thing we don't tolerate, besides cattails, is water shield. We haven't completely eliminated it but we drag it up from the roots with a garden rake every year. Sometimes my husband goes out on the pond in his kayak to get to it but a lot of the time it can be reached from the shore, though this year he waded in almost over his rubber boot tops. Even though these are all native plants, they are weeds if we don't want them there.

One plus in weeding the woods or the pond is just getting out there—sometimes it takes a task to motivate us and then we find how much we enjoy just being out and finding things we wouldn't otherwise have seen. Our recent assault on the perilla mint led us to a previously undiscovered patch of cardinal flower in bloom. As we progress into fall, there may be some roughleaf goldenrod that the deer have missed. Slogging around the edge of the pond leads to the discovery of quite a lot of Maryland meadow beauty and some dwarf St. John's wort. And—oh no!—checking out the pond for this article, I found a clump of the dreaded perilla mint on its banks! The struggle never ends.

—Yolande Gottfried

