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The Azalean

Journal of the Azalea Society of America

President's Letter

Charlie Andrews—Cumming, Georgia

One thing I have learned to do is try to develop year-round interest in my garden. I look to later blooming evergreen azaleas such as Satsuki and Robin Hill Hybrids combined with re-blooming azaleas as well as plumleaf azaleas, hammocksweet azaleas, and late-blooming arborescens to extend my garden azalea season. Hydrangeas, clethra, and hollies are useful as companions with later interest. There are late-summer and fall-flowering plants to choose from and plants with colorful leaves and colorful berries in the fall and winter. Camellias pick up in the fall through early spring. Hellebores also add an early touch. There are many others, but I think you get the idea.

One can draw a parallel with our azalea chapters.

Our chapters should maintain interest for our members. We exist for our members. There should be something of interest available throughout the year. Though each chapter's membership and situation are different, programs, garden tours, field trips, picnics, plant sales, projects, education sessions, hands-on workshops, plant exchanges, cutting parties, and seed collecting are some of many activities that can provide year-round interest for the chapter. What activities depends on the membership's interests. What do the members want from their chapter?

We have all sorts of members. We have plant experts and novices. We have serious gardeners and casual gardeners. We have those who want to try their hand at propagating and others who don't. We have hikers and non-hikers. We have local members and distant members. The challenge is to find things of interest for all. It is not as difficult as it appears. We all joined because we love plants, especially azaleas.

These activities can be organized in an annual schedule and communicated via email to the members. Members can be kept informed by email and a periodic newsletter. The newsletter can be simple or more elaborate if a few members are willing to submit short articles or photos.

Being interested makes members more active.

~ *Charlie*



The Azalea Society of America, organized December 9, 1977 and incorporated in the District of Columbia, is an educational and scientific non-profit association devoted to the culture, propagation, and appreciation of azaleas which are in the subgenera *Tsutsusi* and *Pentanthera* of the genus *Rhododendron* in the Heath family (Ericaceae).

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Deadlines for *The Azalean*:

- Winter 2023 issue is due October 15, 2023
- Spring 2024 issue is due January 15, 2024
- Summer 2024 issue is due April 15, 2024
- Fall 2024 issue is due July 15, 2024

On the Cover

'Raggedy Ann', a double, evergreen azalea with a foliaceous calyx, that is generally associated with Joe Gable although it is not mentioned in the Gable chapter of *Hybrids and Hybridizers* or listed in the *International Rhododendron Register and Checklist (IRRC)*. Michael Martin Mills reports first seeing it decades ago when he visited Caroline Gable in Stewartstown, PA. Photo by William C. Miller III .

Remember, you too can write for *The Azalean*!

To submit your articles and photos for publication, contact: theazalean@gmail.com.



Preview of 2024 ASA Convention: Azaleas in Auburn, Alabama

By John Torbert—Salem, Alabama

In 2024, the ASA Convention, will be in Auburn, Alabama, on Tuesday April 2 through Thursday April 4. hosted by the Alabamense Chapter. Auburn is a small college community in which many diehard native azalea enthusiasts have existed and been responsible for the establishment of plantings on Auburn University campus and throughout the community. This should be peak bloom time for many azaleas.

Headquarters Hotel

We will operate out of the Courtyard by Marriott, located at the south edge of town. The is a new hotel, with nice amenities, a large lounge space in the lobby, a banquet room, and outside space around their pool and fire pit, which will facilitate our plant sale.

A block of 35 rooms is currently reserved in the name of Azalea Society Convention for \$109 plus the ordinary hotel taxes. This rate is good for reservations made at least 30 days before the convention.

To make a reservation, call the hotel at 334-502-0111.



The Auburn University campus is planted with many native azaleas.
Photo by Patrick Thompson

Tentative Schedule

Tuesday April 2

- Pre-conference Azalea101 Workshop
- Registration at Hotel / Plant Sale
- Hospitality Reception / Plant Sale
- ASA Board of Directors Meeting
- Hospitality Happy Hour
- Dinner (on your own)

Wednesday April 3

- Breakfast
- Auburn Arboretum
- Local Garden Tour
- Lunch at Botanic (nursery)
- Local Garden Tour
- Dinner at Crooked Oaks Farm



The namesake of the Alabamense chapter, the Alabama azalea (*R. alabamense*) is found throughout Alabama. Photo by John Torbert.

Thursday April 4

- Breakfast
- Callaway Gardens
- Lazy K (nursery)
- Banquet Dinner & Ceremonies

Azalea 101 Workshop

The Azalea 101 Workshop will be held on Tuesday morning. This will be a five hour long workshop all about azaleas, both evergreen and deciduous. This workshop is designed for the public, and in particular, Master Gardeners to increase their awareness, interest, and expertise in azaleas. Advance registration for this workshop will be required by the public and convention attendees as seating is limited.

For a cost of about \$30, attendees will receive a one-year digital membership to ASA, lunch, and access to a variety of educational sessions about azaleas.

Wednesday, April 3

All activities during the day will be within the Auburn town limits.

After breakfast at the hotel, we will assemble at the Auburn University's Donald E. Davis Arboretum. This is a 14-acre property with one of the finest collections of deciduous azaleas anywhere. The Arboretum's Curator (and Alabamense Chapter Past-President) Patrick Thompson will give us a thorough tour, explaining how this nationally accredited collection of azaleas was developed and all about the work being done to protect, promote, and establish deciduous azaleas in gardens, and in their natural habitat.

We will learn about past and future breeding goals of Auburn Azalea series which should be approaching the peak of their bloom period during the conference.

Other highlights at the Arboretum include an accredited collection of Southeastern native oak species, numerous Alabama habitat gardens recreating coastal dunes, pitcher plant bogs, meadows, rock outcrops, and more.

We will all join together for lunch at Botanic, a new upscale retail nursery with nice garden attractions and an opportunity to shop.

Local Garden Tours

Through the decades, the town of Auburn has had some serious azalea enthusiasts that have trans-

formed their yards into spectacular displays. After the Arboretum, we will visit the gardens of Bob Greenleaf and Ken Rogers. Because these gardens are in somewhat secluded neighborhoods, we will split the group in two; half going to one site first and later the other.

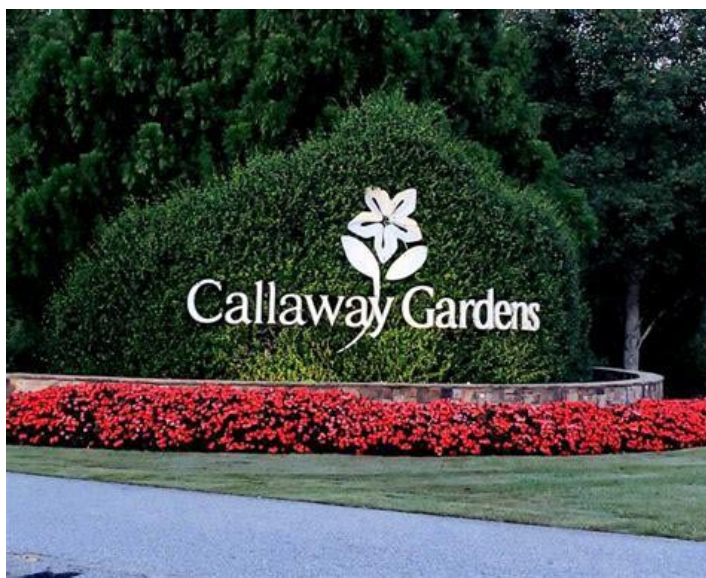
After the garden tour, we will return to the hotel to rest and refresh ourselves, before taking the 20-minute ride to Crooked Oaks Farm. This was the private retreat and Japanese maple farm of Auburn's Coach Pat Dye, who recently passed and donated this property to Auburn's College of Forestry and Wildlife.

After dinner at Crooked Oaks, we will hear a presentation from Dr. Charles Mitchell. Mitchell gives very interesting talks about the history of the rural south with particular emphasis on the evolution of land management practices from the time of the indigenous peoples and the devastating erosion that has occurred. This will be an especially relevant topic given where the tour will be going on Thursday.

Thursday April 4

We will spend all day Thursday at Callaway Gardens in Pine Mountain, Georgia—the southernmost foothills of the Appalachian Mountains. Callaway Gardens is a one-hour ride from the hotel. This is an absolute must-see destination for anyone interested in native and evergreen azaleas.

Almost 100 years ago, Cason and Ida Callaway (after making a fortune in the textile industry) bought 2,500 acres on which they found a population of the rare plumleaf azalea. Already having an interest in horticulture and restoration of eroded



Callaway Gardens. Photo from Callaway Gardens, www.callawaygardens.com.

Society Officers for 2024-2026

For our next election, we will be electing society officers to serve during the term 2024-2026. The positions up for election are Society Treasurer and Secretary. Additionally, we will be electing three Directors to serve during the same period. Those interested in volunteering for one of these positions, or who would like more information, should contact the Chairman of the Nominating Committee, Rick Bauer, at rickfbauer@gmail.com. Volunteers should submit a copy of their resume no later than 30 September. These will be published in the Winter issue of *The Azalean*.



Callaway Gardens. Photo from Callaway Gardens, www.callawaygardens.com.

agricultural, this discovery of plumleaf azalea ignited their determination to create a preserve dedicated to the preservation and education about nature.

Callaway Gardens is now an amazing array of wildflowers, and both evergreen and deciduous azaleas, tied together with trails, ponds, lakes, and famous attractions include the Butterfly Garden and the Victory Garden.

Callaway Gardens has a tram system that will move us through the park and we will have their head horticulturist and other experts to explain the significance of some of our stops.

After we leave Callaway Gardens, we hope to stop at Lazy K Nursery (started by Ernest Koone), which adjoins Callaway property. For anyone interested in the large collection of deciduous azaleas that should be for sale.

Here is a link to a video preview of the 2024 Convention with a sampling of some of the sights: <https://play.soundslides.com/885wYRKR>

Convention Website

More details, including convention registration information, will soon be available on the 2024 convention web page found on the ASA website at <https://www.azaleas.org/convention-2024>.

About the Author

John Torbert is president of the Alabamense Chapter and chairs the 2024 convention's planning committee. He can be reached at john.torbert@gmail.com.



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A New Beginning at the North Carolina Arboretum

By Carson Ellis—Asheville, North Carolina

The North Carolina Arboretum's Native Azalea Collection in Asheville, NC, was first imagined in the 1980s with input from distinguished plantsmen and horticulturists, including Dr. John Creech, David L. Dean, Dr. Henry Skinner, Rich Owings, and Ron Lance, to serve as a conservation reservoir of native azalea diversity. A dynamic natural landscape along Bent Creek, featuring eight acres of rocky slopes, rich bottomland, drainage channels, and a wetland, was selected for the collection. The first azalea specimens were planted in 1992.

In the decades following that initial planting, the Native Azalea Collection has cycled through periods of growth and decline: in 1995, the collection

was accredited by the American Public Garden Association's Plant Collections Network; in 2004, the site was ravaged by flood waters from Hurricane Ivan; in 2008, following restoration work by the Arboretum's Natural Landscapes Crew, the garden was reopened with colorful new signage (and the Azalea Collection was grateful to receive support from the Azalea Society of America in 2021 for an updated printing of these interpretive panels). Most recently, in 2022, the Arboretum hired their first Native Azalea Collection Curator: me, Carson Ellis!

I have worked in horticulture as a native plant and ecological landscaping specialist for the past



Figure 1. On a misty morning in late April, *Rhododendron atlanticum* and neighboring *Rhododendron canescens* perfumed the North Carolina Arboretum's Native Azalea Collection above the carpet of ferns and sedges that characterizes the landscape's herbaceous understory. Photo by Carson Ellis.



Figure 2. The author (Carson Ellis) on a trip to Gregory Bald in mid-June. The trip proved a little early for peak bloom, but backpacking in the Smokies is always a good time and displays from richly colored *Rhododendron cumberlandense*, as well as a few interesting hybrid specimens, did not disappoint. Photo by Emily Ellis.

decade with organizations including the Highlands Biological Research Station, Memphis Botanic Garden, and Tennessee Plant Conservation Alliance. I am humbled to now walk in the footsteps of giants and to join a community with lifetimes of experience studying and growing native azaleas. In my first year working in the Native Azalea Collection, it has been a pleasure to meet and be welcomed by members of the ASA and ARS at local chapter meetings, at the 2023 Joint ASA/ARS Convention in Atlanta, and out in the field. My approach to landscape design is inspired by natural plant communities and some of my favorite experiences have been field trips to see azaleas growing *in situ*! In early June, Steve Wright from Jenkins Arboretum organized an expedition with a great group of *Rhododendron* enthusiasts and I was excited to hit the trails with them on a few site visits around Western North Carolina, including trips to Hooper Bald, Elk Knob, and to J Jackson and Lindy Johnson's beautiful garden where many Zo Warner Hybrids were in bloom.

I was also glad to connect with some of you at the North Carolina Arboretum through new programming out of the Native Azalea Collection, including a great presentation from Patrick Thompson, curator of the AU Davis Arboretum's special collections, and at the North Carolina Arboretum's first "Native Azalea Day," an event which invited the public to the Native Azalea Collection to celebrate spring, participate in walking tours, and watch Asheville's local *plein air* art society paint the landscape. This fall, I look forward to collaborating with botanical illustrator Erin Ellis to offer a new class in the Native Azalea Collection which will guide students in observational exercises to identify and complete botanically accurate water-color sketches of native plants.

In addition to developing new programming in my first year, I have been busy guiding efforts to restore the Native Azalea Collection landscape: the trails have been resurfaced, two wooden bridges redecked and fitted with custom-welded railings, and invasive plant species have been removed by truckloads. With the help of local arborists, I have initiated a site-wide assessment of the overstory and have begun to limb-up and selectively remove trees throughout the landscape, aiming to mitigate hazard trees, establish new planting space, and, importantly, to improve growing conditions by bringing in more light. This emphasis on nitty-gritty landscape maintenance is ongoing but has already transformed the landscape, making improvements for the azaleas and visitors alike, and setting the foundation for future development of the Collection.

Figure 3. On April 29th, over 400 visitors, and 30 artists from the Asheville Plein Air Painters, enjoyed exploring the North Carolina Arboretum's Native Azalea Collection for the Arboretum's first Native Azalea Day event. Using pastels, this artist captured the vibrant orange of *Rhododendron austrinum* growing along the banks of Bent Creek. Photo by Abby Cantrell.



I look forward to continuing to connect with the ASA and ARS communities and invite you all to watch for updates and stay in touch as the North Carolina Arboretum's Native Azalea Collection grows in the years to come!

About the Author

Carson Ellis is the Curator of the Native Azalea Collection at the North Carolina Arboretum. As an undergraduate, she studied environmental science and horticulture, graduating from Mount Holyoke College in 2013. In 2022, she completed her M.S. Biology at Western Carolina University, focusing on topics in plant conservation and ecology. Her thesis work studied the floral visitation networks of rock outcrop plant communities in North Carolina's Highlands-Cashiers Plateau. Her professional work, dedicated to the study and cultivation of native plants, has included positions as an educator, public garden horticulturist, living roof specialist, and nursery manager. Born and raised in Asheville, NC, she is glad to move back to her hometown, where she enjoys spending time with family, hiking, ceramics, painting, and foraging nuts and berries for experiments in fermentation. She can be reached by email at caellis@ncarboretum.org or by telephone at 828-412-8556.



Figure 4. A highlight of the ASA/ARS 2023 Joint Convention in Atlanta, GA, was the opportunity to meet Charles Andrews (shown here pulling the flowers of a tall *Rhododendron calendulaceum* into view) and explore the beautiful and unique azaleas of Hurricane Creek. Specimens of *R. calendulaceum*, *R. canescens*, and an array of hybrids, were in bloom for the visit. Photo by Carson Ellis.



Figure 5. Infrastructure updates in the Native Azalea Collection have improved visitor experience and safety. Here, North Carolina Arboretum staff member Luke Sheaffer assists with redecking one of the Collection's bridges. Photo by Carson Ellis.

2023 Service Award Winners: Dave and Leslie Nanney and Maarten van der Giessen

*By Rick Bauer—Yorktown, Virginia
and Charlie Andrews—Cumming, Georgia*

Distinguished Service Award



Dave and Leslie Nanney. Photo by Barry Sperling.

Dave and Leslie Nanney were honored with the ASA's Distinguished Service Award at the banquet during the 2023 ASA annual convention. This was in recognition of their long association (over 40 years) and contributions to the society and their promotion of azaleas.

The text of the award reads:

David and Leslie Nanney

You are among the longest-term society members, joining in 1979. During this period, you have contributed at both the National and Chapter level. You both have served on the Board of Directors as Directors. Additionally, Leslie has served eight years as the Society Secretary. At the chapter level, Dave served as President of the Northern Virginia Chapter, and you both have made significant contributions supporting chapter activities. Dave is the Legacy Lead for the Holly Springs azaleas and you both were integral to assisting in the establishment of a Holly Springs Legacy Garden at Jenkins Arboretum.

You have worked to improve the society plant database and participate in the beta testing of software for the ASA website. Your impressive

azalea garden is frequently open to the public for tours, encouraging interest in azaleas.

Dave and Leslie, we greatly appreciate your contributions to the society and your efforts to promote azaleas. You are distinguished members of the Azalea Society of America.

See additional coverage in Chapter News (p. 59).

Exceptional Service Award



Maarten van der Giessen.
Photo source: LinkedIn.

Maarten van der Giessen was awarded ASA's Exceptional Service Award. With a great love for azaleas, he has supported and promoted our society for many years.

The text of the award reads:

The Azalea Society of America takes great honor in presenting the Exceptional Service Award to Maarten van der Giessen in recognition of your many years of service in the Azalea Society of America. A longtime member of the Louisiana Chapter, you are a past society director, and have served on many committees, including advertising, the Legacy Project, and chair of national conventions. You are an azalea ambassador. At your nursery, you have rooted millions of azaleas. From these, you often and generously donate plants for conventions and public gardens. Many of your articles, authoritative and always with that touch of van der Giessen humor, appear in *The Azalean*.

Maarten van der Giessen, we greatly appreciate your years of contributions to the society and thank you for your promotion of azaleas. You are an exceptional asset of the Azalea Society of America.

Chapter News



Northern Virginia Chapter plant sale at Meadowlark Botanical Gardens in Vienna, VA. Photo by Carolyn Beck.

Northern Virginia Chapter *Rick Bauer, Corresponding Secretary*

This has been a busy season for our chapter. It started with the ASA-ARS National Convention in Dunwoody, GA. We were co-sponsors of the convention and ran a highly successful plant sale. We thank all involved in planning and conducting this sale. Chapter members Dave and Leslie Nanney were awarded the Distinguished Service Award for their many years of service and contributions to the Azalea Society of America. The American Rhododendron Society (ARS) awarded chapter members Paul and Carolyn Beck with their Silver Medal Award for their many contributions in promoting azaleas and rhododendrons.

The chapter held two successful plant sales at Meadowlark Botanical Gardens in Vienna, Virginia. This was followed by another sale for members of the local bonsai society. This has become an annual tradition as their members purchase azaleas for use in creating bonsai.

On July 16th, we held our annual cutting and plant exchange. Chapter President, Barb Kirkwood welcomed the 28 attendees and brought us up to date on chapter activities. Vice President Ralph Habegger conducted the exchange. We have a large number of azaleas in our inventory and placed many of them in our plant exchange. Attendees were able to leave the meeting with carloads of plants, both azaleas and companions. Addition-

ally, we had a great selection of mature deciduous azaleas for sale.

Our next meeting is on 22 October at Kirkwood Presbyterian Church in Springfield, VA.



Paul and Carolyn Beck receive their Silver Medal Award from ARS President Bill Meyers and ARS Honors Committee chair Bill Mangels. Photo by Don Hyatt.



Dave and Leslie Nanney receive their award from ASA Past President, Rick Bauer. Photo by Kathy Jentz.

Benefits of Phosphite Against *Rhododendron* Root Rot Disease Might Be Assisted By Soil Fungi

By Yu Liu and Jean H. Burns—Cleveland, Ohio

Background and Aims

“*Rhododendron* root rot,” a deadly plant disease caused by soil-borne oomycete pathogen *Phytophthora cinnamomi* (Hardham, 2005), is leading an enormous economic loss in planting *Rhododendron* ssp. and their hybrids. Phosphite ($[\text{HPO}_3]^{2-}$, Phi), a reduced form of phosphate ($[\text{PO}_4]^{3-}$, Pi), is an effective treatment to the infections of *Phytophthora cinnamomi* (Burra et al., 2014; Havlin & Schlegel, 2021; Machinandiarena et al., 2012), usually through either a foliar spray or a soil drench. Phosphite might impact soil environmental conditions and influence the composition of soil microbial communities (Farooq et al., 2022); however, it is unknown whether phosphite has belowground effects on soil fungi which might contribute to an indirect protection against *Phytophthora cinnamomi*. Therefore, exploring belowground effects of phosphite adds knowledge to the sustainability of phosphite application and understanding soil biotic factors like soil microbes in plant-pathogen response.

Method Overview

We conducted a greenhouse experiment on eight *Rhododendron* species. Hand-pollinated seeds were collected at Holden Arboretum (Kirtland, Ohio) (Fig. 1). All seeds were germinated in growth chambers at Squire Valleevue and Valley Ridge Farms in Hunting Valley, Ohio. (Fig. 1). The treatments in our factorial greenhouse experiment included (1) soil treatment (live or sterile soil), (2) phosphite treatment, and (3) pathogen treatment (with or without *Phytophthora cinnamomi*) (Fig. 2). (1) Field soils were collected by shovels at Holden Arboretum. For each focal *Rhododendron* species, we had three replicates of their conspecific soil, and we did not mix these replicates. We autoclaved half of live soil (killing alive soil microbes and nematodes) to obtain sterile soil inoculum. (2) We had different timing of adding phosphite (Fosal Select Alette/Aluminum Fungicide (Prime Source), 80% Aluminum tris (O-ethyl phosphonate), 0.66 cm³ of product per liter of tap water) to plants by soil drench. We treated plants with phosphite either **before** or **after** inoculating *Phytophthora cinnamomi*, so that we evaluated the effects of phosphite to plants as either a preventative or a curative use. For the control, we added the same amount of tap water to plants. (3) We used *Phytophthora cinnamomi* rice inoculum to conduct the pathogen treatment following previous study.



Fig. 1 *Rhododendron* species-true pollination was conducted by hand at Holden Arboretum (top), while we bagged flower buds (second from top) to exclude pollens and pollinators before harvesting seeds so that we avoided hybridizations. Seeds were germinated in trays (third from top). The experiment was conducted in the greenhouse at CWRU Farm (bottom).

Phosphite timing

Preventative
(before-pathogen
use of phosphite)



Curative
(after-pathogen
use of phosphite)



Control
(no phosphite)



Adding
conspicuous
soil

Soil
treatment
(including
live and
sterile soil)

Aug 2, 2021

Aug 16, 2021

Aug 27, 2021

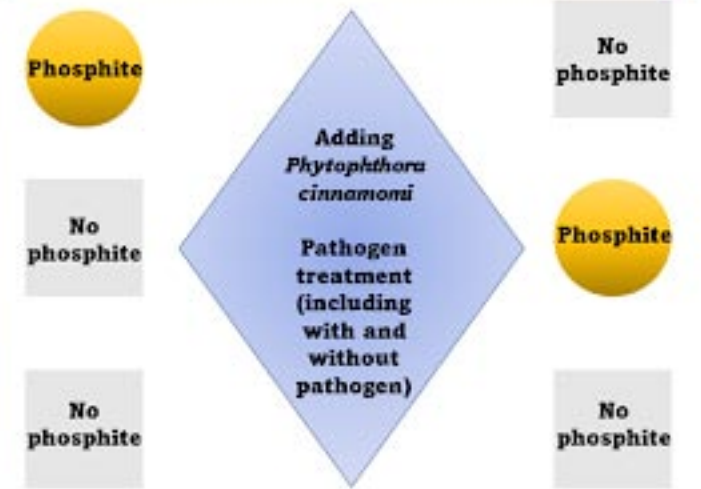


Fig. 2 The experimental design to study the impacts of different phosphite timing to plant performance and the belowground effects of phosphite to soil fungal community.

Species	Susceptibility Estimate
<i>R. atlanticum</i>	
<i>R. keiskei</i>	
<i>R. brachycarpum</i>	
<i>R. kiusianum</i>	
<i>R. calendulaceum</i>	
<i>R. maximum</i>	
<i>R. kaempferi</i>	
<i>R. minus</i>	

Table 1 The estimate of plant susceptibility to *Phytophthora cinnamomi*.

We buried six rice grains into each pot, and we inoculated rice without pathogen in control pots. Plants appeared systematic for disease about two weeks after the pathogen inoculation. The plant survivals were recorded every three days, and we obtained the final survival data when no more death was observed. We harvested each alive plants by collecting its above-ground shoot and belowground root. Plant performance was measured by the dry biomass (dry weight) of root and shoot, so that we had the data of whole plant biomass performance, root biomass performance and shoot biomass performance. During harvesting plants, pot soil samples from alive plants in live soil treatment were also collected for a high throughput sequencing collaborating with Holden Arboretum, which identified soil fungal taxa within each soil sample. With the fungal data, we measured the diversity matrix of soil fungal communities (i.e., diversity, evenness and richness of soil fungal community), so that we can study whether any soil samples had more abundant or diverse soil fungal taxa.

Result Highlight

Based on our measurements, we quantified the plant susceptibility to *Phytophthora cinnamomi* (Table 1). For example, *Rhododendron minus*, *R. kaempferi* (Fig. 3), and *R. maximum* (Fig. 3) had relatively more dead plants in the presence of *Phytophthora cinnamomi*, so they were considered as susceptible species. *R. atlanticum* and *R. keiskei* (Fig. 3) had relatively more survivals in the presence of *Phytophthora cinnamomi*, so they were more resistant species with lower susceptibility. *R. brachycarpum*, *R. kiusianum* (Fig. 3), and *R. calendulaceum* were less susceptible to *Phytophthora cinnamomi*, but they were not as resistant as *R. atlanticum* and *R. keiskei* according to our measurements.

1. Phosphite increased plant survival.

Our results further supported the protective role of phosphite against plant infection of soil-borne *Phytophthora cinnamomi*. Plant survival in the presence of *Phytophthora cinnamomi* was greatly increased using soil drenched phosphite. Different timing of using phosphite showed no significant difference in the protecting plant survival (Liu et al., 2023).

2. Phosphite increased plant biomass.

Our results showed that the use of phosphite increase plant total biomass including both root and shoot biomass, indicating a role of phosphite in enhancing plant performance as a potential bio-stimulant. However, further studies are still needed to understand the importance of such a stimulative role of phosphite in plant productivity and life history (Liu et al., 2023).



Fig. 3 *Rhododendron* species at Holden Arboretum- *R. maximum* (top), *R. kaempferi* (second from top), *R. kiusianum* (third from top), and *R. keiskei* (bottom).

3. Phosphite shaped soil fungal community as an indirect effect of protecting plants.

Our most exciting results from the high throughput sequencing demonstrated a novel potential mechanism of phosphite-mediated protection against pathogens. We found that adding phosphite shaped the soil fungal taxa. A preventative use of phosphite decreased soil fungal richness and diversity, suggesting that phosphite eliminated part of fungal taxa. However, a curative use of phosphite shaped the soil fungal community in different pattern. It increased the fungal richness, and simultaneously soil *Trichoderma* had increased richness and diversity, indicating that phosphite accumulated *Trichoderma* taxa when the *Phytophthora cinnamomi* was present in the soil (Liu et al., 2023).

Conclusion

This study provided novel insights in phosphite-mediated protection against *Phytophthora cinnamomi* via an indirect effect of altering soil fungal community. Different timing of using phosphite (i.e. either before-pathogen or after-pathogen use of phosphite) shaped the soil fungal community in different patterns. The most important take-home message is that phosphite can accumulate a both more diverse fungal community and the *Trichoderma* taxa in the presence of *Phytophthora cinnamomi*. Our findings might contribute to the mechanisms of indirect phosphite-mediated protections. Because *Trichoderma* are known parasites on pathogens, this suggests a specific, indirect mechanism through which phosphite can protect plants against disease. Our study illustrated the value of phosphite treatment as a potential sustainable solution to protect *Rhododendron* against *Phytophthora cinnamomi*, because such effects might alleviate the risk of evolved phosphite tolerance among *Phytophthora* pathogens, even though more studies in plant physiology and pathology are still urgently needed to understand this.

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Fig. 4 The Burns Lab and collaborators at Case Western Reserve University. Yu Xia, Aruni Kadawatha, Noah Clayton, Yu Liu, Trevor Moriuchi, Jean Burns, Saliha Ahmad, Miranda Shetzer, Rosana Villafan, Juliana Medeiros, and Rae Dwyer (left to right).

Sustaining Deciduous Azaleas in a Changing Climate: Lessons Learned from the Southeastern United States

By Patrick Thompson—Auburn University, Auburn, Alabama

Azaleas are well-known in the southeastern United States, but they are so commonplace that they are often overlooked. Horticulturists in the region are mostly familiar with the Asian evergreen cultivars available in the trade. Deciduous azaleas are among those that experts should be sure to become acquainted if they are going to remain part of the landscape. This strong, sensitive, and striking group of azaleas are widespread but increasingly limited in their range. In the case of the southeastern U.S. deciduous azaleas, we continue to cultivate the relationship between wild plants and their cultivated versions. Meanwhile, changing temperatures, rainfall, and habitat loss pose threats to their survival. In response, dedicated growers in the area are curating the gene pool in a way that offers solutions for a resilient future in the face of changing climates across the globe. These and other efforts are critical to ensuring the survival of natural and cultivated gene pools in a landscape that is highly developed, managed, and populated with intentional plants.

Background

All species of azalea belong to the genus *Rhododendron*, which includes nearly 1,000 species across much of the northern hemisphere and south of the equator in Southeast Asia.¹ The taxonomy of the plants in this genus has been in flux since Linnaeus described the now defunct genus *Azalea* in 1735. Regardless of the lumping or splitting at the level of subgenus, section or species, deciduous azaleas are certainly uncommon. There are fewer than 30 species worldwide, with the majority occurring in the southeastern U.S. Southeast Asia is another pocket of deciduous azalea diversity containing at least five different species and subspecies.

A trio of species contributed to the gene pool of the cultivated varieties discussed here. The key species from southeast Asia utilized in Western breeding programs is *R. molle*. Another deciduous species, *R. occidentale*, is a recruit from its native range in the Western U.S. Lastly, *R. luteum*—Europe's only species of deciduous azalea—has a range that spans from southeast Europe into southwest Asia.

As our detailed observations of deciduous azaleas increase, it becomes more apparent that the traditional

concept of a species breaks down over and over in these dynamic plants. They do not exist in a simple linear branching phylogenetic tree, and there are easily observed instances of gene flow between species where they co-occur. This ease of gene flow presents challenges to taxonomists but has enabled plant breeders to create the complex hybrids which continue to fascinate gardeners and researchers alike.

Southeastern U.S. Landscape

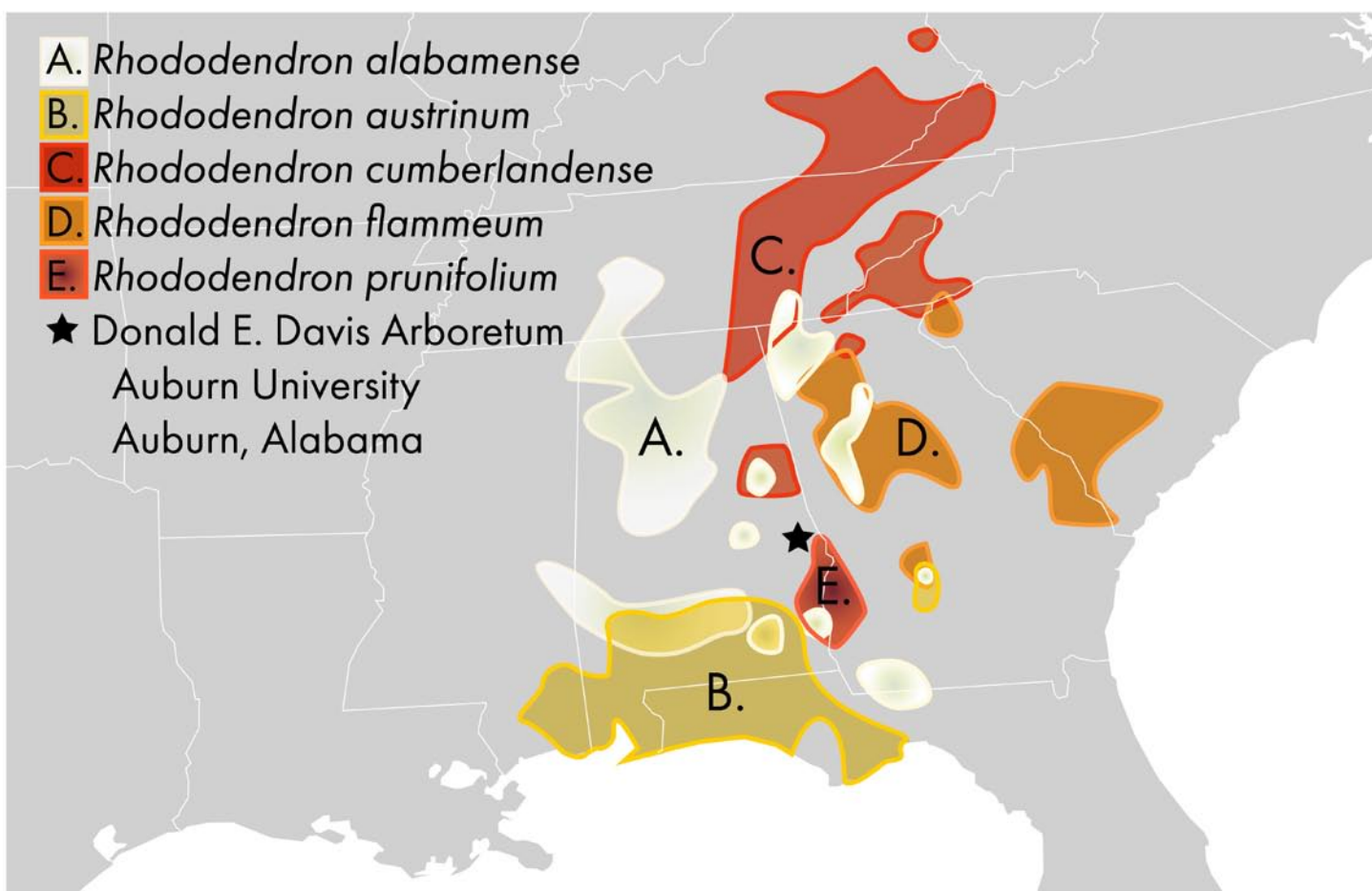
Deciduous azalea species' ranges overlap throughout most of the southeast U.S. Sympatric species occupy different habitat niches that preserve in some degree the genetic integrity of a given species. This is evident in Alabama's Bankhead National Forest where *Rhododendron canescens* populates the draws and wet weather streams between ridges. On the top of the ridges, *R. alabamense* can be found, and in between you can find intergrades between the two species. In Figure 1, the ranges of a selection of species are shown, but these exist entirely within the range of other widespread species like *R. canescens* and *R. viscosum*.

Their phenology* also acts as an isolating mechanism aiding species preservation—the American azaleas do not bloom all at the same time. In addition, the number of chromosomes a species possesses, or its ploidy level, plays a role. Deciduous azaleas species typically fall into the diploid group with 2 sets of chromosomes ($n=26$), or the tetraploid group with 4 sets of chromosomes ($n=52$). Even this is not an absolute division of geneflow, as there are well documented examples of triploid individuals occurring that act as bridges between the two ploidy levels.

Geographic isolation of deciduous azalea species would have been historically limited to pockets at the peripheries. For example, the *R. prinophyllum* populations to the northwest of the region of overlap, and populations of *R. serrulatum* extend into peninsular Florida. In modern times, however, the landscape of the Southeastern U.S. is increasingly developed, logged, and crisscrossed with roads. As a result, the remaining pockets of azaleas are isolated, making natu-

*Phenology is the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life.

DISTRIBUTION OF DECIDUOUS RHODODENDRON SPECIES OF INTEREST IN THE SOUTHEASTERN U.S.



2022 Donald E Davis Arboretum

Graphic by Trae Watson

Figure 1. Natural range (map) of deciduous azalea species in conservation collections at Auburn University's Donald E. Davis Arboretum.

ral geneflow across populations somewhat obsolete.

European Genetic Drift

Deciduous azaleas have long been recognized for their beauty. William Bartram described *R. calendulaceum* as "...the most gay and brilliant flowering shrub yet known" in his widely known book titled "Travels" in 1791. Bartram travelled the range of the American azaleas collecting their banana-shaped seed pods containing hundreds of tiny seeds. The Bartrams were excellent plantmen, but the taxonomy of their day did not encompass the species now known. William's travels took him through the range of *R. alabamense*, which was not described until 1921, and *R. colemanii*, which was recognized as a species in 2011. His endeavors did however, play a significant role in seed dispersal as his family's nursery spent decades sending them back to Europe.

Breeding records of centuries past will never align with the names we now have. We do, however, have knowledge of a Belgian baker in the 1800s making

some of the earliest crosses using the American azaleas. We also know that not long after, breeders in Ghent and England crossed the American azaleas with *R. luteum* and *R. molle* to further expand the potential of the gene pool. The western azalea, *R. occidentale*, was later added into the mix of these complex hybrids. This all paved the way for the exceptional work that gave us the Knap Hill and Exbury azalea hybrids. Moreover, we know that from the time the first American azaleas crossed the pond, they became subject to a variety of intended and unintended selection pressures.

Seedlings that originated and survived in Europe would have originated only from the azaleas the collectors could access. The physical collection of seeds from an expansive natural population created a significant genetic bottleneck. We are only now learning the proper sampling methods necessary to sufficiently capture a majority of the alleles** within a species or genus of plants.² The genetic bottleneck set up these

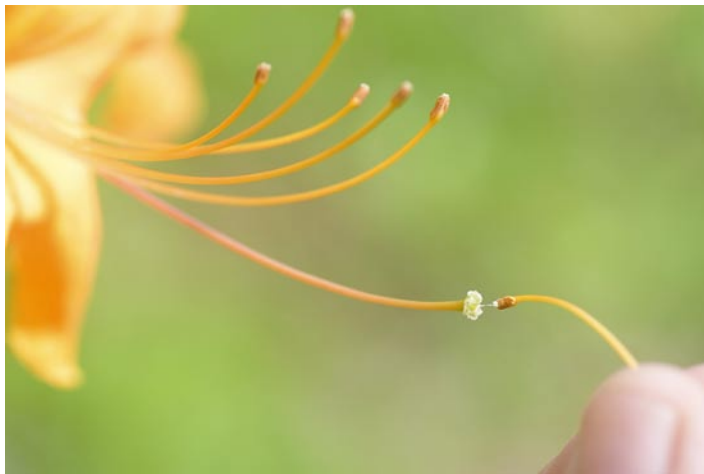
**An allele is one of two or more versions of DNA sequence (a single base or a segment of bases) at a given genomic location.



Natural flower form of *R. alabamense*. Photo by Patrick Thompson.



Unnamed Auburn Azalea hybrid selected for superior yellow blotch. Photo by Patrick Thompson.



Simple, but effective, technique for hand pollination. Photo by Patrick Thompson.

azaleas to be predisposed to increased effects of genetic drift, or the loss of certain alleles within a population over generations.

Belgium and England are both more than 15 degrees of latitude north of the epicenter of deciduous azalea diversity in North America. Generations of seedlings grown out at this northern latitude would with each generation become increasingly adapted to the more

northern climes. As a result, progeny assume no preference for having exceptional heat-tolerance. European breeding programs varied in focal areas for desired traits, but the results by the early 1900s were vigorous plants with a wide palette of colors and large flowers, double flower forms, and fragrance, representing hundreds of named varieties that were developed.

Bridging the Heat-Tolerance Gap

Key species in these European breeding programs, such as *R. calendulaceum*, do not do well in the heat and quick-draining soils of areas such as the southern coastal plains of the U.S. Sites where *R. calendulaceum* could survive in the Southeastern U.S. are in protected microclimates insulated from extreme heat. They thrive in locations like the Blue Ridge Mountains where high elevation acts as a proxy for the security of shady creek banks where they are found at lower elevations. Deciduous azalea heat-intolerance is a reality well-recognized by gardeners and plant collectors in the U.S. Southern Coastal Plains. The Exbury, Knap Hill, Ghent, and Mollis azaleas, among others, can be bought and shipped to this area, but they ultimately die from heat stress during summer when temperatures may reach 40° C (104° F) for consecutive days, or when rainfall has not occurred in weeks.

A southeastern U.S. breeding program, the Auburn Azalea Series, addressing these and other issues, is the culmination of five decades of work by plant collectors, gardeners, plant breeders, retired professors, and for the past decade the staff of Auburn University's Donald E. Davis Arboretum in east central Alabama. Years spent in the natural areas of Alabama and Georgia had exposed these collaborators to azaleas that bloomed in spring, summer, and fall in shades of whites, pinks, yellows, oranges, reds, and all of their combinations. Efforts to recreate those options in the garden were difficult, and, in fact, it became clear that even the botanists across the region were challenged when attempting to place appropriate names on the diversity that existed. Years of collection proved more fruitful than attempting to purchase appropriate plants, though there was a community of azalea enthusiasts in the area that fostered the work. Fred Galle's collection at Callaway Gardens was just an hour down the road. The Dodds, Kelly Strickland, Dr. Eugene Aromi, the Beasleys, S.D. Coleman, and many other passionate growers in neighboring states, helped build the gardens, genetic resources, and inspiration that would be the source for the Auburn Azaleas breeding program.

Retired Auburn University professor, R.O. Smitherman, initiated the development of a world-class collec-



Auburn Azalea Breeder Robert Greenleaf looks over his garden in Auburn, AL. Photo by Patrick Thompson.

tion of American azaleas at the AU Davis Arboretum and donated the most successful specimens of more than 1,000 hand-pollinated crosses that had taken place over the 1980s and 1990s. The breeding program team focused their efforts on capitalizing on the genetics of three late-blooming azaleas that occur nearby, *R. prunifolium*, the fall blooming form of *R. arborescens*, and another vigorous group of azaleas under the name *R. alabamense* 'May Pink' that would eventually be recognized as *R. colemanii*. These plants were part of an effort to fill gaps in the bloom calendar, but they were also crossed with the hybrids that could not survive here, like *R. 'Gibraltar'* and *R. 'Klondyke'*.

Growing in the southern parts of the upper Gulf Coast of the southeastern U.S., *R. austrinum* is another species the breeding team relied heavily upon. Here, it gets plenty of rain, but is subject to high heat, sandy soils, and even saltwater intrusion. *R. austrinum* is a key species for incorporating heat-tolerance into an interspecies breeding program. As Smitherman systematically crossed the material at hand in as many ways as resources allowed, other Auburn University emeritus colleagues D. Rouse and T. Corley grew out

seedlings by the tens of thousands, waiting years to see their blooms, and decades to see how they ultimately performed in Alabama's climate. During this time period, the United States Department of Agriculture acknowledged the increase in average temperatures by shifting the hardiness zone of Auburn from 7b to 8a.

The Auburn Azalea Series breeders also pursued intraspecific breeding programs. Smitherman searched Alabama and adjacent states for all of the nuanced differences in *Rhododendron alabamense*. He crossed the tall ones with tall ones and the short ones with short ones, while incorporating the most fragrant, those with the most distinctive yellow blotch, and those with most pleasing pink blush. Corley planted dozens of *R. calendulaceum* on his property to determine which ones persevered in the Alabama heat. Rouse and Greenleaf sought out and sowed scores of *R. flammeum*. They teased out early bloomers, late bloomers, compact forms, the most exquisite shades of red, even *R. flammeum* flowers that seemed to have a metallic sheen. This proved to be as interesting of an exercise as the hybridization, and an even better fit for the mission of Auburn's Arboretum.

The Arboretum was primarily a teaching garden home to a collection of native Alabama tree species. Around this same time, a movement was gaining momentum in the public garden community. It was clear that botanical gardens and arboreta were uniquely positioned to be effective agents in efforts to preserve the world's botanical diversity as the threat of an extinction crisis loomed larger. The Global Strategy for Plant Conservation³ outlined a need for gardens to, among other things, host collections of imperiled plant species to safeguard them from extinction. The Association of the Public Gardens of America developed its Plant Collections Network in order to standardize this effort, which is directly connected to Botanic Gardens Conservation International. It is within that framework that

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R. flammeum bred by Greenleaf for deep red color.
Photo by Patrick Thompson.



R. 'War Eagle' a 1985 Smitherman hybrid of *R. 'Gibraltar'* x *austrinum*.
Photo by Patrick Thompson.



R. 'Samford Sorbet' a 1987 Smitherman hybrid of *R. colemanii* x *'Gibraltar'*.
Photo by Patrick Thompson.

the Arboretum welcomed Smitherman's support. The Auburn Azaleas found a home where their aesthetic value could be appreciated and curated under a long-term commitment from the University. The value of the collection as a fundraising tool was not lost on the

powers that be. The marketing of the Auburn Azalea Series has bolstered the Arboretum's ability to host a collection of native azaleas that have significant conservation and research value, as well as educational, ecological, and aesthetic value.

Addressing Threats to Survival

The Plant Collections Network prioritizes genetic diversity and detailed provenance information in a collection along with detailed labeling, mapping, and record-keeping. In the quest to achieve their accreditation for developing the world's best collection of *R. alabamense*, Smitherman sought a representative of the species from every state and each county in Alabama where it occurred. Within five years, he had gathered representatives from all five states and the majority of counties. However, this task revealed a painful truth. Between his initial collections in the 1970s and 1980s, and the Arboretum team's return to the sites around 2010, more than half of the sites had been wiped out. Where there were once azaleas, now stood neighborhoods, strip malls, timber lands, and roadsides treated with broad spectrum herbicides. The genetic bottleneck had begun to tighten on the wild populations.

The problem is not unique to *R. alabamense*. Consider the range of *R. flammeum*, which is a swath curling from the west side of Georgia across the center of the state into South Carolina. In the center of the state of Georgia is the sprawling metropolis of Atlanta. Deciduous azaleas are good for many things, but repopulating disturbed areas is not one of them. Where *R. alabamense* suffers the death of a thousand cuts, the geneflow of *R. flammeum* has suffered a massive trauma. There is another red azalea in the south, *R. cumberlandense*. It is suffering in Alabama as well, for different reasons. Habitat loss and habitat degradation is a leading cause of extinction, but increasing global temperatures are expected to take an increasing toll in the coming years.

The rate of climate change coupled with the fragmentation of populations is likely to present a real challenge to the survival of many types of deciduous azaleas. Research into these trends and how our azaleas respond is certainly worthwhile for those who find peace of mind knowing that azaleas will be living wild and free for future generations to enjoy. If you want to see *R. cumberlandense* in the heart of its range, the Cumberland Plateau of Tennessee and Kentucky are the place to go. Visitors enjoy the azaleas in Kentucky's Kingdom Come State Park each year. If plant populations needed to migrate north in order to stay in the climate they need to survive, some species will



Unnamed Auburn Azalea hybrid *R. (flammeum x calendulaceum) x (atlanticum x 'Gibraltar')* crossed by Smitherman in 1997. Photo by Patrick Thompson.

be able to move better than others.⁴ Species that rely on wind or animals for seed dispersal may be able to escape the preserves and parks where they have been protected, but if they do, they will likely land in the designed landscapes that typically don't allow for the slow shift in a species range. In Alabama, you find the southernmost occurrences for the Cumberland azalea. It would be a worthwhile research project to conduct experiments comparing the heat-tolerances within a species like this. Are the southernmost members of the species the most heat-tolerant?

In Alabama, the state's largest remaining population of *R. cumberlandense* occurs in Cheaha State Park, but it is unlikely that this population will try to move north to avoid the heat. This population is clinging to increased elevation to raise it above the heat below. This technique can work for a while, but Mount Cheaha is the tallest mountain in the state of Alabama. As the plants move higher up the slope, they are unfortunately on an escalator to extinction. You can't go any



Dwarfed stoloniferous *R. cumberlandense* from Mount Cheaha State Park. Photo by Patrick Thompson.

higher in Alabama than they already have. If these plants succumb to extreme weather or the increasing threat of wildfires, it could mean the death of the most heat-tolerant members of the species. There could come a day when the *R. cumberlandense* in Kingdom Come State Park could be saved by an effort informed by sound science where the assisted migration of the Alabama *R. cumberlandense* gene pool could give both populations a chance to keep moving forward through time.

In most cases, once populations are lost in the wild there is no getting them back. The assets required to collect, grow out, repopulate, manage, and monitor rare plant populations are in short supply. Alabama is the state with the highest extinction rate in the continental U.S. The list of species in greater peril than the azaleas is long. The species closest to the brink require that much more effort because the effects of their own genetic bottlenecks are fully present, and many are sliding down the extinction vortex.

A Call to Action

The good news for deciduous azaleas is that it is not too late. The bottleneck has not become too restricted. There is also much room for involvement from the general public. Once a species is listed under the Endangered Species Act or regulated by CITES, matters



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Floral diversity in *R. cumberlandense* in Mount Cheaha State Park where it co-occurs with *R. canescens* and *R. arborescens* as well as *R. catawbiense* and *R. minus*. Photo by Patrick Thompson.

become much more complicated. For so many other species in severe decline, conservationists look back and lament the missed opportunities. If only someone had built collections of conservation value before these plants were in dire peril. Auburn's Arboretum is home to some of these collections. The wider the effort to keep well-documented plant material, the more we can reduce the constriction of the genetic bottleneck. The greater the genetic diversity conserved, the more resilient the remaining gene pool will be.

Efforts to secure a future for deciduous azaleas will require coordination between existing gardens and can help inform foci for new gardens. No one garden or gardener can do enough on their own. This collaborative effort involves building a meta-collection that spans not only across gardens but continents.⁵ Performing gap analyses across gardens show us which species are well-represented. Dialing into detailed collections records allows us to see which populations are well-represented in cultivation and which need attention. These findings can then inform the work of plant collectors who follow standards set out by groups like the Center for Plant Conservation to ensure that these collections are not detrimental to the wild populations. Ultimately, maintaining the viability of wild populations is always the best option.

What is the value of preserving the fecundity of the Cumberland azalea, the Oconee, or the Alabama azalea? These plants seem to have just begun spreading their evolutionary wings. The radiation of species coming from the southeastern U.S. has been interrupted by our impacts living on the land. We have also brought these plants into our gardens though. A century of work in Belgium, England, and elsewhere pro-

duced fantastic plants that could one day depend on a return to their heat-tolerant parents to keep their genes moving forward through time. The escalator to extinction is a short one in a personal garden, many cultivars have already been lost to time. The opportunity before us is to move these living works of art through time. The time to breed new heat-tolerant versions of our favorite deciduous azaleas is now.

Garden clubs and plant societies across the globe are experiencing decreases in membership, and public gardens and arboreta can't address the challenges to deciduous azaleas alone. Perhaps this is a calling to be answered. Perhaps this is the challenge we need to bring renewed interest to our azaleas. Crowdsourcing this conservation campaign is a promising possibility, as plant collecting in the information age presents a new world of opportunities. Shifting climate patterns and associated extreme weather events present us with the immediate need to answer the call.

The most popular of the Auburn Azaleas is named 'War Eagle'. It is a cross between *R. austrinum* and *R. Gibraltar*. It has striking full trusses of burnt orange flowers that match the colors of the University. It is not too different from 'Gibraltar', except for one key thing. It can be planted in the full sun in south Alabama. In continuing trials that began in 1986, it has proven that once established it is extremely resilient. Even if the variety 'Gibraltar' eventually dies from heat stress in every other garden in the world, perhaps the line will be carried on through 'War Eagle', 'Aubie', 'Tiger', 'Samford Sorbet', 'Patsy's Pink', or 'Plainsman'; all progeny of a complex hybrid from Europe and wild azaleas from south Alabama.

Japanese evergreen azalea breeding dates back to before 1500AD. One can hardly imagine what 500 years of breeding could do for the deciduous azaleas. The possibilities are quite exciting. Whether you are working with intraspecies expression, interspecies experiments, or introducing wild genes into old blood lines, the last thing a breeder wants to be is limited. To lose any of the American azaleas to extinction or even to see its genetic diversity diminished would be a tragedy. The toolbox represented by the American azaleas has been opened, but we have only begun to see the results from utilizing it. There are plants like *R. colemanii*, which grow to small trees up to seven meters tall, or the one-meter-tall stoloniferous thickets formed by *R. atlanticum*, *R. viscosum*, and occasionally *R. alabamense*. You can find *R. cumberlandense* and *R. alabamense* pushing through bare rock, while *R. austrinum*, *R. arborescens*, and *R. canescens* will

tolerate repeated flooding and can grow with their roots right down in the water. Flower colors, size, fragrance, and durability, bloom time, salt-tolerance, fall color, foliage variations, and heat-tolerance are all things waiting to unfurl into our gardens in a plethora of combinations.

Deciduous azaleas make great decorations, but here in Alabama, they are a very real part of our ecology that needs to remain intact. There are many ways to play a role in their conservation. For example, individuals can support public gardens and societies that are working to ensure the plants survive in the natural and the built landscape. Those who are interested in growing American azaleas should consider joining the Azalea Society of America and participating in our seed exchange. Further, maintain good records and find community that you can share them with. Lastly, to remain informed on *Rhododendron* conservation efforts worldwide, watch for developments from the Global Consortium for the Conservation of *Rhododendron*, a program of Botanic Gardens Conservation International led by the Royal Botanic Garden Edinburgh.

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Unnamed seedlings of *R. ('Gibraltar' x *austrinum*) x *austrinum** planted in Samford Park on the campus of Auburn University in East Alabama. Photo by Patrick Thompson.

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- Frank Schorr, Lawrenceville, GA
- Gregg Stahl, Denver, NC

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