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John McQuire in his Deer Dell Garden - p. 115

Visiting Deer Dell and John McQuire in Surrey, England - Ole Jonny Larsen - p, 6

North American Azaleas - Charles Andrews - p. 11

Using Arborist Wood Chips as Landscape Mulch - Linda Chalker-Scott - p. 33

Stomata and Lenticels—How Plants Breathe! - Susan Clark - p. 53

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To encourage interest in and to disseminate knowledge about rhododendrons and azaleas. To provide a medium through which all persons interested in rhododendrons and azaleas may communicate and cooperate with others through education, meetings, publications, scienti ic studies, research, conservation and other similar activities.

Membership Benefits

- Chapter affiliation with scheduled meetings
- *Journal American Rhododendron Society* published quarterly
- Annual convention and regional conferences
- Seed exchange
- Listing of registration of names and descriptions of new rhododendron hybrids published in the Journal

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CONTENTS SUMMER 2019

Features

6 Visiting Deer Dell and John McQuire in Surrey, England BY OLE JONNY LARSEN

11 North American Azaleas BY- CHARLES ANDREWS

22 An Insect Apocalypse, and the Opportunity for Citizen Scientists to Monitor Rhododendron Pollinators BY GLEN JAMIESON

25 Editor's Note: Canadian Researchers Warn of "Cascading Impacts" as Bumblebee Species Decline

33 Using Arborist Wood Chips as Landscape Mulch BY LINDA CHALKER-SCOTT

37 Deadheading Rhododendrons BY DON WALLACE

38 *Rhododendron* Leaf Traits Along Tropical Elevation Gradients BY MELISSA WHITMAN

44 Rhododendrons Species for Beginners: Subsection *Fortunea* in the *Rhododendron* subgenus *Hymenanthes* BY GLEN JAMIESON

52 An Interesting Hybrid: 'Grandma's Hat' BY DON WALLACE

53 Stomata and Lenticels—How Plants Breathe! BY SUSAN CLARK

55 American Magnolias BY KEN GOHRING

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Rhododendron & Azalea News: www.rhododendron.org/news/newsindex.htm

Society News

26 Awards: Gold Medal: Steve Henning

26 Pioneer Achievement Award: Charles Owen Dexter

26 Award of Appreciation: Dr. Paul Anderson

27 Award of Appreciation: George Argent

27 Award of Merit: Barbara Bulock

27 Mt. Arrowsmith Bronze Medal: Ann de Brincat

27 Mt. Arrowsmith Bronze Medal: Don Bridgen

27 ARS Board of Directors Meeting Wednesday, May 15, 2019

28 Things You Should Know About the ARS Websites

61 New Members from 2/15/2019 through 5/15/2019

63 Book Availability of Ken Cox's Woodland Gardening Book

Front Cover

John McQuire in his Deer Dell Garden. Photo by Ole Jonny Larsen..

SUMMER 2019 VOLUME 73 NUMBER 3
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From the President

Ken Webb

Victoria, BC
Canada

Well, I'm certainly glad to be the President of the greatest society in the world. The American Rhododendron Society has played an important part in the development of my life over the last 25 years. What originally started out to be a search for just a couple more plants for our garden turned out to be sort of a lifestyle for us.

Madeleine and I have met thousands of like-minded people who all live to promote the Genus *Rhododendron* throughout the world. We have attended Conventions all over North America and Europe and look forward to meeting all our friends each time. These are the people who help us learn the things that we need to pursue our passion. We have been propagating up to 2000-3000 rhododendrons a year for decades.

Just a note about the overall situation of the society. Most of the original members who started the ARS are no longer with us anymore and we have a whole new group looking after the society's affairs. At our board meetings, there is quite a bit of discussion about new electronic processes like telephone conferencing, Facebook, and other modern forms of communication. We expect to use these electronic media to simplify some of our meetings and maybe cut down on travel costs. Traveling to conventions has become a major stumbling block in our world today, and many members spend several thousand dollars each year to attend these meetings.

The ARS is really becoming a very important group in the Rhododendron World. With the European convention that we had last year, the Rhododendron Research Network, Rhododendrons International and our "around the world presence," we are becoming a high-profile leader in connecting rhododendron groups and experts in many countries. These activities are all enhancing our society and are helping us build healthy rhododendron organizations worldwide.

All the best to you and your gardens!

From the Editor

Glen Jamieson

Parksville, BC
Canada

I have just returned from a great spring ARS conference organised by the Valley Forge chapter in Malvern, a small city on the outskirts of Philadelphia, PA. I had not been to this part of the USA before, although I had been to ARS conferences in Virginia, North Carolina and New York, and the area more than met my expectations. The Philly area, claimed to be America's garden capital, is known as a major garden centre, and with 36 public gardens, arboreta and historic landscapes within 30 miles (50 km) of the city, there was no lack of interesting sites to visit. The conference consisted primarily of garden tours, with talks only after the Friday and Saturday night dinners. Apart from the amazing number of large, spectacular gardens, the Delaware Valley is a beautiful, largely forested area of rolling hills with tall deciduous trees. The azaleas and rhododendrons had largely finished flowering, but the tulip trees and some magnolias, along with many other shrubs and herbaceous and perennial plants were in full bloom. Peonies in particular were at their best!

What struck me most was how different east coast and west coast gardens are! The west does not have the very large number of older estate gardens so typical of the east, with their huge mansions and extensive landscapes with fragmented deciduous forests, follies and landscape views. I was particularly impressed by the widespread occurrence and abundance of the invasive purple-flowering Pawlonia tormentosa, the Empress tree, along the roadways! West coast gardens are generally smaller, and contain more evergreens at all levels –conifers, and mid-canopy ericaceous plants such as rhododendrons, salal (Gaultheria shallon) and arbutus. Our most extensive invasive spring-flowering shrub here on Vancouver Island is the yellow-flowering Cytisus scoparius, Scotch broom! It's seeing the different garden styles and features that makes travelling to different parts of the world so interesting, and in this respect, the Philadelphia area did not disappoint!

Visiting Deer Dell and John McQuire in Surrey, England

Ole Jonny Larsen
Aalesund, Norway

Photos by the author.

John McQuire in his garden.

I had planned to lead a Scandinavian expedition through the Salween River Valley in Yunnan, China, for three weeks during the autumn, 2018. Nine participants were recruited, and a Chinese travel agent was hired to organize it all. All I needed was a visa to China, which I have had three times before. Normally it takes one to two weeks to get a visa, but last year the Chinese Embassy in Norway overnight came up with a new procedure, which would now take four to five weeks! The result was that two of us were unable to get a visa in time, while the eight others, who had applied a few days earlier, had their applications treated by the earlier procedure and were issued visas. There was thus no expedition for me and my friend this time to the Salween! However, we quickly decided that we needed to do something else instead. Our decision was to visit gardens in England, among them John McQuire's garden "Deer Dell" in Surrey, south west of London. Fortunately, KLM let us change our tickets, so instead of visiting Dali in Yunnan, China, we soon found ourselves in a charming small town called Farnham in England.

I did not know much about John McQuire's garden and his rhododendron collection before I bought the book "Pocket Guide to Rhododendron Species based on the descriptions by H.H. Davidian" (McQuire and Robinson 2009), among frequent users now just called the "Pocket Guide." The book has 692 pages and about 700 photos of rhododendrons. What impressed me most was that the majority of the photos were shot in a place called "Deer Dell", which I did not know about. I soon found out that Deer Dell is the private garden of one of the two authors, namely John McQuire. The other author, Mike L.A. Robinson, is unfortunately not among us anymore.

Roar Aasen in the driveway up to John and Sylvia's house.

The Pocket Guide is a special book in the way that, as the name says, it is meant to be carried with you when you visit gardens, parks or even in nature where you expect to find rhododendrons. Other books on the subject available are either too big or have too many volumes, so they are best studied at home or at least only in your own garden. Still, the Pocket Guide is quite heavy (969

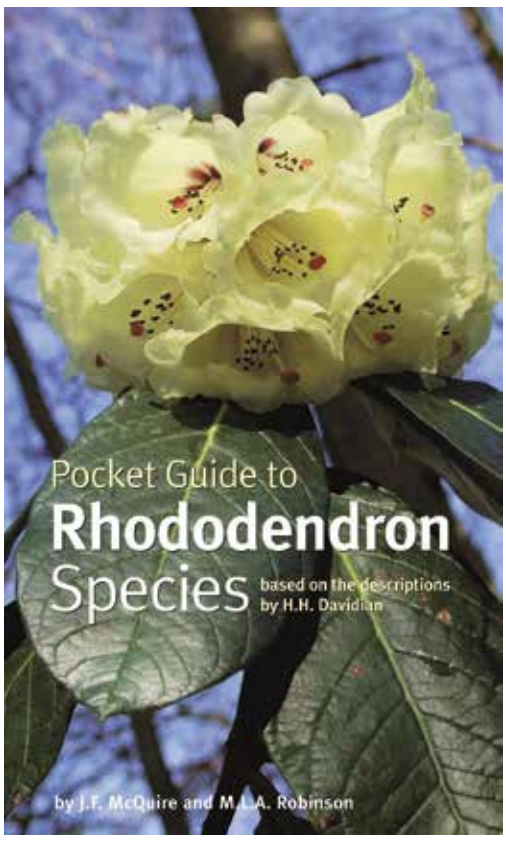
The rare *R. vesiculiferum*.

Leaf underside of *R. vesiculiferum*.

gm; 2.22 lb), so you need a big, strong pocket, but it is the best option available. I have found it a very useful book, and my own copy has followed me twice to China!

Actually, John and Mike did not write the Pocket Guide, at least not most of it, as it was Hagop Haroutune Davidian's work. Davidian worked at the Royal Botanic Garden Edinburgh from 1947 to 1972, when he retired, but he continued working with rhododendrons till his death. He is most famous for his four-volume work on rhododendron species, the biggest ever made of this genus. Davidian fully understood that his work could never be a field guide for everyone, and so in his late years, he started to work on a handbook which would contain a short description of all then cultivated species, with the most important and accurate details for their identification. When Davidian died in 2003, this work was not finished, and the manuscript was stored unpublished. Some years later, Pam Hayward in the Royal Horticultural Society, Rhododendron, Magnolia and Camellia Group, received a copy of the unfinished work through Davidian's secretary Eileen Wood, which was made available by her to John McQuire and Mike L.A. Robinson, who both modified and expanded it. The Pocket Guide was the result, which was published in 2009 by the Royal Botanic Gardens, Kew.

The authors made some changes to Davidian's manuscript. First, they supplied all the photos, mostly showing plants in flower, and then they changed the classification system to the currently accepted one (Chamberlain *et al.* 1996), with Subgenera, Sections and Subsections, although Davidian's old Series classification names are also included in the book, since Davidian used them in all his works. Species more recently introduced to cultivation were also included, described by McQuire and Robinson in the same style as the rest of the descriptions, and these parts are highlighted with yellow colour under the texts. The book is a very handy quick guide to identify rhododendron species by morphological features. Of course, one could wish for more photos of each species, showing things like flower variations and details of leaves and inflorescence, but that it would not be a pocket guide any more. It weighs almost one kg (2.2 lb) as it is.



The front cover of McQuire and Robinson (2009).

I had made an appointment with John for a visit to his "garden," as it is more a piece of land rather than a garden. The property is seven acres (2.8 hectares) in size, and most of it is planted with rhododendrons. When we walked up the driveway to the house, we were met by a sign on the front door which left no doubt about John's opinion about the Brexit situation, "Love Europa. Hate the EU!" That made the first meeting easy, as both I and my friend Roar both voted

Is this *R. codonanthum* or not? John is impatiently waiting for it to flower to confirm its identification.

Part of the formal garden near the house, with the hose still present after the terrible summer drought!

John calls this part of the garden "the jungle.

"NO" in Norway's referendum for joining the EU in 1994.

John is 86, and I was a little worried about how fit he was for walking and talking for hours, as garden visits normally take a while when two devoted rhodoholics meet. My friend Roar, who joined me, is not a rhodo man, but he is very patient! Well, I did not have to worry. John is a tall and slim man with thick grey hair and a sporty outfit who obviously is used to both strolling in the garden and to having long conversations about plant names, botanical details, plant collecting, collectors and propagation. I enjoyed our walk very much, and I am sure that John felt the same.

John and his wife Sylvia bought the house and property in 1970 when he was then working as a pilot, which was his occupation for 30 years. Between flights, he spent his time building up a huge rhododendron species collection, obviously one of the biggest and most complete in the world. Every classic species you can ask for is present in this garden, and the collection also has most of the new introductions from the last few decades.

The property has lots of big trees, mostly pine, that works as a "roof" over the plants, which is good for plant protection on cold nights and against strong sunlight on warm days.

Around the house and the driveway up to the house, there is a traditional garden arrangement with lawns, perennials and ornamental shrubs and trees. The rest of the big property is literally filled with rhododendrons and some introduced trees, in addition to the native forest trees. He has laid out large sections for plantings divided by narrow paths. Some parts have over the years become overgrown and could do with a chainsaw rather than secateurs, and John calls these parts his jungle! It seems like every collector ends up with too many plants on too small space! I know that "illness" from personal experience myself. Other sections of John's garden are well kept, holding new plantings with enough space for the plants to grow for years with no need for interruption.

John's goal has been to collect as many elepidote rhododendron species as possible. Of course, his efforts are first of all for his own pleasure, but he also wants to secure plant species for future growers. He is also not one of those guys who wants to keep rare plants only for himself, and he is more than willing to share cuttings and scions with others in order to spread rare plants around, both to private gardens and to public collections. John is very knowledgeable about rhododendrons. He knew Hagop Davidian personally, and while his books are his favorites, he is also fond of the works of Peter Cox and Peter Hutchinson, and appreciates the works of Cullen, Chamberlain and others who have contributed to the general rhododendron literature.

John with new introductions like *R. magniflorum*, *polytrichum* and *glanduliferum*.

It is not easy to choose special plants in a garden like this. The selection of tender plants impressed me a lot. *Rhododendron* species like *protistum, nuttallii, kyawii*

R. kyawii, "correctly identified using Davidian's description!"

Close-up of *R. kyawii,*

and *magnificum* are not often seen in gardens, and I thought they only were suited for the English west coast and Cornwall, but at Deer Dell they grew in open positions without damage. Newer introductions like *R. suoilenhense, yuefengense, magniflorum* and *politricum* had also found their place and were thriving.

Classic big leaved species were present all over the area, some very large after growing for many years. A few had suffered from drought during the summer of 2018, which John said was the driest summer in 40 years, and he had struggled tremendously to irrigate his seven acres (2.8 ha) all summer. By the time of our visit, things looked normal, but according to John, the ground was still dry just under the surface. A garden can take a summer like that once, but not over two or three consecutive years. If dry summers like 2018 will be the future normal scenario, rhododendron culture in many areas may become seriously threatened.

John has some special and rare plants in his collection. One is *R. vesiculiferum,* which he played a role in rescuing for future culture. This species is close to *R. glischroides* but differs in having white vesicular hairs on the lower leaf surfaces and on some floral parts. It is extremely rare in cultivation and there is a risk for it to die out. Clyne Gardens in South Wales had one specimen, and through a deceased friend, John got a young grafted plant, which he both layered and selfed to increase the number of plants. *R. vesiculiferum* was later been propagated by David Millais, and micropropagation has also been done, so, the species seems to have been saved for future culture.

Another interesting plant in John's collection is *R. codonanthum* (AC 1881A), which is a *Taliensia* species, close to *R. pronum*. John has a fine specimen with this name, but before it flowers, its identity cannot be confirmed.

I will also mention *R. kyawii,* a tender *Parishia* species which I understand is extremely rare in gardens. I have only seen it in Peter and Kenneth Cox's collection in Glendoick, Scotland, where it was planted inside a conservatory, but I have read about the presence of some specimens in very mild, west coast English gardens. John's plant grows in an open garden situation, and the original plant was tracked down in the garden of a deceased collector who had collected it in the wild himself. John was allowed to take scions, and with the help of David Millais, they were grafted. There seems to be some controversy about the identification of *R. kyawii* and also about the relation between it and other *Parishia* species. John has studied the plant closely and finds it 100 % matches the description in Davidian's books, which I guess was made from the original herbaria specimen.

Autumn flower of *R. eudoxim* var. *mesopolium.*

I could have spent days in John McQuire's garden, but the daylight was getting weaker and I had a suspicion my friend Roar had been waiting long enough while John and I talked about plants. I hope the collection at Deer Dell will be valued for what it is, a fantastic gene resource for future rhododendron culture in Britain and elsewhere. Collectors need to be aware of it!

The book *Pocket Guide to Rhododendron Species* is still available

Close-up and underside of *R. suoilenhense* leaves.

to be bought, but I would recommend doing some searching before you order, since price varies a lot by seller.

References

Chamberlain, D., R. Hyam, G. Argent, G. Fairweather and K.S. Walter. 1996. *The Genus Rhododendron Its classification and synonymy.* Royal Botanic Garden Edinburgh: 181 pp.

McQuire, J.F.J. and M.L.A. Robinson. 2009. *Pocket Guide to Rhododendron Species.* Royal Botanic Gardens, Kew, Surrey, UK: 692 pp.

R. suoilenhense, a recent introduction from Vietnam, now flowers at Deer Dell every year.

Ole Jonny Larsen is a member of the Danish Chapter and is a frequent contributor to JARS.

A garden requires patient labor and attention. Plants do not grow merely to satisfy ambitions or to fulfill good intentions. They thrive because someone expended effort on them.

Liberty Hyde Bailey

North American Azaleas

Charles Andrews Cumming, Georgia

Photos by author.

(Based on the keynote presentation given at the Azalea Society of America convention, April 7, 2018, modified from articles originally published in "The Azalean," Summer 2018 and Fall 2018.)

Introduction

You don't know how much I appreciate this opportunity to talk about one of my three loves, the three of which are my wife Mardi, trout fishing, and native azaleas. I do not want to give the standard eye-candy presentation of these no-doubt amazingly beautiful natives. This is an opportunity for us to consider how complex a group of plants they are, how confused we have been about them, what we are just now learning, and what we need to do in the near future. Follow me as we traverse through a maze of complexities you may not be aware of.

Azaleas

North American azaleas–native azaleas or "wild honeysuckle"–are part of the dynamic duo of evergreen and deciduous azaleas. We all know azaleas come in two basic flavors: chocolate and vanilla. Actually, evergreen and deciduous, though not everyone knows the two are not botanically very closely related. They are both called azaleas today only because Carl Linnaeus put both types in the same genus, which he named *Azalea*. It is almost impossible to force a cross between plants of the two types. The rare seedling is almost never vigorous or healthy. Deciduous azaleas are more closely related to the large-leaved elepidote rhododendrons than they are to evergreen azaleas (http://users.wfu.edu/kronka/kakbek/rhododendrons.html). Evergreen azalea species are solely Asian, while deciduous azaleas are found in Asia, Eastern Europe, and North America. Of the deciduous, the lion's share is found in North America, with 17 species as currently counted.

Stepchildren

All azaleas are now classified in the large *Rhododendron* genus, and some consider azaleas the stepchildren of rhododendrons. More than one botanical author has written of "true rhododendrons" and then of azaleas as if azaleas were not true rhododendrons. Arguably, the large *Rhododendron* genus of around 1000 species could conceivably be divided into multiple genera, as several botanists have suggested, such as *Ledum*, *Tsusiophyllum*, *Rhododendron*, *Azalea*, *Menziesia*, *Azaleastrum* (Cox 1948) and *Ledum*, *Tsusiophyllum*, *Rhododendron*, *Azalea*, *Menziesia*, *Azaleastrum, Hymenanthes, Therorhodion* (Copeland 1943). But as of now, azaleas are just as much a *Rhododendron* as *Rhododendron maximum*, the Rosebay rhododendron, or *R. lapponicum*, the Lapland rosebay.

Leonard Frisbie, founder of the Pacific Rhododendron Society, who eventually did so much to bring attention to *R. occidentale*, the western azalea, began his interest in rhododendrons with a personal bias against deciduous azaleas. Introducing a 1949 article "Series Azalea: Subseries Luteum," Frisbie (1949) begins with an apology:

> "In writing about the deciduous rhododendrons, which many consider to be a poor country cousin to the more spectacular evergreen sorts, I would like to have it understood that I am not trying to place them on par with the other Series. With me
> they very definitely run third place behind the quality evergreen species and hybrids. But they do have a place in our gardens."

Frisbie was not alone in considering our American deciduous rhododendrons third-class citizens. I am one, however, who thinks these stepchildren, the North American azaleas, are magnificent. The wild plants are not gaudy or flamboyant. They do not look like they have been put on steroids. They have a natural beauty. The flower trusses are in perfect balance with the size of their leaves. The plants blend well in a natural setting with both evergreen and deciduous plants. Our native azaleas offer strong and varied fragrances unparalleled in other *Rhododendron* species. Our natives come in many colors, including many vibrant shades of orange and yellow. Proper selection will give bloom periods from early spring until fall. And azaleas are generally less troublesome than their large-leaved counterparts.

What's not to like? Oh, they are deciduous? Well, let's then rid our gardens of hydrangeas, dogwoods, cherries, witch hazels,

winterberries, forsythia, lilacs, and, of course, roses.

R. periclymenoides

Complex Group of Plants

Our native azaleas are a very complex group of plants that is not well understood. The problem begins with species. We all talk about species as if we know what we are talking about. We say, "I have this species," or "I have that species," as if we are talking hard facts.

The truth is botanists cannot agree on what a species is. There is no exact definition. Genus and species are man-made concepts in an attempt to classify plants and animals. They are not exact, provable entities like 1+1=2, or the second law of thermodynamics, or chemical elements such as iron, gold, and helium. Yet we use the terms so casually we accept them as hard facts when much of botany, including the taxonomy part, is soft science akin to economics, political science, and social studies.

Plants, especially our native azaleas but also *Vaccinium*, *Crataegus*, *Solidago*, *Rubus*, *Hamamelis*, and parts of *Quercus*, do not always fit neatly into the pigeonholes described in the books and identification keys. I believe our American azaleas may be misclassified. It is not clear how many species we really have or should have. Is it the current 17 or should it be more? Perhaps it should be fewer, say 3 to 5, with more subspecies, varieties, and forma.

What is clear is that there are contradictions and inconsistencies in the current list and difficulties in assigning many of our wild plants to one of the taxa. Our plants have highly variable morphological characteristics that overlap the manmade species descriptions. Where does one species end and another begin?

The "this is a hybrid" excuse goes only so far. Earl Sommerville has said most natives are hybrids, and from the viewpoint of gene exchange he is possibly correct. The idea of an evolutionary tree where this species evolved from that species may be all wrong. Our native azaleas for the most part are a promiscuous bunch. Given half a chance, they will exchange spit with almost any other native azalea. The heritage of our azaleas does not look like a branched tree; it looks more like a spider web of cross pollination back and forth, back and forth, for millennia.

We normally think of a hybrid as H=A x B. A major problem with native azaleas in the wild is that species A and species B have to be somewhere within pollination range to have such a hybrid. Often, they are not. This suggests that these so-called hybrids are as much stabilized as are the so-called species. Perhaps we have species and hybrids all wrong. Both are part of an overlapping continuum. Speciation is as much a function of our language as of an evolutionary process.

I would argue that the real dynamic entity that uses its gene pool to adapt for survival is at a higher level than the current 17 species, *R. vaseyi* and *R. canadense* excepted. It is more at the *Pentanthera* level. Perhaps it is the group that is evolving and not the declared individual species. To avoid confusion, however, we'll refer to the 17.

We assume from our still held pre-Darwinian ideas that species come before hybrids, but is this true? It seems to me species equilibrate out of the cobwebs of hybrids.

We have the real world, and we have herbaria. The real world–the plant populations of the mountains, balds, woodlands, plateaus, and plains of North America–does not match well with the 17 species as described. Nevertheless, we need to know what they are.

I like to think of some of them in groups:

- I put *R. canadense*, *R. vaseyi*, and *R. occidentale* each in a separate group of one. *R. canadense* and R. *vaseyi* are so different from anything else, and *R. occidentale* is the only azalea on the West Coast.
- The group of early pinks is comprised of *R. canescens*, *R. periclymenoides*, and *R. prinophyllum*.

Table 1. 17 North American Species

R. alabamense Alabama azalea	*R. canadense* rhodora	*R. flammeum* Oconee azalea	*R. vaseyi* pinkshell azalea
R. arborescens sweet azalea	*R. canescens* Piedmont azalea	*R. occidentale* western azalea	*R. viscosum* swamp azalea
R. atlanticum coastal azalea	*R. colemanii* Red Hills azalea	*R. periclymenoides* pinxterbloom azalea	
R. austrinum Florida azalea	*R. cumberlandense* Cumberland azalea	*R. prinophyllum* roseshell azalea	
R. calendulaceum flame azalea	*R. eastmanii* May white azalea	*R. prunifolium* plumleaf azalea	

- The early whites are *R. alabamense*, *R. atlanticum*, and *R. eastmanii*.
- I also place *R. colemanii* and *R. austrinum* each in a group of one. *R. colemanii* is the latest named species, a tetraploid. *R. austrinum* is often yellow or orange, but it is quite different from other orange azaleas. Arguably, I could consider *R. colemanii* and *R. austrinum* combined into a single group.
- My orange group is made up of *R. flammeum*, *R. calendulaceum*, *R. cumberlandense*, and *R. prunifolium*.

North America has the lion's share of deciduous azaleas. There is only one in Eastern Europe and a small handful in Asia. In America, one is west of the Rocky Mountains, *R. occidentale*. All the rest reside from eastern Texas and eastern Oklahoma to New England and southeastern Canada. In the main, you will find these 16 species of eastern North America in and around the Appalachian Mountains. They do trail down into the foothills and plateaus and to both the Atlantic and Gulf Coastal Plains. The disjunct populations of *R. prinophyllum* in Arkansas and Missouri suggest the distribution of this species may once have been much larger. The sweet spot is the Southern Appalachians of North Carolina, Tennessee, and Georgia. The entire state of Georgia, though, with its geographic diversity of Mountain, Piedmont, and Coastal Plain regions, has 12 indigenous species, more than in any other state.

The primary reason for this distribution is acid soil and moisture. Rain tends to encourage growth of organic matter and leaches away basic salts. Areas of high rainfall thus tend to have more organic soil and more acidic soils. Areas of low rainfall tend to have little to no organic matter in the soil and significantly higher concentration of alkaline salts. If one looks at a pH map of North America and a rainfall map of the same area one will find the two are quite similar. While pH and rainfall are both a continuum and not an either/or situation, one finds in general that the distribution of native azaleas stops when the pH get too high and/or annual average rainfall becomes too low to sustain their growth. Most native azaleas want constantly moist, not wet soils

I might point out that some western azaleas, *R. occidentale*, do grow in slightly acid to basic serpentine soils. Note three facts related to this: (1) Many *R. occidentale* do grow in acid, non-serpentine soils, (2) the serpentine soils are high in magnesium and iron and low in calcium, which may help alleviate the problem azaleas have with higher pH soil, and (3) the *R. occidentale* found in the serpentine areas do have some morphological differences from *occidentale* in other locations.

Problems with the Current Species

Kron's DNA studies (*Rhododendrons*. <http://users.wfu.edu/kronka/kakbek/rhododendrons.html> and associated links. Accessed June 3, 2018.) show that deciduous azaleas may be more closely related to the elepidote rhododendron subgroup than to evergreen azaleas. Further, Kron found deciduous azaleas *R. molle* (Chinese azalea) and *R. arborescens* (sweet azalea) to be related closer to lepidote rhododendron *R. edgeworthii* and other lepidotes than to the evergreen azaleas.

We do not have space to go over all the problems with the current species, but we can identify a few. The main problem is inconsistency and arbitrariness in species assignment. Consider the *R. viscosum* complex. In her PhD dissertation, Kathleen Kron (1987) moved *R. oblongifolium* and *R. serrulatum* into *R. viscosum* without even variety status. She also removed variety status from *R. viscosum* var. *aemulans* and *R. viscosum* var. *montanum*. Yet Kron kept *R. canescens*, *R. periclymenoides*, and *R. prinophyllum* as separate, distinct species (Kron 1987, 1993).

R. viscosum var. *aemulans* is an early blooming plant, in flower generally from March to April. It is very low and running, forming colonies similar to *R. atlanticum*, and it has fuzzy, ovoid flower buds. Var. *aemulans* is a unique plant found in the Gulf Coastal Plain and west into southeast Texas on the edge of sandy drainages in the transition between dry and wet areas.

R. canescens in Lumpkin County, Georgia.

R. viscosum var. *serrulatum* is a late summer and fall blooming plant, flowering in July to October. It is tall, non-stoloniferous, and has smooth lanceolate buds. Var. *serrulatum* is commonly found in the Florida Panhandle and adjoining states on sandy river banks and hummocks in swamps, and on the Gulf Coast with its roots in heavy concentrations of salt. A common factor with these two distinctly different plants seems to be the narrow, white

R. canescens in Lumpkin County, Georgia.

Buds of *R. periclymenoides* and *R. canescens*.

flower tube. These two types, along with others, are currently considered one species.

R. canescens and *R. periclymenoides* are both early blooming, pink to white azaleas. *R. canescens* is the most common azalea in the Southeast and *R. periclymenoides* dominates from North Carolina northward, though the two species do overlap in distribution. Their colors are similar, with *R. periclymenoides* occasionally producing shades of lavender. Often stated as a distinctive feature are the glandular hairs on the tube of *R. canescens*, but *R. periclymenoides* also has a glandular tube form. *R. canescens* is said to produce somewhat taller, more upright plants. These two types, along with others, are currently considered separate species.

If *R. viscosum* is one species despite its many variations, why not *R. canescens* and *R. periclymenoides*? Further, then why are the similar *R. cumberlandense* and *R. flammeum* separate? Or *R. cumberlandense* and *R. prunifolium*? Why cannot *R. calendulaceum* and *R. cumberlandense* be a ploidal series of a single species like the wandflower, *Galax urceolata*, and the American elm, *Ulmus americana*? Where is a thorough DNA research project when you need it?

Natural Hybrids/Introgression

Another complication in classifying and identifying a particular native azalea is natural hybridization. Of the 17 declared American species, most will cross with the other species, given the opportunity, and do. *R. canadense* and *R. vaseyi* are the exceptions. This means identification keys are of limited value to identify what species a wild plant may be. We look at a plant, but we have not been introduced to its parents or grandparents.

Clement Gray Bowers, who in 1936 wrote "Rhododendrons and Azaleas", the first detailed book on the subject of rhododendrons by an American author, points out that some botanists considered *R. prinophyllum* to be a variety of *R. periclymenoides* and that transitional forms between the two of nearly all degrees have been found. He used the names *R. nudiflorum* and *R. roseum*, which have since been declared illegitimate (Bowers 1936).

R. periclymenoides also hybridizes readily with *R. canescens*. Introduce me to somebody who can tell with certainty to which species a pink azalea in this large overlap area belongs. Henry Skinner (1955) in his 1951 epic 25,000-mile journey "In Search of Native Azaleas" found on the southern end of the Cumberland Plateau below Sewanee, Tennessee, what he called:

> a confused complex reminiscent of *R. canescens*, *nudiflorum*, *alabamense*–all thoroughly mixed together and varying in flower color from pure white to lavender, pale pink with pale tubes, and pink with deep red tubes, many of the plants being highly stoloniferous.

On a brief, late swing through Arkansas, Skinner found *R. oblongifolium*, which is now included in *R. viscosum*. He found it growing side by side with *R. roseum* (now *R. prinophyllum*) and found evidence of hybridization between the two. Skinner thought *R. flammeum*, the Oconee azalea in central Georgia, was "a rather confused species" that "has been on too familiar terms with the aggressive *R. canescens*." With the Oconee azalea, which he called by the old name *R. speciosum*, he found intermediates in characteristics and habitat between *R. alabamense* and *R. canescens*. On Spruce Knob Mountain in West Virginia, Skinner found *R. calendulaceum*, *R. nudiflorum*, and *R. roseum* all growing and blooming together. There, Skinner assumed triple matings were occurring:

> bizarre in the extreme–short and tall bushes bearing large or small flowers in every color from coral pink through salmons to rich lavender, pale yellow or pure white. The last was large flowered and otherwise identical with the Flame

R. arborescens.

Azalea..

Skinner also climbed up to Gregory Bald and saw the well-known swarm of hybrids there.

In some other instances, Skinner's assumptions of hybridization were incorrect. For example, *R. colemanii* is not a *R. alabamense* hybrid (Zhou *et. al.* 2008).

Plantsman David Leach was primarily an evergreen rhododendron expert, but because they were in the genus, he did investigate native azaleas. He provided conclusive evidence that *R. furbishii*, called a species by Walter Lemmon, was instead a hybrid and not a species. He proved this by crossing *R. arborescens* with *R. cumberlandense* and producing identical results. He also crossed *R. furbishii* with *R. furbishii* and produced some *R. cumberlandense* and some *R. arborescens*-looking plants (Leach 1959).

In June 1958, Leach was invited to Hendersonville, North Carolina, to tour rhododendron and azalea populations. For Leach the visit was an epiphany (Leach 1958):

> The overwhelming impression of the azaleas is their massive diversity, far surpassing anything that the botanists have led us to expect. The North Carolina azaleas are a vast, amorphous population shifting endlessly in a dynamic evolutionary phase in which crosses in the wild and great masses of natural hybrids are commonplace. A revelation awaits any student of the genus ...
>
> The travelling enthusiast might just as well leave his botanical keys at home. They are useless in any attempts to identify species in countless hybrid swarms which are encountered at every hand….
>
> … They are a geneticist's dream, but they are a taxonomist's nightmare..."

Leach went on to say the evidence is indisputable that azaleas are in flux, and the species in typical form are often the exception in "…vast seas of Azaleas undergoing introgressive hybridization." He recognized that our wild populations often refuse to fit into the classifications we call species. Instead they are intergrading hybrids constituting uninterrupted progressions of variations linking them to their ancestry. Leach thought the so-called hybrids did not have a genetic disadvantage. In some sites he saw them thriving more than their progenitors. I believe Leach's observations are astute and still hold true.

Kathleen Kron was aware of all of the above and more when she wrote her 1987 PhD dissertation on revisions in *Rhododendron* section *Pentanthera*. Kron recognized that natural hybrids and hybrid swarms occur. However, she dismissed widespread natural hybridization, arguing only occasionally do actual habitat and flowering time overlap (Kron 1987, 1993).

In the 25 years since Kron rejected Skinner's and Leach's field observations of widespread natural hybridization more and more observers have had a
chance to study azaleas in their natural habitats. There is absolutely no doubt Kron was incorrect in her conclusion. Consider the following:

- We have found on many occasions "running arbs" in the Southern Appalachians, as did Henry Skinner, characteristic of the smooth-stem *R. arborescens* mixing with the highly stoloniferous *R. viscosum* var. *montanum*.
- Clarence Towe can show many examples of *R. periclymenoides* crossing with *R. calendulaceum*, the flame azalea, in South Carolina.
- John and Sally Perkins can show probable examples in Audra State Park, West Virginia of *R. prinophyllum* or *R. periclymenoides* crossing with the flame azalea *R. calendulaceum*. These *R. calendulaceum* crosses are strongly suggested by the hybrids being triploids, crosses of the diploid with the tetraploid. These crosses have been verified by ploidy testing.
- In the Florida Panhandle, Ron Miller can show tall *R. canescens* crossing with the low-growing and spreading *R. viscosum* var. *aemulans*, yielding a low, pink, colonizing plant.
- On Mt. Cheaha in Alabama, one can find *R. cumberlandense* in large numbers. Blooming earlier is *R. canescens* and later is *R. arborescens*, yet sometimes the bloomings overlap. The obvious hybrids are outstanding.
- On Hurricane Creek in Lumpkin County, Georgia, where thousands of *R. canescens*, *R. calendulaceum*, and *R. arborescens* reside, dozens of triploids plants have been confirmed through ploidy testing. These plants often grow within a few feet of each other.
- Even some of the tetraploid plants seem to have long-term introgression with the diploids. How otherwise does one get a large-flowered strong pink tetraploid azalea with an orange blotch?

- Already mentioned is *R. flammeum*, the Oconee azalea. This azalea is often found with *R. canescens* and its intermediates. In Fulton County, Georgia, near the old Roswell Mill, *R. canescens*, *R. calendulaceum*, *R. flammeum*, and hybrids are all growing together.
- In Cherokee County, Georgia, is a location that has produced large numbers of ploidy-tested triploids.

More and more natural crosses of the named species are being discovered. There is no doubt that given the chance most of our natives will cross and have for many, many years. The only way to untangle the mysteries is DNA testing and more ploidy testing.

Misinformation

Much misinformation on our native azaleas exists in the literature and has since the beginning. Let me give just a few examples.

1. The Name Azalea

Linnaeus first coined the term *Azalea* as a new species back in 1735 because he thought his new species required a dry, arid habitat (Linnaeus 1735, 1737).

"Azalea from new Latin from ancient Greek (*azaleos*, dry) because it grows in dry soil." (Wiktionary, 3/22/2018)

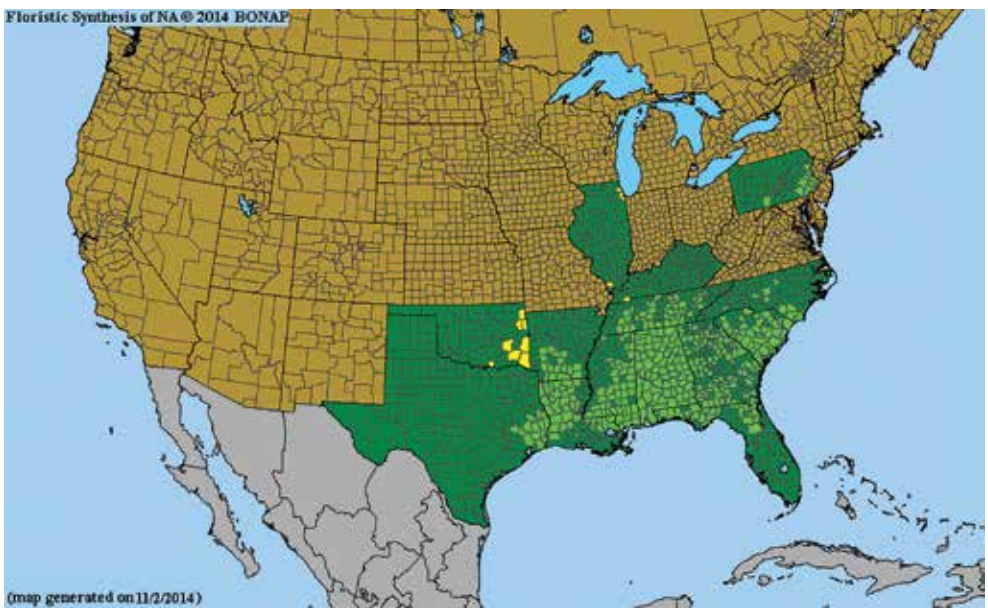
Linnaeus found these plants high in the treeless Lapland Alps in what he said were sandy, rocky, dry places. Since half of the ground was still covered in snow in July with water running in rivulets through the snow, how he determined it was arid is unclear (Linné 1811). With his limited exposure to azaleas, Linnaeus did not realize that almost every azalea prefers constantly moist, not wet soil.

2. Rose Colored *R. arborescens*

Frederick Pursh (1814) introduced *R. arborescens*, perhaps our best white deciduous azalea, as a new species and stated he had seen it in the wild and in Bartram's garden outside Philadelphia. He described the species as having rose-colored flowers. This flower color description was repeated by other botanical authors for almost 100 years, included the well-respected John Torrey, Asa Gray, John Claudius Loudon, and Alphonso Wood. Do you think these authors had actually seen a living plant in bloom? It is not a rare species. Both Michauxs, André and François André had earlier described the fragrant white azalea that each found on mountain stream sides, but neither gave it a botanical name (A. Michaux 1889, A.F. Michaux 1904).

3. *R. canescens*, the Mountain Azalea

Pursh (1814) introduced another point of confusion when he took Michaux's southeastern *R. canescens* and applied it to high elevation plants in the Blue Mountains of Pennsylvania. This confusion lasted for over 100 years.



R. canescens distribution map, showing significant portion of the biomass in the Piedmont and erroneous distribution in Pennsylvania." .

Pursh (1814) apparently was not aware of the new species *Azalea rosea* named by Loiseleur-Deslongchamps in 1812. Loiseleur's species is now named *R. prinophyllum*. It is generally not heat tolerant and resides mostly in northern climes or high elevations from western Virginia northeastward. There are, as you may know, disjunct populations in Arkansas and southeastern Missouri. It is because of this confusion between *R. prinophyllum* and R. *canescens* that you may sometimes see *R. canescens* called the mountain azalea.

4. Species Maps

Species distribution maps often contain errors in both directions, omissions and false positives. You will find, for example, *R. calendulaceum* throughout Alabama

Pink Tetraploid from North Georgia Mountains.

and *R. arborescens* on the Alabama coast. These errors occur because, with little or no verification, the mappers rely on previous published flora and herbarium specimens.

R. calendulaceum is often reported in the state of New York, but no one can or has pointed to indigenous plants there. *R. calendulaceum* is rare even in Pennsylvania, the most northern distribution of the species. This repeated piece of misinformation originated from a 1749 Latin description of a yellow azalea on property on the Hudson River. No one else has been able to offer evidence of *R. calendulaceum* growing as far north as New York. Was a yellow azalea dug elsewhere and brought to the Coldenham estate in New York? (Colden 1749)

5. *R. canescens,* Not in the Piedmont

Clement Bowers, whom I mentioned previously, was a horticulturist from New York. In his 1936 book and 1960 revision as well as in letters for the 1952 "The Azalea Handbook" and Frederick Lee's 1958 "The Azalea Book", Bowers argued that *R. canescens* should not be called by the common name Piedmont azalea. Bowers (1960) asserted time and again, in total error I have to say, that *R. canescens* is limited to the Coastal Plain from South Carolina southward and westward. This New Yorker did not have much field experience in the Southeast. If he had, he would have known a very large portion of the biomass of *R. canescens* resides in Georgia, Alabama, and Tennessee above the Coastal Plain. I am glad to see that the most used common name today for *R. canescens* is the Piedmont azalea, which is the most common azalea in the Southeast Piedmont from Texas to North Carolina. To call this species the Florida pinxter as Bowers suggested is quite misleading. Many if not most of the pink azaleas in Florida are pink tetraploids, probably a color form of *R. austrinum*.

6. When a Hybrid is Not a Hybrid

While the possibility of natural hybrids makes species identification difficult to impossible, it is also true that we have misidentified plants as hybrids when they are just species showing off their variability. Two examples will suffice. Polly Hill introduced the Choptank Hybrids. The original plants came from between Dover, Delaware, and the headwaters of the Choptank River. She transplanted them in her garden in Wilmington, Delaware, and collected and propagated open pollinated seeds. She showed a particularly attractive form with some pink in the flowers to Henry Skinner, and he thought they were hybrids of *R. atlanticum* crossed with *R. periclymenoides*. We now know that *R. atlanticum* is a tetraploid, *R. periclymenoides* is a diploid, and the offspring are almost always triploid. Recent tests to date have shown Choptank Hybrids to be tetraploids, and we have more field experience to know pink is not uncommon in *R. atlanticum*.

'Snowbird', a cultivar at the Biltmore Estate was said to be a *R. atlanticum* × *R. canescens* cross, yet tests show it to be tetraploid. Pink does not automatically mean hybridization with *R. periclymenoides,* or with *R. canescens* in the southern portion of the Coastal Plain.

In southern Alabama and into Georgia there are azaleas that were called *R. alabamense* or *R. alabamense* hybrids. You, of course, know the story of John Thornton, Ron Miller, and others doubting this, and finally with enough field work and lab research discovering a new tetraploid species, *R. colemanii*. However, there are still *R. alabamense* labels today at Callaway Gardens in front of *R. colemanii* plants.

7. Will the Real Tetraploids Please Stand?

or animal has. You have two. Plants can have two, three, four, five, six, or more. *Rhododendron* chromosomes are very small, so small they can only be seen with an electron microscope. Even then they are extremely difficult to visually count accurately.

The first studies made mistakes. *R. calendulaceum* and *R. canadense* were declared tetraploids, meaning they had twice the normal number of chromosomes. *R. atlanticum* and *R. austrinum* were said to be diploid. With advanced technology we now know *R. atlanticum*, *R. austrinum*, *R. colemanii*, and *R. calendulaceum* are tetraploid. *R. canadense* is diploid.

8. All Flower Buds are Chestnut Brown

In Kron's revision of *Pentanthera* are interesting statements on azalea flower buds. This caught my eye because I have looked at flower buds as one of many characters to help distinguish one species from another. Some are lanceolate; some are quite ovoid. *R. vaseyi* flower buds are globose and look like musket balls. Some have pubescence. Some have cilia along the bud scales, and in some cases the cilia are glandular. Some have dark bands along the top of the bud scales.

I find a variety of colors, fairly consistent to the species. Yet, in every case, Kron (1993) described the flower buds as "chestnut brown." The only place I have consistently seen chestnut brown native azalea flower buds is on herbarium sheets of

dried specimens.

9. Can't Tell *R. austrinum* From *R. canescens*

More examples of misinformation exist. We shall end, however, with this old wives tale. How often have you heard it said when the plant is not in bloom, it is almost impossible to distinguish *R. austrinum* from *R. canescens*? In fact is it is simple and easy. New growth on *R. austrinum* is always glandular. New growth on *R. canescens* is almost always eglandular. I will explain the "almost" part later.

For Now, We See Through a Glass Darkly: Unanswered Questions

We now move from misinformation to another issue: things we don't know or don't understand about this complex group of plants. In addition to the puzzlement of what should be the best division of our azaleas into species, we still have many other unanswered questions.

1.How Did *R. atlanticum* Hide So Long? Of historic interest is *R. atlanticum*. It grows in the Coastal Plain from southern New Jersey down to Georgia. This is an early blooming, low-growing, highly colonizing, fire-adapting plant that can cover an acre or more with its runners. It had to have been stepped on by thousands of settlers and soldiers from Jamestown, Charlestown, and many settlements up the coast and along the King's Highway. Yet, it was not recognized as a species until 1917, probably being confused with the later-blooming *R. viscosum*.

2. Why does *R. occidentale* Fail to Survive on the East Coast?

The only native azalea on the West Coast is *R. occidentale*. Though the typical form is a white flower with a yellow blotch, there are very attractive multi-colored forms. We have never been able to successfully grow this species in the east. The reason remains elusive. Climate? In the west it grows on the coast and in the high Sierras at Donner Pass. In the east we fail north and south. Soil? What special conditions might it need? Great Britain seems to succeed with this species.

3. Where are *R. austrinum* and *R. atlanticum* Triploid Hybrids?

We know *R. calendulaceum*, *R. austrinum*, and *R. atlanticum* are tetraploid, and when they pollinate a diploid azalea the result is almost always a triploid. Many natural triploid hybrids with *R. calendulaceum* as a parent have been found. Almost no triploids in areas of *R. austrinum* and *R. atlanticum* have been discovered. Is this because of a difference in the tetraploids? Is it because we simply have yet to recognize a possible natural hybrid and send a sample for testing?

4.Yellow River vs. Escambia River *R. austrinum*

In the lower section of the Yellow River in Florida, the tetraploids are all pink. Going up river, a transition eventually occurs with a mixed area of pink, white, and yellow. Farther up only yellow *R. austrinum* are found. The Escambia River is not far away, but the situation is quite different. Here, *R. austrinum* occurs in mixed colors all along the river: yellow, pink, white, and multicolored. Change in acidity does not seem to explain this difference.

Buds of *R. viscosum* and *R. calendulaceum*.

5. Is *R. canadense* Really an Azalea (or is It Even a *Rhododendron*)?

We have always known the delightful Rhodora, popularized by Emerson in his poem, was unique. Alarm bells went off at the 2013 joint ASA/ARS convention in Asheville when Jason Lattier *et al.* (2013), one of Dr. Tom Ranney's graduate students, presented results showing that *R. canadense* appears to have a base chromosome number of 12, not the uniform base number of 13. The sampling covered multiple locations across the geographic distribution. If this holds true, it begs the question: Should *R. canadense* be considered an azalea? Is it even a *Rhododendron*?

6. Should *R. vaseyi* be Considered One of Our Azaleas?

R. vaseyi is another plant that we know is different. In the 2005 revision of *Rhododendron*, Loretta Goetsch *et al.* (2005) moved *R. vaseyi* out of *Pentanthera*. In their analysis *R. vaseyi* was more closely related to plants formerly in

Ploidy

Ploidy is a term that has to do with the number of sets of chromosomes a plant or animal has. Almost all animals have two sets of chromosomes and are called diploid, di = 2. Humans receive one set from each parent, the X and Y chromosomes. It is not unusual for some plant genera to exhibit different levels of ploidy. Diploid = 2 sets, triploid = 3 sets, tetraploid = 4 sets, and so on. Having more than 2 sets is called polyploidy. In sexual reproduction, tetraploids and higher polyploids have more genetic material to work with. This gives them a better chance at long-term survival. Triploids are usually sterile due to the odd number of chromosomes. Think of seedless grapes or other sterile fruit. In native azaleas, we now know that *R. atlanticum*, *R. austrinum*, *R. calendulaceum*, and *R. colemanii* are tetraploid. All others are diploid. In some cases, ploidy testing may be the only way to separate one species from another similar one, e.g., *R. calendulaceum* from *R. cumberlandense*, or species from triploid hybrids.

DNA

DNA is an acronym for deoxyribonucleic acid. It is a chain of nucleotides, atoms of hydrogen, oxygen, nitrogen, carbon, and phosphorus, carrying the genetic instructions used in the growth, development, determination of morphological characteristics, cell functioning, and reproduction of all known living organisms. In plants, DNA is inherited from seed and pollen parents. Careful DNA studies with native azaleas can help determine the relationships between plants and can allow us to better understand the species.

Menziesia than our other American azaleas. If true, this places some doubt on our even calling *R. vaseyi* an azalea.

7. How Does Color Relate to species?

When is a blotch a sign of hybridization or introgression? Is the pink tetraploid in north Georgia *R. calendulaceum*? Is the pink tetraploid in the Florida Panhandle *R. austrinum*?

Recent Research/Discoveries

Since we have known about our native azaleas for over 300 years, we may tend to think we know them well. While questions remain as we still see through a glass darkly, in fact, we are learning more every day.

1. **New Species**

R. eastmanii was declared a new species in 1999. For years it was said to be a disjunct group of *R. alabamense*. The aforementioned *R. colemanii* (Red Hills azalea) sat quietly in the Red Hills section of Alabama until someone finally realized *R. alabamense* grows in different habitats. The Red Hills azalea became a new species in 2008.

2. **Pink Tetraploids = *R. austrinum*?**

In Florida, John Kunkle Small, Henry Skinner, and all others have assumed any Deep South pink azalea was *R. canescens*. Detailed field examination recently has revealed them to be wrong. Ron Miller discovered the pink tetraploids that in every other aspect are identical to *R. austrinum*.

3. **Can1 and Can2, Two Southern Pink Diploids**

Even more recently as Ron Miller explores the rivers, fields, and woods with an eagle eye, he has discovered that there are two types of southern pink diploids. We call these Can1 and Can2.

Can1: This is the typical *R. canescens*. It has pink to white flowers with glandular hairs on the flower tubes and often twisted, revolute petals. New growth is eglandular, distinct from *R. austrinum*.

Can 2: Then in eastern Texas, Ron discovered pink azaleas with glandular new growth. To his surprise, ploidy tests showed these plants to be diploid. Looking much like *R. canescens*, these Can2 plants reside in a more moist habitat, tend to have broader petals, and are quite stoloniferous. Can2 plants are predominant to the west in eastern Texas and northern Louisiana. They occur only rarely eastward where Can1 dominates. Should Can2 be considered a new species?

4. **Ploidy Research**

Recent ploidy research has opened our eyes to a better understanding of possible species and hybrid relationships. It was the research of Jeff Jones (2007), another of Dr. Tom Ranney's graduate students, that revealed *R. atlanticum*, *R. austrinum* and *R. calendulaceum* are tetraploids with twice the usual number of chromosomes. Soon, the aforementioned *R. colemanii* was added to the list.

John and Sally Perkins joined with a team at the University of Coimbra in Portugal in an ongoing multi-year study of *Rhododendron* ploidy. By testing hundreds of cultivars and wild plants, and the Perkinses making crosses with parents of known ploidy, they have come up with some general ploidy rules. Their ploidy research is a presentation in itself, and I am anxiously awaiting their publications. Here are a few of the Perkins's derived observational rules: *

1. diploid × diploid = usually diploid,
2. tetraploid × tetraploid = usually tetraploid,

3. diploid × tetraploid = usually sterile triploid,
4. tetraploid × diploid = usually failure,
5. fertile triploids can occur but are rare,
6. triploids can produce diploids, triploids, tetraploids, pentaploids, and
7. In diploid × tetraploid F_1s, offspring tend to look more like the tetraploid parent.
   (* seed parent × pollen parent)

New Research Needed

That was an overview of recent research. So, what is needed to better understand these wonderful plants?

1. **Field Research**

We need more field research. We need boots on the ground, studying populations *in situ*. Too much of the previous research results was based on herbarium specimens that do not and cannot accurately represent the entire populations of live plants.

2. **Applied Multimedia Technology**

We need a modern replacement for herbarium specimens as the primary source of data. Using dried specimens was advanced technology in the 16th century. They show only a snapshot or two in the annual cycle of the plant. Much is lost in the dried evidence. A specimen may not represent the typical population or the peak bloom and thus may be misleading. With such scant evidence, the plant may be misidentified by the author and those who examine it. I am not suggesting we eliminate herbarium specimens but supplement them with 21st century multimedia technology with databases of morphological characters and habitat, GPS records, and digital habit, landscape, and both macro-lens and microscopic images.

3. **More Ploidy Testing**

We need much more ploidy testing, especially on wild plants, to better understand what is happening between our tetraploids and diploids. We need to find more fertile triploids and analyze the populations around them to better understand how these triploids naturally occurred. We need to find further evidence of downward introgression and upward introgression from tetraploid to diploid and vice versa.

4. **Hybridization Research**

We need more hybridization research. Systematic hybridization by humans can help us better understand what has been and is going on in nature.

5. **Extensive DNA Testing**

Finally, and perhaps most importantly, we need extensive DNA research on our native azaleas. Such studies will require careful controls to assure large quantities of samples, known provenance of the samples, known character differences among and within populations, and geographically diverse populations. It is my hope that from these studies we can learn how related our 17 species really are.

Our ARS Research Foundation and ASA Research Fund can help support such research.

Conclusion

I hope you now see our native azaleas of North America are indeed a very complex group and not just another pretty face. We still have much to learn about them. Thank you for indulging me with my love of these beautiful azaleas.

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Charles Andrews is the immediate past president of the Azalea Chapter of the ARS. He is also vice president of the Azalea Society of America and a member of the Vaseyi Chapter of the ASA. Charles has contributed many articles to JARS and The Azalean, and serves on the Editorial Advisory Board for The Azalean. Charles has been studying North American deciduous azaleas for over 35 years. He and like-minded "azaleaphiles" spend many hours hiking in the field each year trying to better understand the distribution, habitat, characteristics, and dynamics of this amazing plant complex, primarily found in eastern North America. He believes these plants deserve more scientific study and horticultural emphasis. Charles is working to make accurate information on the history, identification, distribution, and culture of North American azaleas more available.

An Insect Apocalypse, and the Opportunity for Citizen Scientists to Monitor Rhododendron Pollinators

Glen Jamieson
Parksville, BC,
Canada

Many, if not most, rhododendron aficionados are interested in many more plants than just rhododendrons, and indeed, are generally very aware of the overall biodiversity in their gardens and in nature. They appreciate the many birds, butterflies and other insects such as pollinators that are present, and realise that these animals are important to the overall viability of their garden and nature in general. Given this, I would like to bring a sobering reality to ARS members about a calamity that many of us may be unaware of, which may be happening unknowingly to us with significant consequences even in our own gardens.

An article in a recent "The New Yorker" by Brooke Jarvis (2018) about the dramatic declines in overall insect abundance in many areas of the world summarised observations I was beginning to notice myself. As a student in the 1960s, I worked for two summer collecting insects of all types for an entomological museum at McGill University in Montreal, Quebec, and was both amazed at the diversity and abundance of insects. The spring emergences near the St. Lawrence River of both mayflies (*Ephemeroptera*) and caddisflies (*Trichoptera*) were so large that trees, buildings and roadways would be covered with literally hundreds of thousands, if not millions, of these adult aquatic insects, and setting night lights to catch moths and other nocturnal insects would yield sometimes 0.5 to one liter of insects in the morning. Most of the rest of my day would then be devoted to sorting them out and pinning or preserving desired specimens.

I now live on Vancouver Island, British Columbia, by the ocean, and so do not observe these huge swarms of freshwater insects as I did in my youth in Eastern Canada, but over the past few decades, I have begun to sense a general decline in the abundance of many insect species here, except for wasps in late summer and the fall! An example is that there seems to be much fewer insects now smashing on my car's windshield when we drive than in the past! The Jarvis article has helped put this into perspective, and so in support of Ian Efford's (2019) article on bumblebees, I thought it worthwhile to summarise here some of the observations Jarvis presented.

First of all, most published population studies by biologists focus on the abundance of a single species, or group of species (e.g., Murphy and Romanuk 2014 on species richness), so for example there are many articles on the declines of honeybees in the Northern Hemisphere, potential causes and the implications for such a decline on the pollination of plants, in particular for commercial crops. What has been generally lacking are studies that have looked at the relative abundances of a wide variety of different insect species over time at the same location, i.e., the overall state of insect biomass, as opposed to a change in the relative abundances of a few species. This is important, as insects are vital prey, pollinators and recyclers in ecosystems and are important in many food webs everywhere. Jarvis noted that monarch butterflies have declined in abundance by 90% over the past 20 years, while the rusty-patched bumblebee, found in 28 American states, has declined in abundance by 87%. David Wagner, an entomologist at the University of Connecticut, summarised this by stating that "We notice the losses [of species]. It's the diminishments [of communities] that we don't see" (Jarvis 2018).

Scientists in Denmark became concerned about this in 2016, and soon became aware of a paper (Hallmann *et al.* 2017) by an obscure German entomological society in Krefeld, near Düsseldorf, that put this issue into sharp focus. The German study documented an insect decline of 75% over 27 years in nearby nature reserves, measured simply by the weight of flying insects caught with a standard method. At midsummer population peaks, the decline was 82%! By 2017, this study, according to the website Altmetric [Altmetrics are metrics and qualitative data that are complementary to traditional, citation-based metrics. They can include (but are not limited to) peer reviews on Faculty of 1000 (F1000), citations on Wikipedia and in public policy documents, discussions on research blogs, mainstream media coverage, bookmarks on reference managers like Mendeley, and mentions on social networks such as Twitter.], was the sixth most discussed scientific paper that year, with the result that headlines around the world warned of an "insect Armageddon." This triggered so many eager volunteers to help in the proposed Danish studies (see below) that people were being turned away, as many others had also noticed a change in insect abundance but were not sure what to make of it. This raises the questions of "How could this not have been noticed

earlier, and what are the consequences now?"

We all likely agree that humans are not great at remembering the past accurately, especially when it comes to changes in the natural world. Peter Kahn (Kahn 2017, Kahn and Weiss 2017) summed up our blindness by stating "With each generation, the amount of environmental degradation increases, but each generation perceives the environment into which it's born, no matter how developed, urbanized or polluted, as the norm." As a fisheries scientist later in life, my colleagues and I refer to that as the "ratchet principle," with subsequent human generations accepting the ratcheted down abundances of over-fished species as an acceptable situation. With insects one of the most abundant life forms on earth (about a million species have been identified, of an estimated five million that actually exist), it seems it never occurred to most biologists that their overall abundance might dramatically decrease, so virtually no past studies except the Krefeld one have investigated overall regional insect biomass change over time. There were a few worrying signs, as in Britain, as many as 30-60% of species have been found to have reduced ranges, but larger trends were obscure. That is why the speed and scale of the decline shown in Germany has shocked so many biologists.

We are all aware of the potential numerical extinction of charismatic species such as rhinos, tigers and some killer whale populations, but scientists are now beginning to talk of functional extinctions, where while species may still be present, they are no longer prevalent enough to affect ecosystem function, i.e., to fulfil the role they used to exert in, for example, a prey, predator or pollination capacity. Some have suggested that a loss of even just 30% of some species abundances can destabilise ecosystem function and trigger declines in other species. It is the "historically common" species, because of their abundance, that largely structure existing ecosystems, and so when they slowly decline in absolute abundance, like the onset of twilight, their declines can be hard to discern. Most of us are aware of deforestation consequences, but defaunation, the loss of an area's animals, and especially the smaller ones, is equally serious and often much harder to see. Both events can trigger "negative cascading events on ecosystem function," and while we tend to focus on the largest ecosystem species (e.g., raptors, large mammals, etc.), it is really the little species like insects that along with structural species like trees support the natural world and are the base of the pyramid of the world's life forms. Relative changes in their biomass can thus be particularly serious and have far-reaching consequences.

A recent study (Lister and Garcia 2018) has shown that this is not just a European problem, as Brad Lister, a tropical ecologist in Puerto Rico, has recently published that between 1976 and 2013, the absolute abundance of arthropods (insects, millipedes and sowbugs) in his study area that lizards feed on has decreased by as much as 60 fold [note, not 60%!], from a standardized catch rate of 473 mg of bugs to one of eight mg, with resulting declines noted in the numbers of lizards, frogs and birds. Over the same past 30 years, forest temperatures have risen 2.0° C (3.6° F), and their study indicated that climate warming is the driving force behind the collapse of that forest's food web. He also noted that as large as this is, the declines would be largely invisible to the average person walking through the Luquillo rain forest. He expects this may be the case until a tipping point is reached, after which there will be a "sudden and dramatic loss [of components in] the rain forest system," obvious to anyone.

It may be that the more widespread European tradition of amateur's participating in biological studies than occurs in North America may explain why Europe is now acting faster to try and study the decline in overall insect biomass (see https://uniavisen.dk/en/the-insect-mobile-citizen-science/). While travelling through Denmark and northern Germany on an 2018 ARS conference pre-tour, it was pointed out to us that the extensive grass fields we saw were now often being cut two to three times per year to maximise harvest, and that bird populations were declining. A suggested effect was there now was insufficient time for insect bird food generations to be completed between cuttings, and so much fewer insects.

I mention this because with the recent establishment of the Rhododendron Research Network in collaboration with the ARS, there is an opportunity for ARS members to work as citizen collaborators with scientists, and perhaps expand rhododendron studies being planned to include other ecosystem components, such as insect pollinator abundances. Wouldn't it be great if we ARS members could significantly contribute to a better understanding of this issue, and perhaps help determine how best to resolve it!

The concept of the on-going Danish study is described below, and while it does not focus on garden insect biomass changes *per se*, it should be possible to develop appropriate standardized protocols to monitor smaller site-specific insect biomasses in a more localised area. All that is needed is to find a researcher that is willing and able to take an interest in this idea, and to develop and administer a suitable study! By its nature it will need to be long term, as the goal would be to monitor potential change and the consequences over years.

The Danish study by Anders Tøttrup, University of Copenhagen (Fjeldberg 2018), will document a broad cross-section of flying insects found in Denmark, divided into living areas, species, how many insects are found in total, and the different insect grouping's biomasses. To create a large scale insect overview, Tøttrup will use two methods in the Danish insect study, which represent two new ways of doing things.

First, he relies on a method known as citizen science, by incorporating at least 300 civilians in the data gathering process. At least 150 of them must take four car trips over the summer, and the other 150 will drive four trips the next year. They will take

Photo from https://uniavisen.dk/en/the-insect-mobile-citizen-science/.

predestined routes through agriculture, cities, forests and open natural habitats with a hedge or meadow, as well as routes along wetlands and lakes. The insects are to be caught by an open, forward-facing insect net attached to the roof of the cars, and in this way project "Insect Mobile" will gather its data (in the form of insects) without investing heavily in specialist salaries, says Tøttrup.

The other method is helped along by rapid developments in genetic studies. Today, researches can make DNA extractions so quickly and efficiently from the collected insects that Tøttrup will use the method in the "Insect Mobile" data analysis. Five years ago this could not be done–and it makes things much easier now. "We therefore only need to categorize the insects into two rough sizes before the DNA extraction. Previously, a manual categorization would have taken one person an entire day to achieve. It would not at all be achievable if we had to sort all the insects manually," says Tøttrup.

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Glen Jamieson is the current president of the Mt. Arrowsmith Chapter and the editor of JARS.

Editor's Note: Canadian Researchers Warn of "Cascading Impacts" as Bumblebee Species Decline

As a follow-up up to Ian Efford's (2019) spring issue article on bumblebees as pollinators of rhododendrons, in the April 22, 2019 Canadian Broadcasting Corporation (CBC) news, there is an article by Desmond Brown with the above title. The article stated that "A team of researchers at York University [in Toronto] has warned that the American bumblebee [***Bombus pensylvanicus***] is facing imminent extinction from Canada, the highest and most at-risk classification before extinction. Their study was published in the *Journal of Insect Conservation* on April 17.

"About 42 of the more than 850 species of bees in Canada are bumblebees —important pollinators needed to grow crops, including apples, tomatoes, blueberries and legumes, as well as trees, shrubs and wildflowers. Professor Laurence Packer [of York University] said quite a few of the 42 species of bumblebees are exhibiting substantial declines. Packer explained that bees have different preferences, so when some species are lost, the flowers that they prefer are likely to be less frequently pollinated. These kinds of declines in important pollinators are going to have cascading impacts throughout the entire ecosystem."

"The researchers looked at historic data over a period of 100 years and compared it with the last 10 years and found an almost 89 per cent decrease in abundance relative to the other bees. Packer said the American bumblebee joins other bumblebee species, like the rusty patched bumblebee [*Bombus affinis*], which have also shown remarkable declines over recent decades. "We've got similar declines in bumblebees on just about every continent," he said."

Reference:

Efford, I.E. 2019. Are Bumblebees Important as Pollinators of Rhododendrons. *J. American Rhodo. Soc.* 73-2: pp 76-80.

Flowers always make people better, happier, and more helpful; they are sunshine, food and medicine for the soul.

Luther Burbank

Awards

Gold Medal: Stephen M. Henning

You have immersed yourself fully in a wide variety of activities that support the American Rhododendron Society. These include maintaining Henning's Rhododendron and Azalea Pages for over 20 years. This publication provides a wealth of educational material on almost every aspect of rhododendrons. You have written excellent articles and provided rhododendron photos for the ARS Journal. You launched on your personal website both the Rhododendron and Azalea Bookstore and later, the ARS Store, with all proceeds directed to the ARS. You also acted as the Registrar for the very successful 2018 joint spring convention between the ARS and the German Rhododendron Society. Most recently, you served as co-chair for the 2019 ARS Spring convention.

For your outstanding contributions, the American Rhododendron Society is pleased to present the Gold Medal to Stephen M. Henning. May 18. 2019, Philadelphia, Pennsylvania.

Ann Mangels, Steve Henning, and Glen Jamieson. Photo: Linda Derkach.

Pioneer Achievement Award: Charles Owen Dexter

The 75 years that have passed since Charles Owen Dexter's death validates the importance of his accomplishments. He was the first to realize East Coast gardeners needed hardy rhododendrons better suited to the extremes of their climate than the twentieth-century varieties that were sensations in the British Isles and Pacific Northwest. Along with Gable and Nearing he produced hardier plants with wonderful flowers. Dexter produced them in far greater quantities than any others. His legacy is preserved in the Dexter rhododendron collections at Heritage Museums & Gardens, Tyler Arboretum, Scott Arboretum, Jenkins Arboretum, and other major gardens. Gardeners along the Atlantic Coast and inland to the Great Lakes owe to Dexter thanks for all that he did to give them the beauty of his rhododendrons. Presented this 18th of May 2019.

The recipient Gardens of the Pioneer Achievement Award posthumously awarded to Charles Owen Dexter were: Heritage Museums and Gardens, Sandwich, MA - Joe Bruso, President Massachusetts Chapter ARS, accepted on behalf of the Heritage Museums and Gardens (the Heritage representative was unable to attend), and Tyler Arboretum, Media, PA, accepted by Mike Karkowski, Director of Horticulture.

Joe Bruso and Mike Karkowski accepting Dexter awards. Photo: Glen Jamieson.

Award of Appreciation: Paul Anderson

Paul Anderson, you have been the inspiration for many members of the American Rhododendron Society to share your love of rhododendrons with people around the world. You have served as a leader and educator, a mentor and friend to ARS members in the United States, Canada and the many European and Asian members and Chapters you have represented as a Director of the American Rhododendron Society. You were one of the founding members of the Eureka Chapter of the ARS and a founding member of Humboldt Botanical Garden where your beloved genus *Rhododendrons* are grown in the Moss Family Temperate Woodland Garden. The Board of Directors of the American Rhododendron Society recognizes your outstanding contributions and dedication to the American Rhododendron Society."

Note: Paul passed away in April, 2019, and received this recognition shortly before his death. He was the ARS Director of Chapters at Large, a life member of the Seattle Chapter and was also very active in New Zealand Rhododendron Society conferences.

Dr. Paul Anderson.

Awards (Continued)

Award of Appreciation: George Argent

George Argent was an avid plant hunter, especially for vireyas, for more than 40 years, traveling to New Guinea, Australia, New Zealand, Asia and Europe as well as in the United States, all the while connecting the vireya world through his research and books on vireya rhododendrons. He found and introduced new species, and because he believed Hawaii was in a strategic location to master the growing of vireyas, he sent many seeds to Sherla Bertelmann and Richard Marques for them to grow out. He was an avid writer and popular speaker. His books and research are important measures of his significant accomplishments. George was a renowned expert on tropical plants, the Director of Edinburgh Botanical Garden and the recipient of the ARS Gold medal several years ago when the ARS convention was held in Scotland. The Board of Directors of the American Rhododendron Society recognizes your outstanding contributions and dedication to the American Rhododendron Society.

Award of Merit: Barbara Bullock

As Curator of Azaleas at the U.S. National Arboretum for the past 29 years, you have transformed a cherished floral display in Washington, D.C., into one of the finest evergreen azalea collections in the world. You have documented azalea cultivars and existing plantings with excellent photographs and written records. You greatly expanded the collection by adding new varieties and companion plants. Using volunteers, you have maintained plantings and removed invasive weeds. You recently oversaw the restoration of the original Glenn Dale azaleas set out in 1947. Using your expert horticultural knowledge and innate artistic talents, you skillfully created a beautiful landscape while maintaining its scientific integrity. For your exemplary work, the American Rhododendron Society gratefully presents the Award of Merit to Barbara Bullock. May 18, 2019, Philadelphia, Pennsylvania.

Bronze Medals

Mt. Arrowsmith Chapter:
Ann de Brincat

Ann is one of the unsung heroes of MARS. A cheerful, willing volunteer, she has worn many hats and contributed to MARS in many ways. She has served as director for twelve years, including two years as Secretary and one as Vice President. She was Program Chair for four years and has been a long-time worker at the annual Rhodo Show and Sale, both displaying her tender rhodos and working a cash register. Ann has also led several propagation workshops. She has always been generous with her time, participating particularly at the Christmas social by donating the turkey for this annual dinner. Mount Arrowsmith Rhododendron Society happily recognizes this outstanding service with the chapter's highest honor, the Bronze Medal.

Mt. Arrowsmith Chapter:
Don Bridgen

This medal is in recognition of Don Bridgen's long-standing service to MARS, a willing volunteer, always helping out wherever he could. For seven years he served as a director on the executive, choosing the monthly raffle plants and holding them until needed. He has a particular interest in propagating rhododendrons from cuttings and has conducted many propagation workshops for MARS members and the public. Most recently he has joined other MARS members in Victoria in rooting rhododendron cuttings. Don is generous with his time and on many occasions, he has acted as a judge at district truss shows. With great pleasure we recognize this outstanding service to MARS with the chapter's highest honor, the Bronze Medal.

ARS Board of Directors Meeting
Wednesday, May 15, 2019
Brief Highlights of the Minutes

(Updated: May 29, 2019)

President's Report from the Executive Committee

- Special Awards were approved for Paul Anderson and George Argent
- The need for two board meetings per year will be discussed further at the fall meeting.
- On behalf of the ARS, Ann Mangels will write to the USFS with our concerns about the designation of rhododendrons as invasive understory.
- Ann Arbor chapter member have plans to re-start after two years non-operational.
- Ken will continue to work with the owners of the *Hirsutum* website to determine the viability of it being taken over by the ARS.

Issues and Concerns of Board and Committee Members:

- Steve Krebs wants us to work on making good quality rhododendrons available to the public using the ROY Awards and Proven Performers lists, and working with VanVeen Nursery.
- The ARS is in good financial position according to our Treasurer

Continued on next page.

- JARS Editor Glen Jamieson needs people to write more articles
- It was confirmed that non-ARS members of chapters should not hold office or be recipients of the ARS Bronze Medal
- District 4 will conduct a pilot project, creating an award that recognizes contributions to the whole district and with the recipients determined by the district
- Sandra McDonald is stepping down as chair of the Editorial Committee.
- The Endowment Fund has awarded $4,000 to five chapters on Vancouver Island to purchase plants for the Greig Species Rhododendron Garden in Qualicum Beach, BC.
- The Membership Committee has suggested that members not renewing by February 15 no longer be considered members of the ARS. Membership renewal and retention is a challenge throughout the society. Those not renewing can still be kept on the chapter newsletter list. There was some disagreement with this strategy.
- Research Foundation appointees include Harold Sweetman and Bud Gehnrich.
- Christina Woodward of Test and Display Gardens spoke of promising projects with students at the Niagara School of Horticulture.
- The Vineland azaleas that are very tolerant of powdery mildew will be propagated and hopefully be available for the 2021Convention in Nova Scotia.

Things You Should Know About the ARS Websites

Bob Weissman, Electronic Media Committee Chair, Mountain View, CA

The ARS Electronic Media Committee is responsible for maintaining the Society's websites. The sites are:

ARS website (www.rhododendron.org): The website is primarily for the general public–with "how-to" information, a searchable rhododendron and azalea database, a rhododendron nursery database, the seed exchange, the "Rhododendron of the Year" selections, the online Rhododendrons International Journal, the archive of old JARS issues, ARS membership information, Society and chapter contact info, etc. The site averages 50k visits per month from people located in countries around the world.

Office of the ARS (OARS) (www.arsoffice.org): This website provides useful and up-to-date information for view recent JARS issues, search the member database, chapters can download current rosters, view financial activity, download application forms, search the speaker's bureau database, etc. The OARS site has contact information for current Society officers, directors, committee chairs, provides board of director meeting agendas and minutes, the ARS bylaws and policies, Society historical information, lists of Gold, Silver and Pioneer Achievement honorees, etc.

ARS Store (www.arsstore.org): At the Store members and non-members can purchase books and shop online at national merchants such as Amazon, Best Buy, Target, Walmart, Microsoft, etc., that earns money for the Society.

ARS Blog (www.rhododendron.org/blog/default.asp): The ARS Blog has short articles covering a wide variety of topics about rhododendron gardens, hybrids and species, people and events, plant care, companion plants, etc. Items are organized chronologically by date. Readers can add comments and ask questions. The blog posts are searchable.

ARS Pinterest website (www.pinterest.com/rhodosociety/): Pinterest is a social media website designed to enable discovery and sharing of information via photo images. Users upload, save, sort, and manage images, known as "pins", and other media through collections known as "pinboards". The ARS site has pinboards for rhododendrons, azaleas, vireyas, fragrance, cold tolerance, early and late blooming, how to grow rhodos, bonsai, Society information, gardens to visit, etc. Currently, the Pinterest website has 16k monthly viewers.

Rhododendron Research Network (www.rhodo-research.net): This website is for scientific researchers that enables a multitude of opportunities for collaboration, communication and information sharing of rhododendron-related information. Presently, 35 international scientists and ARS members are network participants. Site content includes a searchable database of rhododendron-related scientific literature, a database of rhododendron-hybrid pedigrees, information about network governance and current and future goals, an archive of the network's newsletters, etc.

Other websites owned and independently run by ARS members with rhododendron-related information are:

Vireya Rhododendrons (www.vireya.net): Webmaster Chris Callard has created a comprehensive site that has a vireya species database, listings of named hybrids, information on the history, distribution, classification and cultivation of vireya rhododendrons, and copies of over 50 selected works covering all aspects of vireya culture.

H**irsutum website (www.hirsutum.info):** Created by Herman van Ree, this website has many thousands of rhododendron photo images. The site has photos and information for azalea, rhododendron, azaleodendron, and vireya species and hybrids. Many ARS members have donated photographs for the site. For the past several years, the Hirsutum website has not been updated.

Using Arborist Wood Chips as Landscape Mulch

Linda Chalker-Scott
Puyallup, WA

Photos by Author

Fig. 1. Arborist wood chips are often available free of charge.

Landscape mulches are important components of environmentally sustainable gardens and landscapes. Unlike soil amendments, mulches are simply materials laid on top of the soil rather than worked into it. Select the right mulch and you reap the benefits of healthier soils and plants; choose the wrong mulch and the only plants that thrive are the weeds. This article discusses how to use arborist wood chip mulches in their landscapes.

Benefits from Using Arborist Wood Chips

In areas where trees are a dominant feature of the landscape, arborist wood chips are one of the best mulch choices for trees and shrubs. Studies have found wood chips to be one of the best performers in terms of moisture retention, temperature moderation, weed control, and sustainability. In many urban areas, arborist wood chips are available free of charge (Figure 1), making them one of the most economically practical choices.

Unlike uniformly textured sawdust and bark mulches (Figure 2a), arborist wood chips include bark, wood, and often leaves (Figure 2b). The chemical and physical diversity of these materials resists the compaction often found in sawdust and bark mulches. Additionally, the materials vary in their size and decomposition rate, creating a more diverse environment that houses a diversity of microbes, insects and other organisms. A biologically diverse soil community is more resistant to environmental disturbance and will in turn support a diverse and healthy plant population.

Wood chips are considered to be slow decomposers, as their tissues are rich in lignin, suberin, tannins, and other complex natural compounds. Thus, wood chips supply nutrients slowly to the system; at the same time, they absorb significant amounts of water that is slowly released to the soil. It is not surprising that wood chips have been cited as superior mulches for enhanced plant productivity. Wood chips have been especially effective in helping establish trees and native plants in urban and disturbed environments.

Arborist wood chips provide substantial weed control in ornamental landscapes (Figure 3). The mechanism(s) by which wood chips prevent weed growth are not fully understood, but likely includes light reduction (preventing germination of some seeds and reducing photosynthetic ability of buried leaves), allelopathy (inhibiting seed germination), and reduced nitrogen levels at the soil-mulch interface (reducing seedling survival).

While there are imported wood mulches available for purchase at nurseries and home improvement centers, they are not as cost-effective as locally produced wood chips, which are often free. In a society where using locally produced materials are increasingly popular as a measure of sustainability, arborist wood chips are a natural choice. Finally, the reuse of plant materials as mulches keeps them out of the landfill–a benefit with both economic and environmental attributes.

Fig. 2a. Bark mulch.

Fig. 2b. Arborist wood chips create a diverse environment for plants.

Fig. 3. Few weeds can survive in correctly applied wood chip mulches.

Fig. 6. Plants mulched with wood chips do not have nitrogen deficiencies.

Frequently Asked Questions About Arborist Wood Chips

Q: *Will woody mulch acidify my soils?*

A: No. In field situations it is difficult to significantly alter soil pH without the addition of chemicals. Temporary changes in pH may be found in the decomposing mulch layer itself, but these have little effect on underlying soils. Significant changes in soil pH can only occur after decades or centuries of mulch use.

Q: *Don't woody mulches, like cedar, leach allelopathic chemicals that kill other plants?*

A: No. Many living, growing woody plants contain allelopathic chemicals, which can prevent seeds from germinating or kill young seedlings. Most compounds have no effect upon established plants. Cedars (*Thuja* spp.) have not been found to have this ability. Even *Juglans nigra* (black walnut), the best known allelopathic species, has not been shown to have negative effects when wood chips are used as a mulch.

Q: *Will mulches made from diseased trees infect healthy trees?*

A: No. Most studies indicate that diseased mulch cannot transmit pathogens to the roots of healthy trees. Under no circumstances should wood mulch be worked into the soil as an amendment: not only is this a poor planting practice, but increases the likelihood of disease transfer. Using diseased wood chips as a soil amendment puts them into close proximity to roots where subsequent tissue injury or environmental stress could lead to infection.

Fungal communities found in wood chip mulches are generally decomposers, not pathogens. Under healthy soil conditions, beneficial and harmless fungi (Figure 4) can outcompete pathogens for space on plant roots that grow into mulch layers. Furthermore, healthy plants are not susceptible to opportunistic pathogens such as *Armillaria* and *Phytophthora*, which are widespread, but inactive in well-managed soils.

Fig. 4. Fungal hyphae in a wood chip mulch.

Fig. 5. Fine textured mulch like sawdust holds very little water and burns easily.

Fig. 7. Mowing undesirable plants before mulching keeps soils undisturbed and reduces growth.

Fig. 8. A layer of compost underneath coarse wood chips adds extra nutrients.

Fig. 9. When mulch layers are too thin, weeds will grow rapidly.

Q: *Aren't wood chips a fire hazard?*

A: No. Coarse textured organic mulches, like wood chips, are the least flammable of the organic mulches. Fine textured mulches are more likely to combust (Figure 5), and rubber mulch is the most hazardous of all tested landscape mulches. If organic mulches are kept moist, they are less likely to catch fire. If you use flamers for weed control in areas near wood chips, be sure to soak the mulched area first.

Q: *Won't wood chip mulches tie up nitrogen and cause nutrient deficiencies in plants?*

A: No. Many studies have demonstrated that over time woody mulch materials will increase nutrient levels in soils and/or associated plant foliage (Figure 6). However, there is a nitrogen deficiency at the boundary between the mulch and soil, which probably inhibits weed seed germination.

Q: *Will woody mulches attract termites, carpenter ants, and other pests?*

A: No. Many wood-based mulches are not attractive to pest insects but are actually insect repellent. For instance, cedar (*Thuja*) species produce thujone, which repels clothes moths, cockroaches, termites, carpet beetles, Argentine ants, and odorous house ants. In general, termites prefer higher nutrient woody materials such as cardboard, rather than wood chips.

Action List for Using Arborist Wood Chip Mulches in the Landscape

Begin mulch application before annual weeds are established. Mulch is most effective in suppressing weeds before weed seeds germinate. Therefore, bare soil should be mulched as soon as practical, especially in the spring and fall when weed seed germination is at its peak. If this is not possible, the most effective, non-chemical way to remove weeds prior to mulching is to mow them as close to the ground as possible, followed immediately by mulching.

Prune or mow perennial weeds at the root crown. This is best done in early spring when root resources are lowest; generally just as leaf growth begins (Figure 7). Extensive pulling of perennial weeds from unprotected soil is not recommended, as this disturbance will destroy soil structure and increase erosion, especially in sandy soils or in sloped areas. It is better to keep unprotected soil undisturbed. However, you can pull resprouting perennial weeds in landscaped areas covered in mulch; the mulch layer prevents erosion and facilitates pulling.

Remove particularly aggressive weeds from the site. Weeds that easily go to seed or can reroot themselves after they've been dislodged should be composted or disposed with green waste materials.

Add a thin underlayer of compost. Before installing wood chips for the first time, create a thin underlying layer of a more nutrient-rich mulch (like compost, Figure 8) if there are concerns about nutrient deficiencies. This "mulch sandwich" approach is a logical one that mimics what you would see in the mulch layer of a forest ecosystem. It's not required, though, and over time a wood chip mulch will develop this same structure as the lower layers break down.

Use fresh chips unless there are still concerns about disease. Some of the nutrient value (particularly nitrogen, if the chips contain leaves or needles) will be lost in the composting process. Using fresh chips ensures that some of the foliar nitrogen will feed the landscape rather than the compost pile.

Install chips to the desired depth. A successful wood chip mulch must be deep enough to suppress weeds and promote healthy

soils and plants: research has demonstrated that weed control is directly linked to mulch depth, as is enhanced plant performance. A review of the research on coarse organic mulches and weed control reveals that shallow mulch layers will enhance, rather than prevent weed growth (Figure 9). All plants, including weeds, respond positively to the benefits of organic mulches, particularly the increase in soil water retention. Wood chips maintained at a depth of 4 to 6 inches (10-15 cm) will control weeds without detracting from appearances.

Keep mulch away from trunks of trees and shrubs. Piling mulch against the trunks of shrubs and trees creates a dark, moist, low oxygen environment to which above-ground tissues are not adapted. Fungal diseases require a moist environment to grow and reproduce; piling mulch on the trunk provides exactly the right conditions for fungi to enter the plant.

Likewise, opportunistic pests are more likely to invade a plant whose bark is wet due to excessive mulching. Rather than creating mulch volcanoes (Figure 10), instead, taper the mulch down to nearly nothing as you approach the trunk. This donut-shaped application will protect the soil environment as well as the above-ground plant tissues.

Fig. 10. Mulch volcanoes may enhance pest and disease problems.

Keep mulch away from building foundations. Although wood chips do not attract termites or other pests, they and other mulches can act as a bridge allowing pest insects to enter houses and garages. Maintain a narrow strip of bare soil next to the foundation to prevent infestations.

Reapply mulch as needed to maintain desired depth; replacement rate will depend on decomposition rate. Once mulch is applied, little management needs to be done other than reapplication to maintain minimum depth. High traffic areas are most likely to need replacement.

Further Reading

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Acknowledgement

This article is with permission from: Chalker-Scott, L. 2015. Using arborist wood chips as a landscape mulch. WSU Extension Fact Sheet FS160E. http://cru.cahe.wsu.edu/CEPublications/FS160E/FS160E.pdf

Linda Chalker-Scott is an Associate Professor and Extension Urban Horticulturist at Washington State University. She has a very interesting website at https://puyallup.wsu.edu/lcs/category/myths/, where she presents the facts behind many garden myths.

The glory of gardening: hands in the dirt, head in the sun, heart with nature. To nurture a garden is to feed not just on the body, but the soul.

Alfred Austin

Deadheading Rhododendrons

Don S. Wallace
McKinleyville, CA

(modified from the Second Week of May 2019 website edition, Singing Tree Gardens Nursery)

Every year after the bloom, everyone's rhododendrons are covered with seed heads where the flowers once were. I am always asked if they should be removed, and my answer is "yes if you want more flowers". In theory, if the plant puts its energy into seed production, then fewer flower buds are created for next year's bloom. This theory was validated by Oregon's Portland Parks Department when they did an interesting experiment. One large rhododendron was selected in the park that always bloomed reliably. After blooming, only the bottom half of the plant was deadheaded, leaving the top half untouched. The following spring the bottom, previously deadheaded, half flowered heavily, while the top half had few flowers. To confirm these results they repeated this experiment, only this time they deadheaded the top half of the plant, leaving the bottom half untouched. The next spring, as suspected, the top half of the plant flowered heavily, while the bottom half had few flowers.

So, while this experiment was great proof that deadheading is a worthwhile practice for those wanting more flowers, there is the question: "What about my 50-year-old rhody that flowers with abandon every year with no deadheading?" My only answer to that question would be that some varieties, once reaching maturity, will bloom very reliably every year even without the deadheading. So, my advice would be to deadhead those plants that are easily done. Once they are too tall, don't bother, as there are many other constructive gardening chores that can fill up your time.

Don Wallace is a member of the Eureka Chapter and owner of Singing Tree Gardens and Nursery.

Removing seed heads.

Deadhead this rhododendron after blooming? Yes.

Deadhead this rhododendron after blooming? Absolutly not!

Rhododendron Leaf Traits Along Tropical Elevation Gradients

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[**Editor's note:** As a requirement for receiving research funding from the ARS, recipients must submit a brief summary in layman's terms of their completed research. This article is Melissa's summary.]

A casual walk in nature reveals that plants have an enormous range of leaf shapes, sizes, and colors. Not visible to the human eye are also important characteristics pertaining to the internal and external structure and the chemical composition of their leaves. Such leaf characteristics, or traits, can tell us a lot about a plant species' ecology and evolution, including its preferred growing conditions, habitat in nature, and how it competes with other plants for resources needed for growth, reproduction, and survival.

Take a *Rhododendron* (Ericaceae) leaf for example. Often, *Rhododendron* leaves are leathery and difficult to rip or puncture, which can indicate resistance to pressures of herbivory. Examination of leaf surfaces, and whether there is presence of protective waxes or characteristics such as the density of stomata or trichome hairs, can reveal adaptations to avoid or tolerate stressors such as moisture loss or extreme ultra-violet radiation (Korner *et al.* 1983, Nilsen 2019). Further magnification of internal leaf structures, and the presence of idioblast cells, may explain how some *Rhododendron* species, such as the tropical vireyas, can withstand changes in water content, and thus facilitate a shift from terrestrial to epiphytic growth forms (Tulyananda and Nilsen 2017). Identification of chemicals in leaves, such as grayanotoxins or terpenes, can also provide insights on the invisible arsenal of *Rhododendron* defenses against herbivores or pathogens (Doss *et al.* 1986, Jansen *et al.* 2012).

Summarization of leaf characteristics is a component of plant identification and broader taxonomic studies (Linnaeus 1767, Argent 2006). For instance, within the genus *Rhododendron,* two major clades are defined based on whether species have leaves that are "lepidote" (meaning having scales on their leaves, especially the underside) versus "elepidote" (leaves that are smooth on both sides). Measured in a standardized way, leaf traits can be used like a universal currency for comparing plants from different taxonomic groups and regions of the globe (Wright *et al.* 2004, Russo *et al.* 2010). Commonly used leaf traits include metrics such as leaf size or weight, and concentrations of key nutrients, such as nitrogen, phosphorus, or carbon. More recently, scientists have become especially interested in using specific leaf area (SLA), which is the ratio of leaf area to dry weight, as a rough metric of leaf density that is often used as a means to describe the resource "cost" of producing a leaf.

The manner in which resources are allocated for plant growth, reproduction, and maintenance of physical structures is important when inferring different ecological strategies for survival (von Liebig 1840, Reich *et al.* 1999). There can be a spectrum of leaf trait values, with complex correlations between traits that produce a combination of positive and negative "trade-offs" for a plant. For instance, plants at one end of the leaf spectrum have a "live fast, die young" strategy of survival, with resources used towards rapid growth of leaves and structures, but at the cost of limited defenses against herbivory or disease and a reduced resiliency against environmental stressors. At the other end of the spectrum, plants have a more "slow and steady strategy for increased longevity" method of resource allocation, with tough leaves that last through the seasons and enable tolerance of environmental stressors but are costly to produce.

When a person shifts their focus towards assemblages of species, such as those positioned along an elevation gradient, further ecological insights can be gained from quantifying leaf trait averages and whether they correspond with environmental conditions, such as temperature or moisture availability, that differ with elevation. For instance, a common observation is that plants that occur within warmer, wet lowland forests generally tend to have high specific leaf area (SLA) values, on taller trees with expansive yet thin leaves. In contrast, plants near montane or alpine areas are exposed to colder, more variable conditions and thus plants tend to be more compact in stature with lower SLA values, and smaller thick leaves (Grubb 1977, Reich *et al.* 1999). However, there can also be quite a bit of variation in trait values for a given area because of subtle differences in habitat microclimate, soil, or interactions with neighboring species. Plants that specialize in extremely stressful habitat types (e.g. serpentine soil, granite outcrops) can be spatially independent from climate-based gradients, but restricted to areas with specific edaphic conditions (Whittaker 1954, Kruckeberg 2002).

Since environmental conditions change dramatically with elevation, I expected *Rhododendron* leaf traits to also vary with elevation. However, a counter expectation is that plants with a more stress-tolerant ecological strategy, such as *Rhododendron* with tolerance of low nutrient environments, might have very different leaf trait trends compared to other plants if edaphic conditions, rather than

Fig. 1. Collecting Rhododendron leaf samples from botanical gardens (photo of Bovees Rare Plant Nursery), followed by quantification of functional traits in a lab.

climate, dictate primary leaf characteristics. To address these leaf trait unknowns, I decided to use *Rhododendron* species from tropical regions of Southeast Asia. Within this region of the globe there is a high diversity of *Rhododendron* species that occur from sea-level to mountain summits (Argent 2006), with over 300 species currently described. In my PhD thesis research, which was supported by funds from the American Rhododendron Society, I studied how leaf traits varied with elevation and what that variation could tell us about the ecological strategies of this diverse and fascinating genus.

Species and leaf sampling protocol

I studied the leaf traits of 169 species from the genus *Rhododendron*, section *Schistanthe* (commonly referred to as vireyas). Leaves were sampled from botanical garden greenhouses, including The Royal Botanical Garden in Edinburgh (Scotland, UK), the Rhododendron Species Foundation (Washington, USA), and Bovees Rare Plant Nursery (Oregon, USA). The majority of species originated from wild-collected cuttings or seeds from individual plants of known provenance. Accession information, and a unique identifier code, was recorded for each plant.

From every *Rhododendron*, I sampled an average of five healthy mature leaves with preference towards leaves with maximum sun exposure on different branches. To preserve freshness, I immediately wrapped leaves in moist paper towels and stored them within plastic bags in a cool dark location until leaf traits were measured a few hours later (Fig. 1). I was specifically interested in two leaf traits for statistical analyses, the first being lamina area (leaf blade size) and the second being specific leaf area (a metric of leaf density or investment). For lamina area, fresh leaves were scanned and area (cm^2) was calculated using image analysis software. Lamina weight was measured after drying leaves for a minimum of 36 hours at ~ 40° Celsius. Specific leaf area (SLA) was defined as cm^2 lamina area / g lamina dry mass. Trait values were first calculated for each leaf, then averaged for each individual plant followed by average by species. Measurements for lamina area, mass, and SLA excluded the petiole.

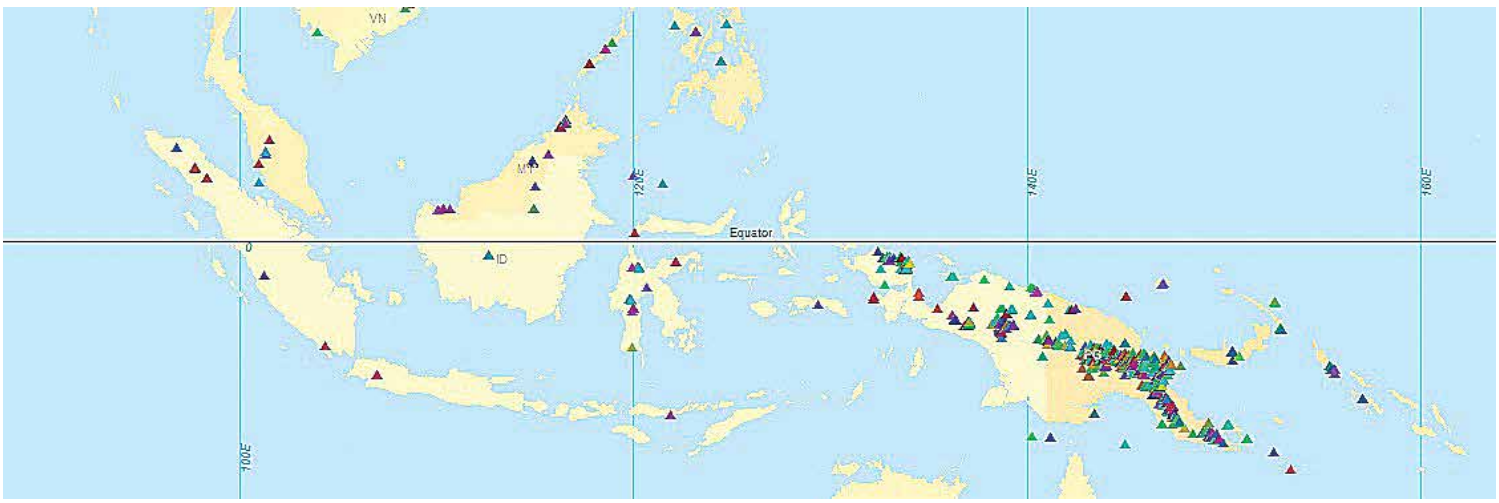

Fig. 2. Map of *Rhododendron* species distribution near the equator. Each color represents a different species. Coordinate data from GBIF. (Note: The horizontal line is the equator or latitude 0 degres. The vertical lines from left to right are longitude 100, 120, 140, and 160 degrees east.)

Rhododendron species along elevation gradients

Species included in this study are native to tropical and subtropical portions of Southeast Asia (e.g., Borneo, Papua New Guinea) and occur across a wide range of habitat types (Fig. 2). Information on elevation range for each species was obtained from botanical monographs (Beaman *et al.* 2001, Argent 2006, van der Ent *et al.* 2014) and occurrence records from a query of the Global Biodiversity Information Faculty (GBIF 2018). For statistical analyses, I used linear regression with elevation midpoint (the halfway point between the maximum and minimum elevation) as the predictor of observed *Rhododendron* leaf traits (lamina area, SLA).

Comparison to other plant species

I performed a broad review of the literature (referred to as a meta-analysis) for SLA values for woody plant species from tropical regions of the globe as a means to compare *Rhododendron* traits with other taxonomic groups along an elevation gradient. Keywords used in the literature search included descriptions of various habitat types with higher moisture availability (e.g., "lowland rainforest," "montane cloud forest"). Additional information for Southeast Asian tropical forest was also included (S.E. Russo, unpublished data for Lambir, Borneo). Elevation values were derived from plant collection data or inferred from locations of study sites. Average values for SLA and elevation were calculated at the species level. Altogether, I found SLA data for over 500 woody tropical species from various tropical regions of the globe (literature listed in supplemental bibliography below).

Do leaf characteristics of *Rhododendron* species change with elevation?

I found that the average *Rhododendron* lamina area (cm^2) across 169 species significantly declined with increasing elevation ($P = 0.013$), meaning that larger leaves were typically on plants from low elevations combined with observations of smaller leaves for plants from higher elevations. For example, species associated with lowland rainforests tended to have large leaves (such as *R. intra-nervatum*, with leaves that averaged 135.5 cm^2 in size) as compared to species commonly found within montane thickets, such as *R. ericoides* (Fig. 3) with especially small needle-like leaves (0.04 cm^2). Differences in lamina area with elevation may be attributed to factors such as light availability, with larger leaves for plants associated with shady understory habitats within tropical lowland forests, as compared to habitats with full sun exposure, such as exposed rocky areas at or above the tree-line. Lamina area might also reflect differences in nutrient or moisture availability, with smaller leaves associated with more stressful growing conditions.

Fig 3. Left photo: *Rhododendron ericoides* on the summit of Mt. Kinabalu (~ 4000 m). Right photo: a branch of the same species held in my hand to illustrate its small leaf size.

In contrast, specific leaf area (SLA) values for *Rhododendron* species did not correlate with elevation (*P*-value non-significant). The average SLA value for the 169 *Rhododendron* species sampled was equal to 56.13 (cm^2/g), which is a relatively low number that supports the generalization that the *Rhododendron* species tend to have a stress-tolerant ecological strategy with high investment in their leaves. I also observed that SLA varied from 29.75 - 112.20 between *Rhododendron* species, which might be explained by the huge range in habitat types that different species are adapted to. For instance, some of the tropical *Rhododendron* species can grow as epiphytes, while others are typically found on extremely low nutrient soils, while some species are opportunistic colonizers of disturbed habitat types such as landslide areas or riparian zones.

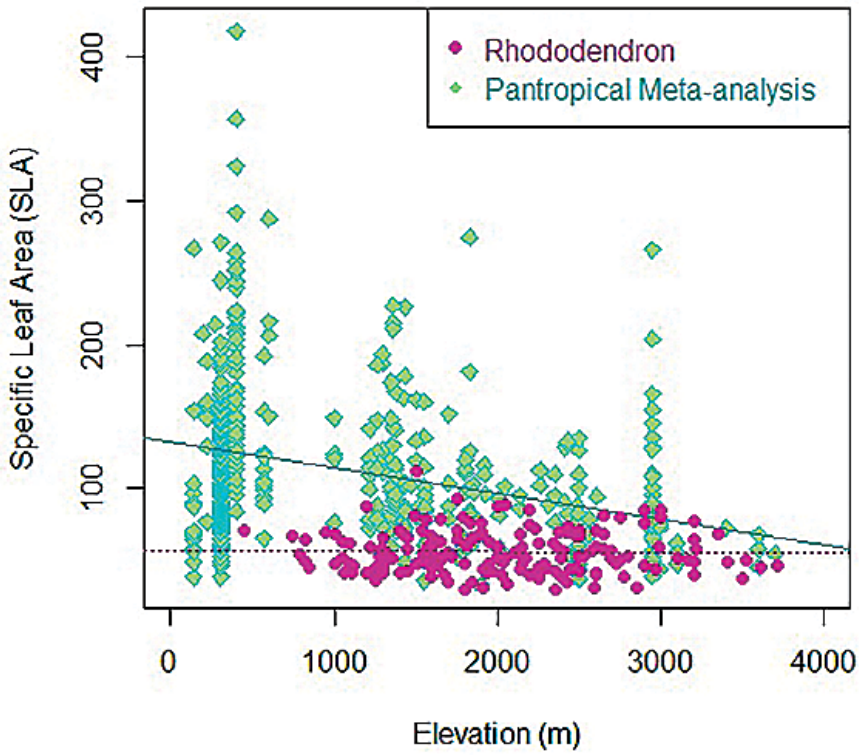

Fig 4. A comparison between specific leaf area (SLA) values for a broad selection of tropical woody plants from a literature review (509 species) compared to Rhododendron (169 species). Each point represents a different species; solid line represents a significant decline in SLA with elevation, dashing is non-significant.

How do Rhododendron leaf traits compare to other tropical woody plants?

When I used elevation as a predictor of specific leaf area (SLA) for woody plant species (excluding *Rhododendron*), I found a significant negative relationship (Fig. 4, $P < 0.001$), meaning that in general leaves at lower elevations are relatively delicate, and are thought to both grow and decompose quickly, as compared to higher elevation leaves that are more dense, tough, and tend to be long lasting. The woody plant results are in contrast to those observed with *Rhododendron,* where SLA was found to be non-significant. The wide range of SLA values (shown on Fig. 4, *y*-axis) for woody plants at lower elevations suggest a broad breadth of possible ecological strategies especially within lowland tropical rainforests, potentially reflecting the higher biodiversity also found within those areas. Another observation is that more distantly related species (the dataset represented multiple plant families) tend to have a wider range of traits than species of the same genus (*Rhododendron*) at all points along an elevation gradient.

Broader conclusion

Rhododendron is a unique genus to test many concepts in ecology, in part because of high levels of diversity combined with species occurrence across broad latitudinal and elevational gradients. As demonstrated by this study, another noteworthy distinction of the *Rhododendron* genus is that many of its species are able to maintain a relatively consistent ecological strategy of stress-tolerance across a gradient spanning over 4000 meters, from sea-level to mountain summits, as indicated by specific leaf area (SLA) being independent from elevation. However, the decrease in lamina area (leaf blade size) with elevation shows that species still adapt to their environment. Overall the ability of *Rhododendron* to maintain a fairly narrow ecological strategy, as inferred by their leaf traits, is in contrast to general trends observed for other tropical woody flora. One could say that the *Rhododendron* genus "marches to the beat of a different drummer" when it comes to defying conventional expectations for how leaf traits should look for species originating from different points along a broad elevation gradient.

Acknowledgements

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Rhododendron Species for Beginners: Subsection *Fortunea* in the *Rhododendron* subgenus *Hymenanthes*

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Rhododendron* subgenus *Hymenanthes is a subgenus of the genus *Rhododendron*, with a widespread distribution in the temperate Northern Hemisphere. They are elepidotes (without scales) and the subgenus includes two sections, **section *Ponticum***, divided into 24 subsections and about 180 species, and since 2005, **section *Pentanthera*.** The species in section *Ponticum* are evergreen shrubs and small to medium-sized trees (up to 20 m (65 ft) tall), with medium-sized to large leaves (very large, over 40 cm (16 inches) long, in a few species). The flowers are large, produced in terminal trusses of 5-40 together. Plants in this section are the plants that most people think of when they hear the word rhododendrons, and they are widely planted in temperate climate gardens.

In a previous article, I discussed the general characteristics and taxonomic relationships of species of deciduous azaleas in subgenus *Hymenanthes*, section *Pentanthera* (Jamieson 2018) and from the evergreen rhododendrons in section *Ponticum*, subsection *Taliensia* (Jamieson 2019). Here I discuss species in subsection *Fortunea*, also in section *Ponticum.*

Subgenus *Hymenanthes*

Section *Ponticum* (24 subsections, about 304 species (McQuire and Robinson 2009))

1. *Arborea* (12 species)
2. *Argyrophylla* (20 species)
3. *Auriculata* (2 species)
4. *Barbata* (6 species)
5. *Campanulata* (4 species)
6. *Campylocarpa* (7 species)
7. *Falconera* (14 species)
8. ***Fortunea*** (27 species)
9. *Fulgensia* (1 species, *R. fulgens*)
10. *Fulva* (4 species)
11. *Glischra* (11 species)
12. *Grandia* (15 species)
13. *Griersoniana* (1 species: *R. griersonianum*)
14. *Irrorata* (16 species)
15. *Lanata* (6 species)
16. *Maculifera* (14 species)
17. *Neriiflora* (44 species)
18. *Parishia* (5 species)
19. *Pontica* (19 species)
20. *Selensia* (8 species)
21. *Sherriffii (*3 species*)*
22. *Taliensia* (49 species)
23. *Thomsonia* (15 species
24. *Williamsiana* (one species: *R. williamsianum*)

Section *Pentanthera* (2 subsections, 19 species)

1. *Pentanthera* (18 species)
2. *Sinensia* (one species: *R. molle*)

Overview

One of the greatest of plant collectors in the Far East was Robert Fortune (1812-1880), who was born at Kellor in Berwickshire, England. After serving his apprenticeship, he received a thorough training at the Royal Botanic Garden, Edinburgh, under William McNab. He was a skilled gardener, and became the superintendent of the Hothouse Department of the Horticultural Society's gardens at Chiswick, outside London. When hostilities between Britain and China ceased after the signing of the Treaty of Nanking in 1842, the opportunity to collect plants in China became possible and the Society decided to send a collector to Asia. Fortune applied for the position and was accepted. Between 1843 and 1862, he made four trips to China and Japan and wrote four books about his travels.

He discovered and introduced large numbers of specimens of various genera, with his most valuable introductions being *Rhododendron fortunei,* and introducing the tea plant (*Camellia sinensis*) from Chekiang, China, to India in 1855. Fortune returned to Britain in 1862.

He discovered *R. fortunei* growing at 920 m (3000 feet) on his third expedition (1853-1856) to Zhejiang in the mountains of eastern China. The plant was not in flower but was reported by the local Chinese to have beautiful large flowers. Fortune collected a considerable quantity of seed, which he sent back to Chiswick, where a number of vigorous plants were grown and distributed. It was the first of the Chinese rhododendrons to be introduced to Britain.

Later, other forms of *R. fortunei* were collected and it is from one grown by Sir Edmund Loder at Leonardslee and crossed with pollen from *R. griffithianum,* that the hybrid 'Loderi' was created in 1901. It is still considered to be one of the most beautiful of all rhododendron hybrids. There are more than 30 named clones of the *R. griffithianum* X *R. fortunei* cross, including 'Loderi King George', 'Loderi Venus' and 'Loderi Pink Diamond'. Overall, there are now more than 80 hybrids with *R. fortunei* as a parent!

When Robert Fortune introduced this rhododendron into cultivation nearly a century ago, everyone who saw it in flower must have realized immediately that here was something new and different. Its flower colour of pale lilac (just off white) was not exceptional, nor was its fragrance a new feature among rhododendrons, for many of the Sikkimese species such as *R. maddenii*, *R. dalhousiae* and *R. griffithianum* were even more richly scented and had individual flowers of even larger size than the ample ones of *R. fortunei.* What made *R. fortunei* unique was the modeling of its corolla, the poise of its flower, a charm difficult to describe, but supremely satisfying even to the eye untrained in appreciation of artistic proportions. The fact that there are seven lobes, instead of the five found in most other flowers of the genus, added a sumptuousness that contributed still more to its striking beauty (Nearing 1957).

These seven corolla parts of the flower are a leading feature by which most of the 27 species are brought together in subsection *Fortunea*. Sometimes the lobes number only five, sometimes as many as eight, but the characteristic number for the subsection is seven. Elsewhere in the genus *Rhododendron*, very few species have seven corolla lobes, the only ones with this number regularly being *R. auriculatum*, *galactinum*, *watsonii*, *eritimum* and *metternichii*, while about 10 other species have seven lobes occasionally (Nearing 1957).

McQuire and Robinson (2009) describe *Fortunea* as a very diverse subsection. As trees or shrubs, they have leaves oblanceolate or oblong to orbicular, without hairs (glabrous) and with essentially smooth surfaces, and their usually five to seven-lobed corolla is usually pink or white, funnel or open-campanulate, and sometimes fragrant. Cox and Cox (1997) state *Fortunea* species are characterised by their white to pink flowers and their glabrous leaves, while most species in subsections *Thomsonia* and *Campylocarpa* share their glabrous leaves, these tend to be smaller and more rounded and their flowers are usually red, yellow, or deep pink. Cox (1990) stated the majority of this subsection have larger foliage and are in the main vigourous and hardy, and are perhaps the most heat tolerant after plants in subsection *Pontica.* The flowers are often glandular (sticky), somewhat fleshy, and with a small calyx. In summary, *Fortunea* species contain many useful species for severe climates, with *R. fortunei* being the hardiest species with scented flowers.

McQuire and Robinson (2009) divide the species into three groups, based solely on their leaf shape: **Group A** – leaves lanceolate or oblanceolate, usually large, and more than three times as long as broad; **Group B** – leaves oblong or obovate; and **Group C** – leaves orbicular or rounded, usually relatively small. Species descriptions in the following are largely from McGuire and Robinson (2009), Cox and Cox (1997) and Cox (1990) and the RSF website (https://rhodygarden.org/cms/plant-database).

Rhododendron,* subsection *Fortunea (about 27 species, 21 discussed, red font species are more available)

Group A (leaves lanceolate or oblanceolate)

R. asterochnoum
R. calophytum
R. davidii
R. fortunei.
R. glanduliferum
R. griffithianum
R. huianum
R. jingangshanicum
R. maoerense
R. praevernum
R. sutchuenense
R. vernicosum

Group B (leaves oblong or obovate) *R. decorum*
R. oreodoxa
R. qiaojiaense
R. serotinum

Group C (leaves orbicular or rounded)

R. faithiae
R. hemsleyanum
R. orbiculare
R. platypodum
R. yuefengense

Species Details

Group A (leaves lanceolate or oblanceolate)

R. asterochnoum (epithet: with star-like down)

This hardy Sichuan species is a shrub or small tree from 3000-3660 m (10,000-12,000 ft) elevation, and is closely related to *R. calophytum*, differing in the sparse, discontinuous, whitish, stellate indumentum on the leaf lower surface. Its flowers are seven-lobed, about 4.5 cm (two inches) long, white, tinged with rose, and often with a blotch.

R. asterochnoum var. *asterochnoum.* Photo: Marc Reuling.

R. calophytum var. *calophytum.* Photo: Hank Helm.

R. calophytum (epithet: beautiful plant)

This Sichuan species is a shrub or small tree 4.5-15 m (15-49 feet) high from 2400-4000 m (8000-13,000 feet) elevation and is one of the hardiest of the really large growing species. New growth has a sparse silver indumentum that disappears when the leaves mature. The flowers have a long, red pedicel, very short (1 mm; 1/25 in)) calyx, are five to seven-lobed, and are white to pink with a deep red blotch and spots. Its 15-20 stamens are very small compared to the style, which has a large, disk-like stigma. The species differs from its nearest relatives *R. sutchuenense* and *R. praevernum* by having more stamens, a larger stigma and longer leaf pedicels. It flowers from February to April, and so its flowers may be damaged by late frosts.

R. davidii (epithet: after L'Abbe Armand David, early plant collector in W China)

This rare Sichuan plant in cultivation (reintroduced after 1990, older plants are incorrectly named and are *R. oreodoxa* or hybrids of it) is a one to six m (three to 20 feet) shrub or tree from 1300-4000 m (4300 to 13,200 feet) elevation. Its flowers are seven to eight-lobed, pink to purplish blue, spotted purple, with a 1-2 mm (1/25-2/25 in) calyx and ovary that are both densely glandular. It has longer, narrower leaves and a more glandular ovary than *R. oreodoxa*.

R. davidii. Photo: Dr. Stephan Bubert.

R. fortunei (epithet: after Robert Fortune)

This 1.8-9 m (six to 30 feet) shrub or tree is from 600-1200 m (2000 to 4000 feet) elevation. Petioles are purplish, bluish or reddish, and the flower is seven-lobed, often wavy, fragrant, and white to pink. This species is hardier than *R. decorum* and *R. vernicosum* and is distinguished from them by leaf shape and petiole colour. There are two subspecies, *fortunei* with obovate leaves, 1.8-2.5 x as long as broad, and earlier flowering, and *discolor*, with oblanceolate leaves, 2.8-5 x as long as broad, which flowers about a month later (June-July) than subsp. *fortunei*. Subsp. *fortunei* is the hardiest scented species and is relatively heat resistant. Subsp. *discolor* Houlstonii Group has smaller, narrower leaves than subsp. *discolor* and flowers in May.

R. glanduliferum (epithet: gland-bearing)

This two m (seven foot) shrub from 2200 m (7250 ft) elevation in Yunnan has flowers with a densely glandular pedicel and calyx and a corolla that is densely setulate (covered in small bristles)-glandular on their outer surface. It was only introduced into cultivation in 1995 and is rare in the wild.

R. fortunei subsp. *fortunei*. Photo: Coen Zonneveld.

R. fortunei subsp. *discolor.* Photo: Kathy & Bill McKay.

R. griffithianum (epithet: after W. Griffith, a former superintendent of the Calcutta Botanic Garden)

This one to 15 m (three to 50 ft) species is from Nepal, Sikkim, Bhutan and Assam at an elevation of 1800-2900 m (6000-9500 feet), and has usually smooth but flaking and peeling bark of several colors. Trusses are on a long, stout rachis that is usually slightly glandular. Flowers are five-lobed and very large, sometimes scented, and are white or tinged or veined pink to red, with a large calyx. With all the above characteristics, the species is quite easily distinguished, and although it has some of the largest rhododendron flowers, it is fairly tender, so shade and shelter are often required for its successful cultivation.

R. glanduliferum. Photo: Douglas Justice.

R. griffithianum. Photo: Rinus Manders.

R. huianum. Photo: Rinus Manders.

R. jingangshanicum. Photo: Theo Damen.

R. huianum (epithet: after Professor Hu, China)

This two to nine m (six to 30 ft) shrub is from Sichuan, Yunnan and Guizhou at an elevation of 1000-2700 m (3250-9000 ft). Its leaves are acuminate (taper to a point), and its flowers are six to seven-lobed, pale or more often deep rose-purple in colour, with nectar pouches. The calyx is large and the ovary and style are both glandular. The above characteristics make it quite distinctive, and it is separated from *R. davidii* by its larger calyx and glandular style. See the profile of this species by Maria Stewart (in the Spring 2019 JARS).

R. jingangshanicum (epithet: after Jinggang Shan (Shan = Mountain)

This 2-5 m (6-16 ft) shrub has leathery, cuneate (wedge-shaped), wavy edged leaves and is from Jiangxi at an elevation of 1100-1200 m (3600-3900 m). It has dark pink flowers and is a new introduction.

R. maoerense. Photo: Rinus Manders.

R. praevernum. Photo: Rinus Manders.

R. maoerense (epithet: from Maoershan, Guangxi)

This species has only recently been introduced into cultivation. It is an eight to twelve m (25-40 ft) tree from an elevation of 1800-1900 m (6000-6300 ft), and its new growth is maroon to deep red. Petioles and pedicels are purplish, with the later glandular. Flowers are seven-lobed, pale pink to white, and the calyx, ovary and style are all glandular.

R. praevernum (epithet: before the spring)

This compact shrub or small tree (1.8-4.6 m (six to 15 ft) high) is from Hubei at an elevation of 1600-2500 m (5000-8200 ft). Its leaves are entirely hairless (glabrous) and its flowers are white to purplish-lilac with a distinctive large purple or crimson blotch at their base. The species merges with *R. sutchuenense* (intermediate forms are called *R.* x *geraldii*) but in its typical form,

R. sutchuenense. Photo: Everard Daniel.

R. vernicosum. Photo: Ken Gibson.

has smaller leaves, hairless lower leaves and the prominent blotch. It is an easy and showy species, but flowering from February to April, can be subject to frost.

R. sutchuenense (epithet: from Sichuan)

This two to six m (6-20 ft) shrub or tree from 1400-2500 m (4500-8000 ft) elevation in Sichuan is large and umbrella-shaped. Its leaves are moderately woolly or hairy on the underside midrib, and its five to six-lobed flowers are pale pink with red spotting but no blotch, with a reddish stigma and 13-15 stamens. It differs from *R. calophytum* by having no blotch and shorter and wider leaves, and from *R. praevernum* by having a hairy underside midrib, and again no blotch. This is one of the toughest and finest larger-growing species with fine trusses of long-lasting flowers.

R. vernicosum (epithet: varnished)

Height to one to 7.6 m (three to 25 ft), this southwestern Chinese species from 2700-4300 m (9000 to 14,000 ft) elevation forms a rounded shrub or small tree. Its six to seven-loved flower is usually pale pink to bright rose with or without crimson spotting. Its distinguishing feature is an ovary and style densely glandular with dark red glands, while all other *Fortunea* species have either white or yellowish glands or are glabrous (no glands). It has no scent, and the upper leaf surface becomes sticky, waxy and shiny if heated over a flame. This species is widely distributed in China, and so clones can differ in hardiness, partly due to the early growth of some forms, as the species usually flowers in April and May.

R. decorum subsp. *decorum*. Photo: Everard Daniel.

R. decorum subsp. *diaprepes*. Photo: Everard Daniel.

Group B (leaves oblong or obovate)

R. decorum (epithet: ornamental)

This wide-ranging species (north Vietnam to SE Tibet) from 1800-4500 m (6000-15,000 ft) grows to one to nine m (three to 30 ft) in height. The six to eight-lobed flowers are fragrant, white to lavender rose, with a yellow, green or crimson tinge at their base, with or without markings, with tiny short hairs at the base of the stamens (puberulous). There are two subspecies, *decorum* coming from further north and east than *diaprepes.* Subsp. *decorum* occurs in fairly dry sites where most other rhododendrons cannot survive, is vigourous and is one of the easiest grown species. Subsp. *diaprepes* is a lower altitude variety (up to 3400 m (11,000 ft) elevation) and is less hardy and later flowering, with larger flowers and earlier growth. Different clones flower at different times giving a long flowering season.

R. oreodoxa (epithet: glory of the mountains)

This southwestern Chinese species is a shrub or small tree 1.5 to 5 m (5-23 ft) high from an elevation 0f 2300-3800 m (7500-12,500 ft). Its five to eight-lobed flowers are white to rose, with or without purple spots, with a minute calyx and a glabrous (no glands) style. It differs from subsection species by having thin shoots, smaller leaves, no scent and an early flowering. This species is fine, easily grown, vigourous, free-flowering and somewhat frost hardy.

There are three varieties, var. *oredoxa* with a glabrous ovary; var. *fargesii* with a glandular ovary, wider leaves and lilac to deep pink flowers heavily speckled inside; and var. *shensiense* with a glandular ovary and sparsely rufous-tomentose pedicels.

R. oreodoxa var. *oreodoxa*. Photo: Frederick Thurber.

R. qiaojiaense. Photo: Hans Eiberg.

R. qiaojiaense (epithet: its geographical distribution in Qiaojia County, Yunnan)

This rhodo's name is pronounced "chow-ja-en-se," and it has only recently been introduced from an elevation of 2000-3000 m (6550-9850 ft) in Yunnan, China. Its almost oval leaves have a thick texture, being similar to *R. decorum* and *R. vernicosum,* but with a different flower. The plant seems to branch readily, making what should be a compact, rounded garden beauty. The new growth often has a bronze color. It will most likely bloom white and be fragrant. In its native habitat it grows between 1.8-3.6 m (6-12 ft) tall. It's easy to grow and is best grown in a mix of sun and shade, with relief from hot afternoon sun. http://www.rhododendron.dk/ and http://chimacumwoods.com/the-plants/qiaojiaense/

R. serotinum. Photo: Dr. Stephan Bubert.

R. serotinum (epithet: late, i.e., autumnal)

This smaller species (2.5-3 m (eight to ten ft)) from Yunnan, China, has seven-lobed flowers that are fragrant, white to flushed rose with a red blotch and red spots. This may be a late-flowering form of *R. decorum* with red throat markings, as it typically flowers from July to September. It has never been collected in the wild, being obtained from French seed from a collection by Delavay.

Group C (leaves orbicular or rounded)

R. faithiae (no image of flower)

This very rare species (known from only two or three locations in the wild, but listed in the current RSF catalog) is sure to be a widely-grown and popular new species in gardens. It is probably most closely related to *R. hemsleyanum* and the recently introduced *R. serotinum* and shares some of the same characteristics–large, fragrant white flowers in mid-summer, a large habit and impressively big and bold foliage, with the new growth a light burgundy colour. As seen in the wild, this was a spectacular plant with large elliptic leaves to 25 cm (ten inches) or more in length. Probably best with a bit of shade in the afternoon to preserve the summertime flowers.

R. faithiae foliage. Photo: Tracey Shandler.

R. hemsleyanum (epithet: after W.B. Hemsley, an English botanist.)

This three to six m (ten to 20 ft) upright, spreading Sichuan shrub has auricled, deeply cordate (two round lobes forming a deep recess at the base) leaves that are usually undulated and are bright or pale matt-green on top. Cox (1990) suggested the foliage is the best in the *Fortunea*. The flowers are fragrant, mostly white with a yellow-green throat, and a glandular ovary and style. It flowers from May to July and is an exotic, distinctive looking species that needs wind protection, but is otherwise robust.

R. hemsleyanum. Photo: Coen Zonneveld.

R.. orbiculare subsp. *obiculare.* Photo: Coen Zonnerfeld.

R. orbiculare (epithet: circular [referring to its leaves]

This 1.2 to three m (four to ten ft) shrub from 1650-4000 m (5400-13,000 ft) in Guangxi, China, is compact and dense in the sun and leggy in the shade. Its distinctive roundish leaves are deeply cordate, glaucous and have long auricles that often overlap, and its flowers are seven-lobed and deep pink to purplish rose, with no markings. There are two suggested subspecies, *orbiculare* with orbicular leaves and *cardiobasis* with longer, more heart-shaped leaves. However, recent evaluations (S. Hootman, pers. comm.) suggest subsp. *cardiobasis,* from the Dayao Shan, should be a recognised full species with no relation to *R. orbiculare,* while *R. orbiculare* subsp. *orbiculare,* from the Maoer Shan, is a round leaf form of the very variable *R. fortunei,* with coriaceous, pale or olive-green leaves. They have the same upright inflorescences of pale pink, open to funnel-campanulate flowers in mid- to late May, right in the same time frame as "typical" *R. fortunei* and several weeks after *R. orbiculare,* which has completely differently shaped flowers (campanulate). In addition, the growth of the Maoer Shan "*orbiculare*" is much more upright growing and tree-like as you would expect from the species *fortunei*. The species *orbiculare* has a very rounded and bushy habit, usually quite a bit wider than high.

R. platypodum. Photo: Dr. Stephan Bubert.

R. yuefengense.. Photo: Dr. Stephan Bubert.

R. platypodum (epithet: broad-stalked)

This two to eight m (six to 26 ft) Sichuan species from 1900-2200 m (6000-7000 ft) elevation has distinctive, leathery, broadly elliptic, rounded or oval dark green leaves that extend down the one to two cm (1/3 to 2/3 in) petiole (decurrent), that is flattened above, rounded below. Flowers are seven-lobed and pinkish-red or pink.

R. yuefengense (epithet: from Yuefeng, China)

This 0.5-1.5 m (1.5-5 ft) Guangxi shrub from 1800-2150 m (5950-7100 ft) elevation also has distinctive, glabrous, oval or broadly elliptic leaves with a cordate base, with a petiole that is flattened above, rounded below. Flowers are seven-lobed and a very pale purple, which are white at the base and within. Its growth habit is wider than tall, and is a choice, distinctive species that is easily cultured.

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Glen Jamieson is the current president of the Mt. Arrowsmith Chapter and the editor of JARS.

An Interesting Hybrid: 'Grandma's Hat'

Don Wallace
McKinleyville, CA

(From the April 2018 Eureka Chapter newsletter)

'Grandma's Hat.' Photo: Don Wallace.

Indeed, the flower on this rhododendron does remind one of a hat you might see someone's grandma wearing. A good name. The flower is full and a perfect shape to always be a prizewinner at any flower show. Each flower has a white background adorned with dark-purple edges, and a rich reddish-purple-black spot-ted flare in the throat and upper lobe. The plant grows large, between six and eight feet (1.8-2.4 m) tall and wide over the years and has nice dark leaves. Unfortunately, the hybridizer left us with no record of the parents. I received this plant from Clint Smith who owned a small rhododendron nursery in Washington state and brought plants to both my nursery and the Eureka Chapter ARS every year in the distant past. Clint always had a smile on his face as he joked about the names of plants. I don't remember what he said about 'Grandma's Hat', although I am sure it was funny. He always made me laugh.

Don Wallace is a member of the Eureka Chapter and owner of Singing Tree Gardens Nursery in McKinleyville, CA.

Stomata and Lenticels—How Plants Breathe!

Susan Clark
Concord, MA

Photos by
Glen Jamieson

(Reprinted from the March 2019 Massachusetts Chapter Newsletter)

We don't usually think much about plant metabolism, about how our rhododendrons and other plants grow. If pressed, we will probably mutter a bit about carbon dioxide and oxygen and photosynthesis—but what is respiration anyway? College seems so far away! This little essay on natural history is not the place for a serious description of plant metabolism and all the organic chemistry and physics that involves. So I will keep it brief and uncomplicated, but there will be some vocabulary involved. We are talking here about two metabolic functions, photosynthesis and respiration. Basically, during photosynthesis, which occurs only in daylight, plants take in carbon dioxide and give out oxygen. Plants respire 24 hours a day, giving out carbon dioxide and taking in oxygen; in the dark, they only respire. These two processes, photosynthesis and respiration, are the reverse of each other. Both are essential for a living plant.

Photosynthesis produces food (long glucose molecules) from water, oxygen, and sunlight. All plant growth comes from this, a stunning almost miraculous feat to produce so much of the world's biomass from such elemental ingredients. Respiration, which also occurs in the plant cells, unlocks the energy in the carbohydrates that photosynthesis produces. The respiring plant uses oxygen to produce energy and discards carbon dioxide. Respiration happens all the time the plant is metabolically active, resulting in a constant exchange of oxygen and carbon dioxide between the plant and the air. But at night, when there is no photosynthesis, only respiration, oxygen is taken in but not given out, and carbon dioxide is only given out. Fortunately, in a 24-hour cycle, more carbon dioxide is used in photosynthesis than is given out in respiration; more oxygen is given out during respiration. How wonderful for those of us who must have oxygen since photosynthesizing plants vastly outnumber oxygen-breathing animals!

So now back to the less demanding essay on natural history and our topic of stomata and lenticels. Stomata, a Greek word meaning "mouths" (the singular is stoma), are pores found on the outer surface or epidermis of plants. Most are on the somewhat protected undersurface of leaves but they also are found on green stems, anywhere that photosynthesis takes place. They come in many shapes, sizes, and colors but they all serve the same essential function of allowing gas exchange between the living plant cells and the atmosphere: oxygen mostly out, carbon dioxide in, and gaseous water both ways. Not surprisingly, in aquatic plants, stomata are found only on the upper surface of floating leaves and are missing entirely on submerged leaves.

Stomata open and close in reaction to light intensity and humidity. The more the cells are actively photosynthesizing, respiring, and transpiring (water vapor exchange), the more open the stomata are. Typically an unstressed plant's stomata are most open during the day during photosynthesis. Dryness at the leaves causes the stomata to close to conserve water. The chemical mechanisms that react to all this and that cause the stomata to expand and contract are rather complex and not completely worked out yet. Stomata are very small, usually lens-shaped, ranging from 10 to 80 μm (micrometers) long. Fall leaf drop in deciduous plants ends all this in the leaves. Maturation of green stems to brown by the end of summer also finishes their stomata, but here the plant needs a different route, as the stomata turn into lenticels.

The word lenticel is a good Latin term meaning a "small window". Lenticels are the other structure that allows the exchange of gases (water, oxygen, and carbon dioxide) between the living cell+s (cambium, phloem, xylem, or cork) under the bark and the exterior. These living cells are responsible for the growth of stems, trunks, and roots as they divide. All this cellular work must take place underneath the protective and basically impervious bark. This tough covering is the plant's armor, its protection against damage from insects, herbivores, abrasion, and desiccation. But it must still allow the plant to send water and nutrients to shoots and leaves as the plant grows and repairs itself.

Lenticels, the little windows, allow the exchange of gases through the bark. They develop as stems mature from green to brown and photosynthesis can no longer take place in the stems. Up until now, the stomata, actual openings in photosynthesizing surfaces, have provided the gas exchange routes. But now the stomata fill up with porous spongy cells between the living cells and the tough outer covering to provide a sheltered route for the gases but not for insects and pathogens. Usually these spongy areas bulge out enough that a close observer can see just where respiration now takes place.

When the leaves come down, we can more easily see the woody stems of our deciduous plants. This makes winter a good time to look for lenticels. On many plants the lenticels are wonderfully visible. The invasive buckthorns (*Rhamnus* spp.) are positively ornamented with rather silvery horizontal lenticels, an excellent field mark. Cherries (*Prunus* spp.) have beautiful, long lenticels. Bittersweet (*Celastrus* spp.) and porcelain-berry (*Ampelopsis glandulosa* var. *brevipedunculata*) have raised dot or dash-like lenticels. Much of the distinctive bark pattern of each plant comes from the lenticels. Google "lenticel images" and you quickly begin to see just how decorative and distinctive these essential organs are, and how variable, with different shapes, horizontal or vertical

distribution, colored, large or small enough to be hard to spot, especially if the bark is rough or flakey, but always present. Lenticels are an unsurprisingly essential clue to identifying trees in winter.

And lenticels are found not just on bark, but on respiratory roots, on tubers like potatoes, storage roots like carrots and parsnips, and fruits like apples and pears. All of these plant parts are composed of living cells that need to exchange gases with the environment. The potato's lenticels are lens-shaped and look like small black dimples on the skin, for example, while apples' appear as whitish dots.

Our familiar world has so many marvels that we overlook all the time. Some like the stomata are hard to see without at least a hand lens and some determination. But lenticels are mostly very visible if we stop to look. And they are marvelous and absolutely essential, both to the life of each plant but also to all of us who breathe oxygen. Finally, we might consider the curious minds of early botanists who looked at these diminutive features and saw little windows and mouths, an odd pairing of images.

Susan Clark is and a member of the Massachusetts Chapter.

Lenticels on a branch of *Acer griseum*.

Lenticels on a branch of *Prunus serrulata* 'Shirofugen'.

"My garden is my most beautiful masterpiece"

Claude Monet

American Magnolias

Ken Gohring
Marietta, GA

Photos as noted.

The family Magnoliaceae is one of the most spectacular plant families in the world. It consists of two subfamilies found in the Americas and eastern Asia: *Magnolioideae*, of which *Magnolia* is the best-known genus, and *Liriodendroidae*, a monogeneric subfamily, of which *Liriodendron* (tulip trees) is the only genus. The tulip tree found in North America grows throughout the eastern states, north to Canada. It is the tallest of the native eastern American trees. The Asian tulip tree grows in central and southern China and in Indo-China. *Magnolia* includes over 200 species, and the magnolias are widely distributed, with some found in subtropic North America, south to tropical South America and in the West Indies. In Asia they are found in Japan south and west to southern India. The geographical distribution of the magnolias is fragmented due to various geological events such as ice ages and continental drift. The magnolias found in the United States cover a wide range of locales, ranging from New York south and west to Texas. The range for one species, *Magnolia acuminata,* includes southern Ontario, Canada.

The eight native North American magnolias are found in both shrub and tree form and are generally characterized as having large leaves and large showy flowers with a strong fragrance. Two are considered evergreens but are marginally so as one variety of the sweetbay, *Magnolia virginiana,* loses its leaves in the more northern areas of its range. The flowers of deciduous North America magnolias appear after the plant's leaves emerge, in contrast to many Asiatic forms whose blooms occur before leaf set. While most Asiatic magnolias are early spring bloomers, American magnolias bloom in late spring to early summer. As such they are not generally affected by late winter cold periods which would prevent bloom set.

Magnolia fruit are cones that at maturity, yield fleshy seeds that dangle from the cone, attached by a fiber-like string that holds the colorful seeds for birds and other animals to gather and disperse. If not taken by birds or animals, the seeds fall to the ground where they attract rodents that help with dispersal. Many of the native American magnolias are understory trees.

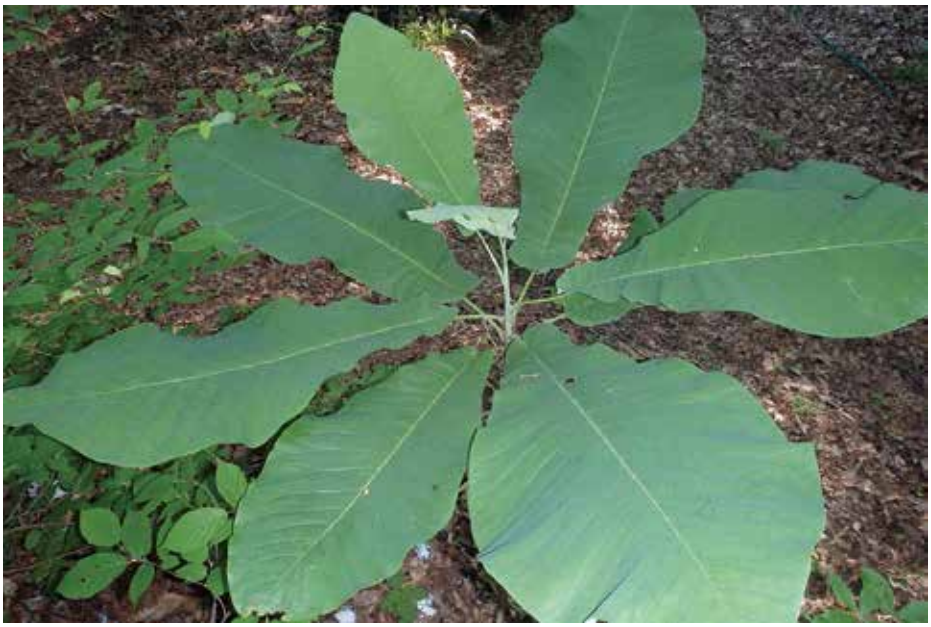
Botanists indicate that magnolias are one of the oldest tree forms, developing after the conifers in the evolution of plants. They display two features that characterize steps in the evolution of plants. These are insect pollinated flowers and jacketed seeds. Magnolias evolved before bees, and their large fragrant flowers attract mostly beetles as pollinators. Not all magnolia blooms are sweet scented, as beetles are also attracted to foul smelling odors in many instances. Geologists have concluded that magnolias evolved about 80 to 100 million years ago.

Fossilized remains found in Idaho indicate that at one time, magnolias covered a much wider range. The genus' spirally arranged floral parts are representative of a very primitive flower type.

Because of their marvelous leaves and attractive flowers, magnolias are considered some of the most popular flowering trees. Magnolias were well known and appreciated by Asian cultures long before they became popular in Europe. In fact, the Europeans first became familiar with the genus after their exploration of America. The Aztecs knew of and appreciated forms of *Magnolia macrophylla* and in 1688, the sweetbay magnolia, *M. virginiana*, was introduced in Europe, where taxonomists named it to honor Pierre Magnol, a prominent 17th century French botanist; hence the name magnolia!

Magnolias grown from seed exhibit a wide variation in size, strength, flower, and foliage characteristics and usually take longer to flower than plants propagated from asexual methods. However, rooting success is variable among species. Surface and air layering and grafting are used in addition to rooting

Magnolia macrophylla. Photo: Patrick D. McMillan.



Magnolia macrophylla leaves. Photo: Ken Gohring.

semi-hardwood cuttings and the use of tissue culture methods. Seed germination percentage is variable, likely because of the way magnolias are pollinated, since beetle pollination may be less successful than that of flying insects.

Big Leaf Magnolia (*Magnolia macrophylla*)

Seeing this magnificent tree in its natural environment would probably cause one to agree with the observation that this species has the largest simple leaf and bloom of any tree in North America (with the possible exception of certain palms). It is considered by some to be the most spectacular deciduous tree found in the Southeast because of these large leaves, which can grow up to 36 in (91 cm) in length and span 12 in (30 cm) or more. The leaves are bright green above, but have a fuzzy silver-gray coloration on the underside. One cultivar with the descriptive name of "Whopper" is said to have leaves up to 18 in (46 cm) across.

The big leaf magnolia has large ivory-colored flowers up to 15 in (38 cm) wide with purple blotches on their inner petals. The blooms appear in April, May, and June, and have a fragrance that one author described as "impressive" but with "a disagreeable odor." Personal observation of these plants in bloom did not indicate any unfavorable odors. The blooms are followed by a reddish, egg-shaped fruit that can grow up to 3 in (eight cm) in length.

The big leaf magnolia is a medium-sized tree, with the record tree reaching 70 ft (21 m) in height. Most trees top out at 30-40 ft (9-12 m). The big leaf magnolia normally grows beneath other trees, which helps protect its large leaves, which are frequently subject to wind damage.

This species is relatively easy to transplant. It has little economic importance or use because of its rare nature. Its natural range in the United States is from Kentucky to Florida to Louisiana, with the heart of its range in southern Mississippi and western Alabama. It is found in disjoint areas in Virginia and the Carolinas. It is generally found in bottom lands, ravines, and slopes in relatively loose, moist, well-drained, acidic soil. There is a closely related variety found in Mexico.

Umbrella Magnolia (*Magnolia tripetala*)

The species derives its common name from its growth habit, with its large leaves that cluster into a crown near the branch tips, creating an umbrella effect. The leaves are usually 8-16 in (20-41 cm) in length, being widest near the tip end. They are readily distinguished from the leaves of big leaf, Fraser, and pyramid magnolias, which exhibit lobes near the base of the leaf

Magnolia tripetala. Photo: Richard and Teresa Ware.

Magnolia fraseri. Photo: Patrick D. McMillan.

at the stem. In contrast, umbrella magnolia leaves form a sharp acute angle at their base. They are also usually smaller in size than the big leaf magnolia's leaves.

Typically, it reaches a height of 20-30 ft (6-9 m) with a maximum of about 40 ft (12 m). The natural range of the species begins in Massachusetts and extends along the lower areas of the Appalachian Mountains to a terminus in east central Alabama. Disjoint populations are also found in west central Arkansas into eastern Oklahoma. The umbrella magnolia's trunk has relatively few branches, but there are usually a number of suckers growing from the base of the plant. In most plants this characteristic is said to be an indication of stress, but in this species it appears to be normal.

The umbrella magnolia bears large, white flowers with a distinctive fragrance, which one author has described as a "strong goat smell." The umbrella magnolia can be incorporated into the landscape if the right setting is chosen. It is best used in a shade garden along a stream, if possible. It has been used in sunny locations as a specimen tree; however, if there is much wind or lack of moisture, problems are likely. Two cultivars of the species ('Bloomfield' and 'Woodlawn') were introduced in the 1970s; however, they are likely rare in commerce today. The species has also been crossbred with Asian species and with the sweetbay magnolia.

Fraser magnolia (*Magnolia fraseri*)

This species is also known as the mountain magnolia. Its prime natural range is from West Virginia south to northern Alabama and Georgia. It is found mainly in the Appalachian and Blue Ridge Mountains. It is hardy outside of its natural range with a specimen able to withstand the cold climate of Ontario, Canada.

The Fraser magnolia is a small tree reaching 40 ft (12 m) in height. It has several attractive features such as lovely flowers, leaves and bark. Its lobed leaves are normally eight-twelve in, (20-31 cm) long and have a shape that has been described as resembling a kite with broad middle and sharply tapered end. The large and showy blossoms are fragrant but considered unpleasant. The blooms are up to 10 in (25 cm) across and have six to nine petals. Its fruit is similar to other magnolias-cone-like with individual bright red seeds. Its attractive features result in it being used as an ornamental. It is sometimes used as a native alternate to Asian magnolias. Its ability to survive in colder climates is a plus.

Pyramid Magnolia (*Magnolia pyramidata)*

Some taxonomists classify this species as a variety of *Magnolia fraseri.* The natural range of the two differs with the pyramid magnolia found predominately in southern Alabama and the western panhandle of Florida. Some are found in natural areas of Georgia and areas west to eastern Texas. The Fraser magnolia is a mountain tree and the pyramid magnolia a coastal plain tree. The Fraser magnolia is a much larger tree with wider spreading branches, has a different shaped leaf, larger flowers and other physical differences. The pyramid magnolia is a miniature version of the Fraser magnolia.

Magnolia pyramidata. Photo: Patrick D. McMillan.

Magnolia acuminata. Photo: Will Stuart.

Magnolia virginiana. Photo: Gill Newberry.

Pyramid magnolia, a single trunked tree, can grow to a height of 30 ft (12 m) and has a narrow pyramid shape. It is not widely distributed and is nowhere abundant. It is cultivated to some extent but not widely so. It requires an acidic, moist soil and shade.

Magnolia ashei. Photo: Sam Pratt.

Cucumber Magnolia (*Magnolia acuminata)*

This magnolia is one of the largest magnolias and is cold hardy. The natural range is primarily in the Appalachian Mountains, extending northerly into Pennsylvania, New York and Ontario, Canada. There are disjoint populations in several areas of the Southeast. It is usually found as scatted specimens rather than groups. The trees have straight trunks and grow up to 100 ft (31 m). These properties enable it to be used as shade trees in public areas and gardens.

Its blooms are not outstanding. They are relatively small and usually found in the upper reaches of the tree. They are yellow-green in color and have an unpleasant odor. The oval leaves grow up to 10 in (25 cm) long and to 5 in (13 cm) wide. The species has been used in hybridization projects to produce yellow flowered and cold-hardy cultivars. A small variety, var. *subordata,* which has prominent yellow blooms, has been used to produce several named cultivars with yellow flowers. The pointed leaf tips are noted in its name's epithet, *acuminata.* It derives its common name from the shape of its fruit when unripe.

Sweetbay Magnolia (*Magnolia virginiana)*

The wide-ranging magnolia's natural growth area extends from Long Island south to include all southeastern states and westward to Missouri and Oklahoma. It is evergreen in many of its natural locations (zone 7 south), deciduous elsewhere depending on climate. It is also called swamp magnolia because of the areas where it is found in the wild. It is variable with two primary varieties. The variety *virginiana* is a large multiple stemmed plant that is usually less than 20 ft (6 m) in height. This variety is usually found in the northern ranges of species natural range. A southern variety, *australis,* can grow to a height of 100 ft (31 m) in the wild but usually tops out at 50 ft (15 m) in cultivation. While both varieties are usually found in wet areas in the wild, they do not require wet areas in cultivation.

Its creamy white blooms can reach 5.5 in (14 cm) in diameter with up to 15 petals but usually grow to 3 in (8 cm). It has a strong pleasant fragrance. Its native areas are lowlands and swamps. Most forms found in cultivated areas top out at 20 ft (7 m).

It is frequently cultivated as an ornamental. It has great application in parks and gardens, primarily because of its large scented flowers, attractive foliage and rapid growth qualities. A special attraction is the foliage's silver colored leaf underside. The foliage is said to glimmer when blown in the wind.

Ashe Magnolia (*Magnolia ashei)*

The Ashe magnolia's natural range is restricted to eight counties in the panhandle of western Florida. However, it is popular with gardeners. Its limited natural area does not prevent it from being grown elsewhere. A record form in Pennsylvania grows 1000 mi (1609 km) north of its natural locations.

Its small size is a significant factor in it being used in cultivated areas. The height is usually less than 30 ft (9 m), with a single trunk. While normally found as an understory tree, it grows well in sunny areas. Ashe magnolia is considered by some taxonomists as a variety of *Magnolia macrophylla.* The natural ranges of the two are well separated.

Magnolia grandiflora bud. Photo: Ken Gohring.

Magnolia grandiflora flower. Photo: Ken Gohring.

The Ashe magnolia is a shrub or small tree that has large leaves and flowers. Most forms are less than 20 ft (6 m) in height but some specimens, including the record tree in Pennsylvania, are over 50 ft (15 m). It has large leaves, up to 24 in (60 cm) and large blooms, up to 12 in (31 cm) across with a sweet fragrance.

Southern Magnolia (*Magnolia grandiflora*)

I once said that as long as I live in the South, I am going to have a magnolia in my yard. I meant the lovely southern magnolia, *Magnolia grandiflora*. The widespread acceptance and planting of this tree indicates that I am not alone in my appreciation of this species. However, I have not been very wise in my plant selection, as the specimen that I have is 20-plus years old and has grown to a height of 25-30 ft (8-9 m), with few blooms.

Southern magnolia is a broad-leaved evergreen tree that can grow to 90 ft (27 m) in height with trunk diameters up to 3 ft (0.9 m). The trunk is usually straight with spreading limbs that result in a dense, broad pyramid shape. The leaves can grow to 8 in (20 cm) in length and are leathery in appearance, with dark glossy green coloration on top and white or rusty, velvet-like undersides. Usually leaves of southern magnolias grow from the ground up making undergrowth by other vegetation impossible. The flowers normally grow up to 12 in (31 cm) in diameter and have a pleasant fragrance. The flowers commence in spring and form throughout the summer. Southern magnolia's red seeds emerge from a reddish brown cone that reaches up to 4 in (10 cm) in length and are attached by the characteristic magnolia seed threads.

The natural range for the southern magnolia starts in the extreme southeast corner of North Carolina and extends along the Atlantic Coastal Plain in a widening belt into east Texas. This plain includes the southern half of Georgia and northern half of Florida and includes significant portions of Alabama, Mississippi, and Louisiana. The natural range is confined to areas 500-600 ft (152-183 m) in elevation or less. The species is most prevalent in Louisiana, Mississippi, and Texas. Mississippi is known as the Magnolia State, and the tree is the state flower of both Mississippi and Louisiana. The species is so popular that man has helped it spread to areas far beyond its natural growth area.

Southern magnolias are deep-rooted plants, with young plants developing a tap root. As the trees grow, the root structure becomes extensive with many deep roots developing, giving the trees a firm base. Botanists say that this root system is a key to their survival in their natural range, an area where hurricanes appear over periods of time, and that the strong root structure prevents uprooting. Southern magnolia is tolerant of shade. In its formative years it endures significant shade but as a tree becomes older, it needs more light.

Over the years, through vigorous breeding and selection processes, many cultivars with diverse properties have been developed. The species does well in zones 7 to 9. Now there are cultivars that enable the growth of southern magnolia in some areas of zone 6. One such popular cultivar is 'Bracken's

Magnolia grandiflora fruit. Photo: Ken Gohring.

Brown Beauty'. Other cultivars feature various characteristics, such as large flowers up to 16 in (41 cm), compact size, pyramidal shapes, and bloom set at an early age. In many southern metropolitan areas, residences are located on small lots where all vegetation has been cleared before construction. The areas where the landscapers are allowed to plant have become so small that they use compact forms of plants. One of the more popular trees is southern magnolia. Dwarf cultivars like 'Baby Doll', 'Little Gem', and 'Saint Mary' are used extensively. In many cases southern magnolia is used in urban areas because of its ability to grow in areas with large amounts of sulphur dioxide or soils with relatively high salt content.

In many natural areas near where southern magnolias have grown for several years there are an abundance of small and mid-size southern magnolia plants, with the quantity a function of the number and size of larger parent plants. These areas are outside of the natural southern magnolia range. It is a vigorous species, and adult plants produce numerous seeds annually. The species can produce seeds at about ten years of age, and larger, older trees are more proficient in the reproduction process.

There are many famous southern magnolia trees. There is some debate as to the American champion *Magnolia grandiflora.* The state of Mississippi lists a specimen that has a height of 80 ft (24 m) and a spread of 78 ft (24 m). It is listed as the Mississippi state and national champion. Some sources list a Mississippi specimen, some 120 ft (37 m) tall as the national champion. Another fine plant is said to grow near the south portico of the White House, planted by Andrew Jackson in memory of his wife. The largest private planting of southern magnolia is outside its natural range; these trees are in southern Tennessee on the Milky Way Farm owned by the Mars candy company family.

Ken Gohring is a member of the Azalea Chapter and a frequent contributor to JARS.

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COMMERCIAL

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Evergreen Foundation

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Vanessa Koelling
Mike Samilian
Kevin Spellman

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Kenneth Nilsson
Christina Strandman Ullrich
Kaarel Voitk

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Patrick Lavin
Donna McElrath
Susan Schott
Parrish Walker & Natalie Breeden

VALLEY FORGE
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