

NORTH CAROLINA
BOTANICAL
GARDEN

CONSERVATION GARDENER

SPRING & SUMMER 2018
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THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

IN THIS ISSUE

ON THE COVER

Black swallowtail caterpillar on Solidago sp.
Photo by Catherine Bollinger

Solidago rugosa

Rough-leaf Goldenrod



Goldenrod illustration by Sandra Brooks-Mathers



Papilio troilus (Spicebush swallowtail) butterfly on Sassafras albidum (Sassafras) illustration by Dot Wilbur-Brooks

Wildlife, including swallowtail caterpillars and butterflies, rely on rich biodiversity for survival.

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To inspire understanding, appreciation and conservation of plants and advance a sustainable relationship between people and nature.

Biodiversity is like a box of crayons

BY DAMON WAITT, NCBG DIRECTOR

Dear Members and Friends,

Biodiversity is like a box of crayons. You never know which color you're going to need.

As one of the region's foremost centers of botanical research, the North Carolina Botanical Garden bears a unique responsibility to do all we can to advance the cause of biodiversity. From our native plant displays that celebrate and funnel the flora of our region into our gardens, to our conservation program that protects land and preserves imperiled species, to our Herbarium research that documents and discovers new species, the understanding and preservation of biodiversity is an essential element of what it means to be a "conservation garden." If plant species were crayons, our box would be the one with the sharpener on the back.

With over 800,000 specimens, the UNC Herbarium contains more crayons than any other herbarium in the southeastern U.S. Founded in 1908 by William Chambers Coker, the Herbarium has been part of the Garden since 2000. While the uninitiated may

think an herbarium is a mausoleum of dried, pressed, and annotated plants, it is a living, breathing hub of botanical research. Herbarium Director Alan Weakley and colleagues recently published three papers in the *Journal of the Botanical Research Institute of Texas* that collectively named a new genus, several new species, and a new variety, increasing our understanding of biodiversity in the southeast.

Our conservation program prevents crayons from rolling under the couch and becoming lost forever. Through research and germplasm storage, the program preserves the genetic resources of 45 species of endangered southeastern plants as a last resort against extinction. The conservation program also preserves and manages over one thousand acres of the most vibrant landscapes in Chapel Hill including the Piedmont Nature Trails, Battle Park, and Mason Farm.

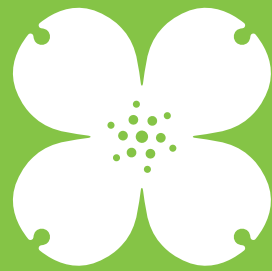
Our horticulture program uses over 2,100 crayons to illustrate the flora of North Carolina in habitat portraits (Piedmont, Sandhills, Coastal Plain,

and Mountains) and other displays. It is a leading source of information and expertise on which hues to use in your own landscape, manufactures new crayons on site in our native plant nursery, and distributes a rainbow of 50 different species of wildflowers to Garden members each year.

After 50 years of adding new crayons to our programs, our plant biodiversity box is bursting at the seams. If we are going to meet the challenge of today's (and tomorrow's) threats to biodiversity, we are going to need a bigger box. With new and expanded facilities, we will be able to house the historical records of three million specimens, create a home for our research, conservation, and horticulture programs, and train the next generations of botanical artists. As illustrated below, the Plant Biodiversity Research Center is a forward-thinking design that will inspire action and change.

This is our creative vision for protecting and conserving plant biodiversity in the 21st century...in color.





NORTH CAROLINA
BOTANICAL
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Botanical Garden

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Upland chorus frogs greet spring in
our Coastal Plain Habitat.



This most wonderful time of the year

BY JENNIFER PETERSON, MANAGING EDITOR

It's spring! Spring is my favorite season, and so much of what makes it wonderful for me happens here at the Garden. I love the croaking of the chorus frogs when the weather begins to shift. I delight in watching the delicate spring ephemerals emerge. I inhale the warm, fresh air with enthusiasm.

I also excitedly anticipate old friends returning from their winter naps or vacations – the first butterfly is always a special sight. We are fortunate to see so much wildlife in our Garden, including pollinators and birds. This is not a happy accident, though. The Garden is rich with biodiversity, a varied smorgasbord of plants to delight even the pickiest eater.

Unfortunately, wildlife do not find such feasts easily anymore. Due to habitat destruction, pollution, and other factors, our Garden is an oasis in

a food desert for some animals. (You can read more about this in Catherine Bollinger's article on page 6.)

But, this is a problem we can fix. By planting a variety of native plants in our home and business landscapes, we can provide wildlife with food throughout our communities. (Read more about how to do this in Catherine's other article on page 10.)

Last year, I took a caterpillar class with my daughters here at the Garden. Armed with our new knowledge, we set out to find caterpillars in our own yard. We were disappointed that we didn't find much. You can be sure, I will be carrying home plants from the Spring Plant Sale & Festival (May 12) to enhance the biodiversity of my own backyard and invite more wildlife friends to visit during this most wonderful time of the year and all year long.



SIMS
LECTURE

IN THE FOOTSTEPS OF SPRING: RETRACING NATURALISTS EDWIN WAY TEALE AND JOHN K. TERRES

APRIL 15; 2:30 - 3:30 P.M.

John R. Harris retraces the paths of renowned naturalists Edwin Way Teale and John K. Terres, highlighting what's been lost and celebrating how much remains in these wild places. Book signing and reception follow lecture. Free, pre-registration required.

DETAILS AT
GO.UNC.EDU/FOOTSTEPS

Chrysopsis mariana, Maryland golden-aster.
Illustration by Dot Wilbur-Brooks



Meet the 2018 Wildflower of the Year

BY HEATHER SUMMER, NCBG SEED PROGRAM COORDINATOR

Chrysopsis mariana, Maryland golden-aster, is a cheerful member of the Asteraceae (Sunflower Family) that is common throughout the southeastern United States. It can be found in well-drained open woods and dry forests and is a familiar sight on North Carolina roadsides from the mountains to the coast. Beginning in mid-summer and lasting through mid-fall, Maryland golden-aster brightens the landscape with clusters of brilliant, golden-yellow daisy flowers atop loosely branched, upright plants. The rigid, sturdy stems can grow up to three feet tall, and both the stems and leaves are covered in short, silky hairs.

Like all members of the sunflower family, Maryland golden-aster has an interesting floral structure. What appears to be a single flower is actually a cluster of much smaller flowers, composed of ray flowers (the "petals") and disc flowers (the "center"). Each individual ray or disc flower is called a floret, and the entire cluster of florets is called a head. Maryland golden-aster has approximately 40-70 florets per head

and each one forms a single seed. Attached to each seed is a clump of feathery hairs (called a pappus) that aids in dispersal by allowing the seed to "float" in the wind. This pappus makes the seed heads of Maryland golden-aster look like beautiful, fluffy bronze puffballs in the fall and early winter.

Maryland golden-aster is a tough, well-behaved plant that prefers dry, well-drained clay or sandy soils. It can withstand the heat and humidity of the south and is very drought-tolerant once established. In a garden setting, it is quite happy in a sunny to partly shady site with dry to average soil. It does not like to have its feet wet and will quickly decline if soils are soggy for too long. It is a relatively short-lived perennial, and although it will not spread by rhizomes, it will persist in the garden by re-seeding.

Versatile, hardy, and easy to grow, Maryland golden-aster is the perfect choice for folks new to gardening with native species. Plant it in a native perennial border or meadow garden with *Asclepias tuberosa* (butterfly

milkweed), *Symphyotrichum* spp. (asters), and *Muhlenbergia capillaris* (hairgrass) for a bright splash of color. With its long bloom time and showy fluffy seed heads, Maryland golden-aster is sure to provide plenty of interest and enjoyment in your garden across multiple seasons.

For a Wildflower of the Year brochure and packet of Maryland golden-aster seeds, send a stamped, self-addressed, business envelope with attention to NCWFOY 2018 to North Carolina Botanical Garden, UNC-Chapel Hill, CB 3375, Chapel Hill, NC 27599-3375.

The North Carolina Botanical Garden and the Garden Club of North Carolina work together to promote the use of native plants in home gardens. Each year since 1982, a showy native perennial has been chosen and seeds of that wildflower are distributed to interested gardeners. To view a list of the past North Carolina Wildflowers of the Year, visit the Garden's website: ncbg.unc.edu/north-carolina-wildflower-of-the-year.





Protecting Plant Diversity

BY CATHERINE BOLLINGER



Biodiversity – the variability among all forms of living organisms within species, between species, and among environments – is a particularly hot topic these days among scientists who study life on our planet, largely because much of it is being lost rapidly. Esteemed Harvard biologist Edward O. Wilson calls the current loss of Earth’s biodiversity “among the deadliest threats that humanity has imposed on itself.”

HIPPO: An acronym of ranked biodiversity threats

HIPPO delineates the primary threats to the diversity of plants and animals. Generally, more than one of these threats occur simultaneously, thereby increasing the risk to threatened species. Ranked in order of their severity, the threats are:

Habitat Destruction – Whenever usable habitat is destroyed by human

Invasive Species – The invasion of non-native plant, animal, and microbial species into regions in which they did not evolve threatens biodiversity in several ways. Invading species may prey on or parasitize native species, reducing native populations to near or full extinction. Invaders may hybridize with natives, thereby genetically annihilating species. Invaders may outcompete natives for food or the space they require to exist. In the southeastern U.S., numerous invasive plants are outcompeting natives for space, including shrubs like *Elaeagnus angustifolia* (Russian olive) and *E. umbellata* (autumn olive), and the various species of non-native *Ligustrum* spp. (privet).

Pollution – Discharging toxic synthetic chemicals and heavy metals into the natural environment reduces species diversity and easily pushes rare species toward extinction. Even nutrients such as phosphorus and nitrogen are lethal to the health of ecosystems, especially aquatic ones, when they are overabundant, as occurs often in rain runoff from suburbs and agricultural fields where fertilizers are excessively applied.

Population Growth – The sheer increase in the number of human beings currently alive on the planet negatively impacts plant and animal diversity because humanity is claiming for itself the resources that other species also need to survive.

Overharvesting – When scientists explain this threat to biodiversity, they usually cite examples such as Earth’s overfished oceans. But overharvesting threats to plant diversity also exist. In North Carolina, the illegal harvesting of *Dionaea muscipula* (Venus flytraps) from their limited remaining habitats along the coast pose a very real threat to the continuing existence of



Volunteers replant Venus flytraps recovered from poachers.

Loss of plant diversity is a substantial component of biodiversity loss, and that loss involves two mechanisms: the outright death of individual species and the loss of genetic diversity within and among species populations. The disappearance of a plant species via either of these mechanisms often drives the extinction of animal species that rely on those plants for food and/or shelter. Put simply, without the plants they need, animals can’t survive.

activities, the plants and animals that occupied that habitat are displaced or killed. Many species require significant amounts of contiguous, healthy habitat to thrive. When those spaces are eliminated, or even just broken into smaller fragments, many species are severely impacted. Also, some species occur in limited geographic areas, making them especially susceptible to extinction via habitat destruction.

Top: This longleaf pine savanna in North Carolina’s Green Swamp represents one of the complex ecosystems that makes the southeastern Coastal Plain a global biodiversity hotspot.

Bottom: Venus flytraps naturally occur in only one small geographic area in the entire world: longleaf pine savannas within a 90-mile radius of Wilmington, NC.

NORTH CAROLINA BOTANICAL GARDEN



“Because of the rapid rise of plant species extinction rates in North America, botanists are trying to understand exactly which rare plant species still exist in their native habitats.”

this unique species. At the other end of the state, in the mountains, the illegal harvesting of *Panax quinquefolius* (American ginseng) poses a similar threat.

Plant diversity in North Carolina and North America

North Carolina’s rich plant diversity is a result of its varied geology (different rocks become different soils), topography (mountains to Piedmont to Coastal Plain) and latitude. These factors allowed numerous distinct ecosystems to evolve. One of the most rich and complex ecosystems in North America is the longleaf pine savanna, which once dominated eastern sections of a region stretching from North Carolina to Texas. This ecosystem is one of the reasons the southeastern Coastal Plain of North America is recognized as a global biodiversity hotspot. In North Carolina, ongoing conservation efforts are attempting to preserve the species richness of this region in the face of increasing threats to its biodiversity.

Because of the rapid rise of plant species extinction rates in North America, botanists are trying to understand exactly which rare plant species still exist in their native habitats. They need this information to establish a baseline from which they can measure rates of extinction as we move deeper into the 21st century. One of the scientists leading this effort is Wesley Knapp, mountains field ecologist and botanist for the state of North Carolina’s Natural Heritage Program. He and numerous co-researchers across the U.S. and Canada, including Alan Weakley, director of the UNC Herbarium, are compiling data on potentially extinct species by querying plant conservation databases, searching the literature, and vetting the resulting list against a large group of botanical experts from across North America.

The work is ongoing, but in a recent presentation, Knapp noted that we are probably losing more plant

NCBG manages conservation land to protect biodiversity at several locations, including Mason Farm Biological Reserve.

species than we realize, especially those that occur in areas not considered biodiversity hotspots, because those environments are not typically being preserved by current conservation efforts.

The role of herbaria in protecting plant diversity

An herbarium is a collection of dried plant specimens that is curated and maintained by a museum and/or academic institution. Specimens include data on where they were collected and any other information deemed relevant by the botanist who obtained them. The historical collections in herbaria – often centuries old – serve as key reference materials for botanists attempting to understand the distribution of a given species over time and most especially the identity of a species. When botanists want to determine whether a recently collected specimen is a new species, they consult herbarium collections to compare their specimen with any similar ones in those collections.

Extinction matters

Why are scientists worried about documenting the rapid rise in extinction rates? After all, species have been evolving and going extinct ever since the first organisms appeared on Earth. The issue is the rate at which these events occur; it takes far less time to kill off a species than it does for a species to evolve. The Center for Biological Diversity estimates that, until recently, the average rate of extinctions on Earth was about five species per year. However, now we are losing one thousand to ten thousand times more species; literally dozens are disappearing daily.

In his recent book *Half-Earth: Our Planet’s Fight for Life*, Edward O. Wilson states that he believes this decade may well represent the tipping point for the future of our planet. He thinks there is still just barely enough time to reverse extinction rates and preserve remaining plant and animal diversity. Everyone can help by supporting conservation efforts and by acting locally to enhance the native biodiversity of urban and suburban areas, including home landscapes.

“Everyone can help by supporting conservation efforts and by acting locally to enhance the native biodiversity of urban and suburban areas, including home landscapes.”



BOTANICAL GARDEN FOUNDATION LAND TRUST

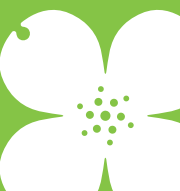
The Botanical Garden Foundation, Inc. (BGF) is the membership organization that supports the Garden, its mission, and its programs. In addition, the first purpose stated in its Articles of Incorporation is “to receive funds, and to hold lands, regardless of geographic location, for the use of the North Carolina Botanical Garden in carrying out its objectives of conservation, scientific investigation, teaching, public service and public recreation.” In other words – the BGF’s formative prime directive was as a land trust, or an organization that acquires land or conservation easements, or that stewards land or easements to achieve conservation purposes.

Of North Carolina’s 23 land trusts, the BGF is the third oldest after the Highlands-Cashiers Land Trust (founded in 1883) and the Eno River Association (founded in 1966). The “regardless of geographic location” clause allowed the BGF to receive lands from anywhere in the days when land trusts were few and far between, with the intention to transfer these to a local land trust once established.

Today the BGF owns 128 acres of conservation land, holds 115 acres of conservation easements, and oversees the conservation and management of the 84-acre Penny’s Bend Nature Preserve (owned by the Army Corps of Engineers). The Laurel Hill and the Stillhouse Bottom Nature Preserves represent the largest lands held for biological diversity protection, and the Morgan Creek Preserve is the largest conservation easement, which is owned by the Town of Chapel Hill.

— Johnny Randall, Director of Conservation Programs

One function of the Botanical Garden Foundation is to serve as a land trust, conserving land such as the Gordon Butler Nature Preserve south of Fayetteville, NC.



Below: Pollinators love the variety of native species found at the North Carolina Botanical Garden.
Right: Black swallowtail caterpillar beginning to create its chrysalis on a goldenrod. Photo by Catherine Bollinger

You've probably noticed that lawns do not attract butterflies, but a mix of native plants blooming throughout the growing season will.

Everyone responsible for a home or business landscape can contribute to native plant diversity by re-visioning the old notion of "curb appeal" to instead embrace the beauty and importance of landscapes lush with native plantings. For example, by replacing some or all of your non-native, nearly biologically inert lawn with a mix of native trees, shrubs, and flowers, you will measurably improve not only the native plant diversity in your landscape, but also its native animal diversity by providing the plants animals need for food and shelter.

Diverse species of native pollinators as well as non-native honeybees are threatened by loss of habitat and

pesticide poisoning. Small patches of native plantings in suburban and urban landscapes may prove key to the survival of these essential species. Most of our native animal species from birds to salamanders to frogs and small mammals are increasingly displaced by the rapid urbanization of the southeastern United States. The relatively small number of preserves and parks scattered through our region are not sufficient to sustain native biodiversity, but if public and private landowners restored even a portion of their landscapes to native plantings, we might be able to create enough scattered patches of high-quality native ecosystem remnants to slow biodiversity loss. It's a matter of adjusting our perspective to see the value, beauty, and importance of lush native plantings in suburban and urban landscapes.

Benefits of native diversity in your landscape

You might be surprised to learn that replacing traditional non-native landscape plants with diverse natives is as beneficial to landowners as it is to biodiversity. These benefits include:

Healthier plants – By creating mini-ecosystems of native plants on your property, you support the natural controls these balanced systems provide. For example, in a small pollinator garden with food and nectar plants blooming all season, insect pests such as aphids are much less likely to overwhelm plants because of the many insect predators attracted to such plantings. In my own small pollinator gardens, I have watched assassin bugs, praying mantises, syrphid flies, and myriad spiders devour insects on my plants, along with lizards, treefrogs, toads, and small nonpoisonous snakes.

Herbicides and pesticides are rarely, if ever, needed in well-designed native landscapes.

Less maintenance – Grass lawns are well-documented resource hogs. Vast amounts of nutrients and water are poured on these nearly biologically sterile green carpets. Substantial amounts of time and money are spent maintaining lawns. Drinking water supplies are polluted by fertilizer, pesticide, and herbicide runoff. Once established, native plantings require no additional fertilizer, and only water during severe droughts. Instead of weekly watering and mowing, maintenance involves cleaning up the area in early spring when new growth becomes visible, winter pruning of any branches damaged by weather, and occasional weeding during the growing season until your plantings fill in enough to shade out competitors.

Prolonged beauty and visual interest – When you plant a mix of native trees, shrubs, flowers, and grasses suited to the growing conditions of your property, every season will reveal new surprises, from abundant spring, summer, and fall flowers to colorful fruits to spectacular autumn leaf color displays and striking winter silhouettes and textures.

Food and shelter for native wildlife – Native animals displaced by rapid urbanization benefit from native plantings that meet their food and shelter requirements. Pollinator species appreciate an array of flower types that bloom throughout the growing season. Insect- and berry-loving birds will flock to suburban and urban landscapes enriched with native plantings. Dense-growing native shrubs offer preferred nesting sites for many bird species. As the saying goes, if you build it, they will come, and you will be rewarded with endless beauty and entertainment as you watch the wildlife.

Beyond your backyard

If you are interested in ways you can support plant diversity beyond your home or business landscape, a number of options exist:

Support conservation efforts – Supporting local conservation efforts allows you to see the results of that support in your area. By joining groups with a regional focus, such as the North Carolina Botanical Garden, you can support its work, and by visiting the Garden and taking offered classes, you can learn how to increase biodiversity in your own landscape.

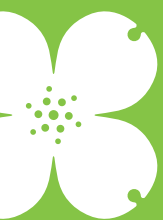
The New Hope Audubon Society, the chapter of the National Audubon Society in the Garden's local region, offers bird-friendly habitat certification during which they evaluate your property and offer suggestions for increasing native plant diversity to support birds. The North Carolina Native Plant Society offers a similar program, evaluating the native plant diversity of your landscape and offering suggestions. The North Carolina chapter of The Nature Conservancy is working to preserve biodiversity of whole systems in the state, such as longleaf pine forests.

Join neighborhood conservation efforts – The region of North Carolina where the North Carolina Botanical Garden is located is home to a number of organizations trying to protect the watersheds that feed drinking water reservoirs. They sponsor annual clean-up events that can always use more hands to pull out the tons of plastic, car tires, and other debris that annually wash down streams. If your neighborhood includes a greenway, start or join the group trying to maintain its plant diversity by removing invasive species. Consider supporting small local grassroots projects, such as a new group



Improving plant diversity in your backyard

BY CATHERINE BOLLINGER



SPRING
PLANT
SALE

Improve the biodiversity in your backyard with native plants from NCBG and other local vendors. Enjoy food trucks, music, kids' activities, and more!
ncbg.unc.edu/native-plant-sale

SATURDAY, MAY 12, 3-7 P.M.



in Chapel Hill, NC called the Piedmont Patch Collaborative (piedmontpatch.org), which is working to teach private and public landowners how to collaboratively restore native landscapes one patch of Piedmont at a time.

By acting locally to increase native plant diversity in home and regional landscapes, you support global efforts to slow species extinction rates. In recent decades, humanity has so transformed native environments across the globe that scientists have named this most recent geologic time period the Anthropocene – the age of humans. This title recognizes the inescapable fact that humans are responsible for the increasingly rapid loss of plant and animal diversity on planet Earth. There's still a little time left to slow this alarming decline. We can start by increasing native plant diversity in our own backyards.

A writer and editor for over 30 years, Catherine Bollinger prefers to write about botanical subjects whenever she can. For the last eight years, she has been blogging about her landscape at www.piedmontgardener.com.

Right: If you are lucky enough to own property already populated with healthy natives, like these wetland beauties, embrace the plant diversity they represent. Photo by Catherine Bollinger
Below: Gardens filled with native plants are essential to native wildlife, and add beauty and curb appeal to a landscape throughout the year.



Newcomb's Wildflower Guide was written for the northeastern U.S., and its southern range limit is Virginia. Nonetheless, it treats a substantial portion of our mid-Atlantic wildflower flora, including almost all of our plant families.

In Praise of a Wildflower Guide

BY RICHARD LEBLOND, UNC HERBARIUM ASSOCIATE

In 1990, I was contracted by the North Carolina Natural Heritage Program to conduct botanical surveys on Camp Lejeune Marine Corps Base in Onslow County. Until then, my botanical experience had largely been restricted to Cape Cod in Massachusetts. It was there that I learned the trade, and for better or worse, I was mostly self-taught.

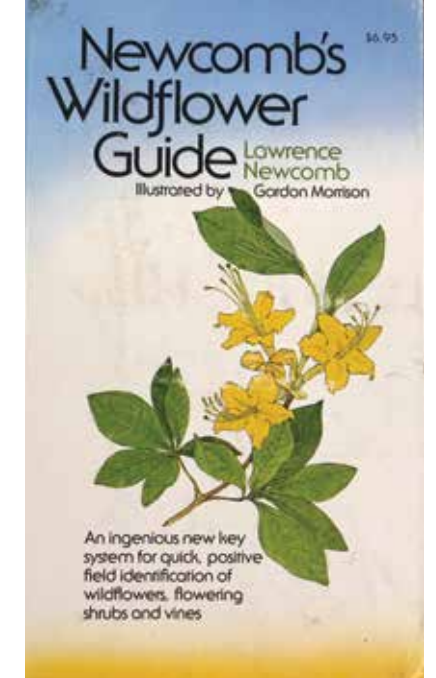
A month after my arrival in North Carolina I was invited to join a crew from The Nature Conservancy (TNC) on its visit to a site in Pender County famous for its diversity and abundance of rare species, including some found only there and at a few nearby locations.

The majority of species were unknown to me. For most I knew the family, which in botany is better than half of the identification battle. And if I didn't know the family, I had a companion who more often than not took me to the right address.

That companion was *Newcomb's Wildflower Guide*, which had been my first teacher as a budding (sorry) wildflower enthusiast. But when the leader of the TNC crew saw *Newcomb's*, she looked at me as if I had just shown up for a motorcycle race with training wheels on. "Real botanists use technical manuals" was written all over her face.

But by this time in my life I was using technical manuals, not only for the wildflowers, but for the grasses, sedges, and rushes as well. Yet in this new land, *Newcomb's* was still a useful tool.

Nowadays *Newcomb's* sits on a book shelf, but it is still cherished as my first mentor. What makes it special is its identification key, which somewhat mimics the dichotomous keys of the technical manuals. *Newcomb's* differs by using English instead of Latin, and by focusing on characteristics that can be seen with the naked eye. It quickly teaches you how to look



at a plant, at its basic structure, and then asks you questions that, step-by-step, lead to the treasure: its name. And though the paths all head off in different directions, they start at the same place.

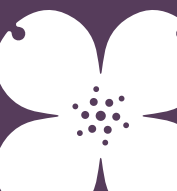
I confess I was a little embarrassed by the TNC leader's response, and no doubt she was concerned about what the Heritage Program and Camp Lejeune had gotten themselves into. I sheepishly tucked the book into my backpack, where it rested against my plastic collection bag which contained – unknown to me at the moment – two species that turned out to be new to science (and the world). *Newcomb's* had nothing to do with the identification of these new species (both sedges), but everything to do with setting me off down the path to their discovery.

WILDFLOWERS OF THE ATLANTIC SOUTHEAST

Plants surround us in our daily lives, even in the urban or suburban areas where most of us now live, and yet we tend to go about our daily lives seeing only undifferentiated greenness. Richard's essay reminds us that "botanical literacy" has to start somewhere – and that somewhere is usually a good wildflower guide encountered in childhood or later in life. If we are at all curious about knowing about those plants around us, a wildflower guide teaches us that plant identification is not an unknowable mystery revealed only to the cognoscenti, but something anyone can learn with a little practice. But south of the northeastern United States, similar books offering a "way in" to botanical knowledge have been hard to find.

In 2019, the North Carolina Botanical Garden and Timber Press will publish a "*Newcomb's*-like" book, *Wildflowers of the Atlantic Southeast*, covering the coastal states (and West Virginia) from New Jersey to Georgia, home to a fifth of the U.S. population. This new resource should help improve our botanical literacy – and also light a green fire under some children and lifelong learners, starting them down the path to becoming another Richard LeBlond, Ace Botanist, discovering and naming new plant species!

— Alan Weakley, UNC Herbarium Director

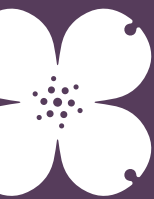




Above: Herbarium specimens of *Allium keeverae* (Keever's onion) and *Allium cuthbertii* (Cuthbert's onion).
Left: Alan Weakley, director of the UNC Herbarium, studies one of the Herbarium's 800,000 specimens.

Herbarium names new, rare North Carolina species

BY EMILY OGLESBY, NCBG COMMUNICATIONS ASSISTANT



Within rows of cabinets winding around the top floor of Coker Hall rest over 800,000 plant specimens. Pressed between sheets of cardboard and then glued and sewn to archival paper, the flattened and dried plants rest gently on top of one another, organized by plant family, then genus, then species.

Herbaria are often described as plant museums, but that belies the critical role they play in our basic understanding of the world around us. Each preserved specimen serves as a data point: a plant found at a specific place and time in a world where plant species are constantly evolving and human activity is contributing to

changes in plant distribution at an unprecedented pace. From dried specimens, researchers can conduct studies about plant evolution and diversification, not only by comparing morphology of different specimens but also by extracting DNA. In some cases, herbarium specimens are the only evidence remaining of now extinct species. Herbaria are also ground zero for the discovery and naming of new species: as keepers of the holotypes of species (the single specimen on which the new species description is based) as well as other specimens that represent a range of characteristics within a species, they help provide data that proves the distinction between varieties, species, and genera.

Overseeing this behemoth, the largest assemblage of plant specimens in the southeastern United States, is Herbarium director Alan Weakley. In his time at the Herbarium, Weakley has named about a dozen new species and contributed to the research of countless more. In November, Weakley, along with a team from the Herbarium that includes undergraduate and graduate students at UNC-Chapel Hill and several UNC Herbarium associates, debuted three new species in a paper in the *Journal of the Botanical Research Institute of Texas*.

The naming of one of this year's new species begins with an ecologist named Catherine Keever. Born in

and raised in the early 20th century in the Brushy Mountains, a small range in the western part of North Carolina separated from the Blue Ridge Mountains by the Yadkin River Valley, Keever took advantage of universities' dwindling enrollment during World War II to earn her PhD in botany at Duke University. She went on to have an illustrious career in ecology and botany, making major contributions to our understanding of ecological succession in the southeastern U.S. One of the primary focuses of her research was primary succession on granite domes in the Brushy Mountains - that is, studying the way plants colonize the sheer mountaintop rock faces that dot the tops of the North Carolina mountains and upper Piedmont.

In May 1989, Alan Weakley, then monitoring rare plants in his work with the North Carolina Natural Heritage Program, visited the Brushy Mountain domes with Keever and saw what was beginning to be recognized as an unusual form of *Allium cuthbertii* (Cuthbert's onion). Cuthbert's onion, a small, uncommon member of

the onion family, is native to the southeastern U.S. and is typically found in sandy Coastal Plain soils. But the form they encountered in the mountains was distinct: it was larger and had pink flowers, and the striking difference in habitat led to speculation that this might be a different, as-of-yet unnamed species.

Given the state's long history of human habitation and increasing urbanization, many might expect the flora of North Carolina to have been already thoroughly catalogued - that undiscovered plant species only exist in remote jungles unsullied by human contact. In fact, "we're still discovering new species all over the southeastern United States," says Weakley. Around 400 new species native to the southeastern states have been discovered in the last 50 years, many of which are local endemic species that live in specialized habitats. There's a long list of plants still to be studied, and not enough researchers or funding to keep up with the backlog. Discovery can be a slow and lengthy process, but ongoing efforts to digitize specimens in herbaria across the southeastern

U.S. (funded by the National Science Foundation) are helping make it more efficient. Now, instead of having to mail specimens back and forth between herbaria or make visits in person, high quality digital photographs can take the place of a physical specimen in many studies of plant taxonomy and distribution.

Nearly 30 years after Weakley visited the Brushy Mountains with Keever, UNC undergraduate Parker Williams, working with graduate student Derick Poindexter, took on the strange Brushy Mountains onion as a research project. In addition to the differences in size and flower color, they were able to use herbarium specimens to study other morphological characteristics, comparing specimens categorized as Cuthbert's onion collected from 10-15 granite domes in the Brushy Mountains with Cuthbert's onion specimens collected elsewhere. What they found confirmed their earlier suspicions: consistent differences in the size of the plant, the color of the flower, the size and texture of the seeds, the size of the seed capsules, and the number of veins in certain modified

**MEMBERS
SEED
LIST**

Our annual Members' Seed List has gone digital! As a member, you are entitled to eight free packets of seed. Be sure to order yours from the list found online.

DETAILS AT
NCBG.UNC.EDU/2018_SEEDLIST



A granite dome in the Brushy Mountains of western North Carolina. Photo by Jeffrey S. Phippen, www.jeffhippen.com

leaves pointed to a new species. Plus, this new species, found on around a dozen granite domes, was geographically separated by around 100 miles from the nearest confirmed Cuthbert's onion population.

Armed with this evidence, the UNC Herbarium team moved forward with the naming of this new species. "Naming a new species is essentially a hypothesis that you publish and defend," says Weakley. "There's no committee that decides, 'Yes, this is a new species.'" You have to make your case, and theirs is a strong one, unlikely to be refuted. The name they chose pays tribute to the great ecologist who dedicated so much of her life to the study of those mountains: *Allium keeverae* (Keever's onion).

Challenging, exposed habitats like the shallow soil mats forming on Brushy Mountains granite domes are often home to rare species that have evolved in isolation. Alan Weakley

and Jim Allison named *Hypericum radfordiorum* (Brushy Mountains St. John's wort), also endemic to the range's granite domes, in 2011. These newly identified species are of critical conservation concern: the only populations in the world grow on just a dozen mountains, few of which are under conservation management. Knowing something's name and being able to recognize its rarity are the first steps in conserving it.

Sometimes, narrow endemics like Keever's onion are only discovered as distinct species after it's too late: the same journal article announcing Keever's onion reports what is essentially the posthumous validation as a distinct species of an asphodel species endemic to the North Carolina mountains. Once thought to represent natural variation within *Nartheicum americanum* (yellow asphodel), close study of herbarium specimens by Herbarium associate Bruce Sorrie and Weakley confirmed

that the North Carolina mountain population was a distinct species, *Nartheicum montanum*, not seen since 1919 and apparently extinct.

Unlike *Nartheicum montanum*, whose scientific confirmation arrived too late to help save it from extinction, the recognition of Keever's onion and Brushy Mountains St. John's wort as species with only a few populations each provides the opportunity for conservation success by working with private landowners in the area.

The staff and collections of the UNC Herbarium are undertaking the critical, foundational work of figuring out what species are all around us. Understanding how our local flora operates and evolves can help us predict and prepare for the upheaval human activity creates in the natural world. By cataloging the incredible biodiversity of our region, we can target species and land for conservation and continue to preserve our unique natural heritage.

DISCOVERING MAGIC IN THE GARDEN

SATURDAY, APRIL 7, 1-4 P.M.

Join us for a family-friendly celebration of spring and the Garden's natural wonders with fun, hands-on activities and nature play.

NCBG.UNC.EDU



The Best Part of Summer

BY ELISHA TAYLOR, NCBG YOUTH AND FAMILY EDUCATION MANAGER



It's an early morning in July. The cicadas are already buzzing in the trees and the air shimmers with humidity in the sunbeams that fall across the pathways. Laughter rings out in the Garden. A group of high school students is busy filling bird feeders, setting up nature journals, and cracking one another up while practicing their best bumblebee impersonations for a puppet show about pollination.

These enthusiastic students are Counselors-in-Training (CITs) with the Garden's popular **Nature Explorers Summer Camp** program. Camp is designed to connect children to nature, foster a sense of wonder and respect for the environment, and cultivate a love for science learning. Teen volunteers assist Garden educators in achieving these goals and in making camp a safe and fun experience for the nearly 100 kids who participate each year. CITs commit to working at least two weeklong camp sessions and earn service-learning hours toward a graduation requirement. Engaging

campers during outdoor explorations, playing group games, reading stories, and helping with nature crafts are all part of a day in the life of a CIT.

Students gain leadership and teamwork skills and real work experience in environmental education. According to Jake, a summer 2017 CIT, "I learned responsibility, how to better engage kids, and so many amazing things about nature. It inspired me to explore my own curiosity."

Kids often cite CITs as one of the highlights of camp, and the feeling is mutual for three-time volunteer Lindsey: "I love working with the kids and developing relationships with them throughout the week." A low staff-to-child ratio (3:1) allows for greater attention to the needs of the campers and more opportunities for kids to make meaningful connections with teen role models. Being a CIT also offers a wonderful chance to make friends with other like-minded students and a rare invitation to unplug and

connect with the natural world. Alice, a former camper and CIT for five years, "just fell in love with doing camp, so I came back every year. I've learned a lot about insects and native flora and fauna. My friends always tease me when I point out, 'Oh, this is that butterfly!'" Others have shared that the experience inspired or reinforced interests to pursue careers in botany or wildlife biology.

CITs provide the Garden an invaluable service, contributing more than 500 volunteer hours each year, and help to make camp, as Alice once said, "the best part of summer" for kids and staff alike.

Do you know a high school student who would make a great CIT? For more information and the application, see the camp webpage ncbg.unc.edu/summer-nature-camp. Applications are due April 4. Please contact Elisha Taylor, camp director, at taylores@email.unc.edu or 919-537-3770 with questions.



Venus flytraps don't eat the insects that pollinate them

BY MATT SHIPMAN, REPRINTED WITH PERMISSION FROM NC STATE UNIVERSITY

While most people are familiar with Venus flytraps and their snapping jaws, there is still a lot that scientists don't know about the biology of these carnivorous plants. Researchers have for the first time discovered which insects pollinate the rare plants in their native habitat – and discovered that the flytraps don't dine on these pollinator species.

Venus flytraps (*Dionaea muscipula*) are in a genus all their own, and are native to a relatively small area, restricted to within a 100-mile radius of Wilmington, N.C.

"These findings answer basic questions about the ecology of Venus flytraps, which is important for understanding how to preserve a plant that is native to such a small, threatened ecosystem," says Elsa Youngsteadt, a research associate at North Carolina State University and lead author of a paper on the work. "It also illustrates the fascinating suite of traits that help this plant interact with insects as both pollinators and prey."

"Everybody's heard of Venus flytraps, but nobody knew what pollinated them – so we decided to find out," says Clyde Sorenson, co-author of a paper describing the

work and Alumni Distinguished Undergraduate Professor of Entomology at NC State.

To that end, researchers captured insects found on Venus flytrap flowers at several sites during the plant's five-week flowering season. The researchers identified each insect and checked to see if they were carrying Venus flytrap pollen – and, if they were carrying pollen, how much.

Out of about 100 types of insects found on the flowers, only a few were both common and carrying a lot of pollen: a green sweat bee (*Augochlorella gratiolella*), a checkered beetle (*Trichodes apivorus*) and the notch-tipped flower longhorn beetle (*Typocerus sinuatus*).

The researchers also retrieved prey from more than 200 flytraps at the study sites. The three most important pollinator species – despite being found so often on the flowers – were never found in the traps.

"One potential reason for this is the architecture of the plants themselves," Youngsteadt says. "Venus flytrap flowers are elevated on stems that stand fairly high above the snap traps of the plant,

and we found that 87 percent of the flower-visiting individuals we captured – including all three of the most important species – could fly. But only 20 percent of the prey could fly. The pollinator species may simply be staying above the danger zone as they go from flower to flower, making them less likely to be eaten."

But other factors may also come into play.

"We know that the snap traps are different colors than the flowers, and may possibly lure different species," Sorenson says. "We don't yet know if they release different scents or other chemical signals that may also differentiate which portions of the plant are attractive to pollinators versus prey. That's one of the questions we plan to address moving forward."

Researchers also plan to investigate additional Venus flytrap sites to see if the plant relies on these same core pollinator species in other parts of its native range.

"We also want to learn more about the flytrap's pollination biology," says Rebecca Irwin, study co-author and a professor of applied ecology at NC State. "How much and what kind of nectar do they produce? How much pollen do they need to reproduce successfully?"

"And we know that Venus flytraps need periodic fires in their native habitat in order to thrive, but how do these fire events – and their aftermath – affect the plant's reproductive success? There



Mike Kunz, conservation ecologist at NCBG, collects potential pollinators of Venus flytrap. Photo by Dale Suiter, US Fish and Wildlife Service

is still a lot to learn about these plants and their pollinators," Irwin says.

The paper, "Venus Flytrap Rarely Traps Its Pollinators," is published in the journal *American Naturalist*. The paper was co-authored by Michael Kunz of the North Carolina Botanical Garden at the

University of North Carolina at Chapel Hill; Dale Suiter of the U.S. Fish and Wildlife Service; and Alison Fowler, Sara June Giacomini and Matt Bertone of NC State. The work was done with support from NC State University.

We appreciate all memberships and additional gifts to the Garden!
Tribute Gifts below were received from July 19, 2017 to January 24, 2018.

Gifts “where the need is greatest” are more important than ever!

BY CHARLOTTE JONES-ROE, DIRECTOR OF DEVELOPMENT

Please give to support the whole Garden, then consider giving to your favorite site or program or making a planned gift.

This year we are especially grateful to our friends who have made gifts that may be used “where the need is greatest.” Gifts for general support are so helpful in making sure the Garden can stay on budget, retain staff, and provide opportunities for students. In the last few years, unrestricted bequests from loyal friends who planned ahead have helped the Garden move forward at an unprecedented pace. In this year of great plans for the future of our conservation garden – as well as some state funding cuts – please consider making an extra gift for where the need is greatest to help keep the Garden open and on course toward a bright future.

Recent unrestricted gifts include \$5,000 each from James and Beth Joslin, Paul and Mary MacDougal, Harriet and D.G. Martin, Stuart and Linda Paynter, and Nolan Lovins. Designated gifts of note include \$50,000 from Syngenta Crop Protection and \$9,500 from the Center for Plant Conservation; \$20,000 from Janice Swab in memory of her late husband Ed for the Herbarium’s Edward C. Swab Floristics Fund; and \$16,000 from Chicita Culberson for care of Villa Pinea. Dave Robert sent \$15,000 to launch the fundraising for the much-

needed arbor replacement at Coker Arboretum, and he will again sponsor an event at the Dead Mule Club to raise funds for student interns at Coker Arboretum and Battle Park. Florence and Jim Peacock’s generous gift will install hands-on interpretive materials and displays for our youngest visitors in the Peacock Children’s Discovery Room. Tom Kenan and other friends of the Arboretum have contributed more than \$10,000 to make sure the Abundance of Springs in the Arboretum will continue to give pleasure to birds and people every day. The Burt’s Bees Greater Good Foundation provided \$7,000 for Horticultural Therapy. Charles and Barbara Burch Safford directed \$7,000 for the new Herbarium building, while Anne Harris provided \$7,000 for immediate Herbarium use. There are many more wonderful and thoughtful gifts than I have space to acknowledge here. On behalf of all the staff, we want you to know that ALL your dues, gifts and contributions are deeply appreciated and essential to the success of the North Carolina Botanical Garden.

Planned gifts continue to make a big difference in the Garden’s work. The late Barbara Roth, founding president of New Hope Audubon, left yet another gift to build the Mason Farm Endowment. Dr. Roth helped defend Mason Farm from a highway years ago, and her generous

gifts in life and through her planned gifts, totaling \$96,890, have helped build the endowment that generates funds to assist our conservation staff in caring for this important University natural area and research site. We recently received another generous distribution from the estate of Bill and Mary Coker Joslin, \$103,962 to build the Coker Arboretum Endowment. This permanent fund has passed the \$1 million mark this year and the income generated annually makes a big difference in our ability to staff and care for this campus treasure. From Mary’s estate there also came another gift, \$77,981, to help with the planning and construction of our new UNC Herbarium. Mary’s uncle, William Chambers Coker, founded the UNC Herbarium more than a century ago. We are grateful for continued support by Dr. Coker’s nieces, nephews, students, and friends for this important facility.

Charlotte Jones-Roe
 Director of Development
 (919) 962-9458

Stephen Keith
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 (919) 843-2411

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Ever wonder what books we read at the Garden? Check out our list of favorite gardening books. These easy to use and understand books help gardeners of all levels reach their gardening goals—whether it’s to grow delicious vegetables, eliminate an unruly invasive, or brush up on their gardener lingo. Find them in the Garden Shop! Members receive a 10 percent discount.

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If you would like to speak with someone about making a special gift to the Garden, call Charlotte Jones-Roe at 919-962-9458 or UNC's gift planning experts at 800-994-8803.

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NEW! CERTIFICATE PROGRAM IN THERAPEUTIC HORTICULTURE

This fall, the Garden will offer a new certificate program in therapeutic horticulture for health and mental health professionals and teachers. The program's comprehensive curriculum, which covers gardening basics like botany and native plant propagation as well as therapeutic gardening techniques and communication skills, will enable professionals to successfully integrate gardening and nature-based activities into their therapeutic work.

Classes (totaling 70.5 hours) will be offered one weekend per month over 10 consecutive months, starting in September 2018 and ending in June 2019. A 40-hour internship will also be required for certificate completion.

Registration opens on Monday, April 2.
NCBG.UNC.EDU/CERTIFICATE-PROGRAMS

CHAPEL HILL GARDEN TOUR

STROLL INTO SPRING · THURSDAY, APRIL 26, 6 - 8 P.M.
Director Damon Waitt will discuss plans for the Garden's future while we thank the hosts of this year's tour. Appetizers and beverages.
TICKETS: NCBG.UNC.EDU

CHAPEL HILL GARDEN TOUR
SATURDAY, APRIL 28, 10 A.M. - 4 P.M.
SUNDAY, APRIL 29, 11 A.M. - 4 P.M.
This year's tour celebrates the University of North Carolina and the Chapel Hill community, showcasing the gardens of UNC officials along with NCBG's Display Gardens and Coker Arboretum. The tour includes *plein air* artists, musicians, select garden-related vendors, and a photography contest. The Chapel Hill Garden Tour is a biennial charitable and educational event of the Chapel Hill Garden Club. Proceeds support NCBG's programs and Children's Wonder Garden as well as the educational and community service projects of the Chapel Hill Garden Club.
TICKETS: CHAPELHILLGARDENCLUB.NET

MARK YOUR CALENDAR

April 7
Discovering Magic in the Garden Spring Family Festival

April 15
Evelyn McNeill Sims Native Plant Lecture
featuring John Harris

April 26
Stroll into Spring Prelude Party

May 6
Dead Mule Club Fundraiser

May 12
Spring Plant Sale & Festival

June 2
Carolina Moonlight Garden Party

September 15
Sculpture in the Garden Preview Party

September 28 & 29
Fall Plant Sale

October 26
Boo-tanical: Pumpkins in the Garden

November 4
Jenny Elder Fitch Lecture
featuring Brie Arthur

December 8 & 9
Winter in the Garden Holiday Festival

For more information:
ncbg.unc.edu/2018-events

North Carolina Botanical Garden

The University of North Carolina
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