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“Rhododendrons International” (RI) is an online journal distributed free to all the world’s known rhododendron associations for their internal distribution. It can also be accessed on the American Rhododendron Society website at https:// www. rhododendron.org/ri-index.htm. This fifth issue of RI includes five articles, some modified slightly from those printed initially, that I have extracted from various rhododendron publications that I feel are worthy of wider world-wide distribution. Articles in this volume are from “Rhododendron Species 2018,” the journal of the Rhododendron Species Botanical Garden in Federal Way, WA; “Rhododendrons, Camellias & Magnolias” 2018 and 2019, Royal Horticultural Society Group; and the “Journal American Rhododendron Society.” I regularly search botanical publications for worthwhile rhododendron articles I deem to be of international significance for wider distribution through RI issues. I also welcome submissions from authors of such material that I might not be aware of, so please feel free to bring such material to my attention at rhodojournal@gmail.com, and please put “Rhododendrons International” in the subject line.

Rhododendron occidentale and its Modern Day Plant Hunters

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Cobham
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(Reprinted from the RHS Group *Rhododendrons, Camellias & Magnolias 2019*: 15-26.)

Rhododendron occidentale growing by Hunting Creek, California. Photo: Molly Nilsson.

Rhododendron occidentale is a species of deciduous azalea from the USA. Since this species was discovered, its value as a parent in hybridisation programmes in Europe and particularly in the UK, was recognised almost immediately. However, it wasn't until the 1950s that American plantsmen became really fascinated by *R. occidentale*. Since then, interest has grown apace and today there are numerous plant hunters and groups of enthusiasts that trek, every year,

R. occidentale (Palomar 1318). Photo: Mike McCullough.

through the rugged terrain that is home to *R. occidentale*. Their objective is to find new intraspecific variants and to renew their acquaintance with old friends, both human and plant.

This article will tell you a little about *R. occidentale* growing in the wild and its habitat, the photos will say more than any words can, and there are short biographies of some of the most notable plant hunters of recent times. They have brought wonderful selections of this species to our attention. Some of them have also found amazing mutations of *R. occidentale*. I touch on propagation, hybrids and where you can see these fascinating plants in the USA but I leave the detailed taxonomy to the experts.

***Rhododendron occidentale:* Its Habitat and its History**

The Western Azalea, *Rhododendron occidentale*, is an isolated species native only to California and South West Oregon, in the far west of the USA. This deciduous shrub adorns many stream sides, emitting its marvellous sweet, musky fragrance on warm June and July days. It is found from sea level to over 2700 m (8860 ft). The basic habitat of *R. occidentale* is on soils formed from specific rock types but always where there is sufficient water. From the northern end of its range near Myrtle Creek, Oregon, to roughly the latitude of San Francisco in the south, this soil type is ultramafic or serpentine; south of this, *R. occidentale* is found on soils derived from other mafic rocks but always near water.

Note: *Serpentinite is a metamorphic rock that is largely composed of Serpentine Group Minerals, e.g. antigorite, lizardite and chrysotile. These hydrous silicate minerals, rich in magnesium, are called serpentine minerals, as they resemble a snake's skin. Antigorite is green in colour as much of the magnesium has been replaced by iron. All are poor in calcium. Care must be taken in handling soils containing chrysotile, the fibrous form of serpentine rock, as it is a source of asbestos. Mafic rock (ma from magnesium and fic is the latin word for iron) has a high content of both magnesium and ferric oxides.*

R. occidentale and the sympatric elepidote *R. macrophyllum* are known as "Pioneer Species" as they both thrive after a wildfire. The Biscuit fire area in the Siskiyou National Forest is a perfect example; the fire covered about 500,000 acres (202,342 ha), mostly in Oregon, burning from late July until December in 2002. Dick Cavender, a modern day plant hunter, visited a serpentine area west of Cave Junction, Oregon, in 2005. The forest on serpentine rock there was sparse, consisting of very stunted pines but both *R. occidentale* and *R. macrophyllum* were 3 feet tall (0.9 m) and flowering. He has witnessed this again in 2011 at Lone Mountain Forest and at Chrome Ridge in 2018.

R. occidentale was first discovered during the British expedition of Captain Beechy in 1827 and was also collected later by Douglas, Hartweg and Burke. At

R. occidentale and *R. macrophyllum* growing at Lone Mountain “Ghost” Forest after a wildfire. Photo: Dick Cavender.

first it was not recognised as a distinct species, being named in 1855 by Torrey and Gray as “Azalea californica”; a year later this was changed to “Azalea occidentale.” *R. occidentale* was introduced into cultivation by William Lobb, who sent seeds from California in about 1850 to the Veitch Nursery in Exeter; a plant from these seeds flowered in 1857. Anthony Waterer Senior of Knap Hill Nursery was the first known hybridizer of *R. occidentale* in the 1860s. He apparently had a poor success rate for nearly ten years. It is thought that he probably used *R. occidentale* as the pollen parent at first, and later had flower-producing plants to use for

Leaves of *R*. ‘Washington State Centennial’. Photo: Harold Greer seed parents. His hybridisation of the Ghent azaleas with *R. occidentale* was the beginning of the Knap Hill azaleas. There is a very large plant of *R. occidentale* growing at the former Knap Hill Nursery in Surrey, believed to date from 1860s. The Dutch Nursery, Koster's, also produced deciduous azalea hybrids using *R. occidentale* from about 1895. Later the Exbury hybrid deciduous azaleas were developed by the Rothschilds using *R. occidentale* as a parent.

R. occidentale is a diploid with the exception of 'Double Dig 12' which is a tetraploid. In 1972, Frank Mossman wrote the following concerning his hybridization with *R. occidentale*, a diploid: "We have found that *Rhododendron occidentale* will cross with many other rhododendrons or azaleas if *R. occidentale* is the seed parent, but *R. occidentale* as a pollen parent produces few seed" (Perkins 2012).

R. occidentale is a very variable species which is what makes it so fascinating. It is a totally isolated species, producing an enormous variety of flower size and colour, most but not all having the characteristic yellow blotch. The truss size too is variable, with anything from the average 5–12 flowers per truss, up to 25–54 flowers per truss in selected forms. *R. occidentale* is a much-branched sturdy shrub growing up to about 4.5 m (15 ft) tall. The variability within the species makes definitive morphology more complex than this article can cover. Suffice to say that the degree of pubescence seems to be a function of the availability of water. The leaf shape and size is equally variable but one thing is certain, the leaves change from green to yellow, crimson or scarlet in the autumn.

Modern Day *R. occidentale* Plant Hunters

Leonard Frisbie, a nurseryman based in Tacoma, Washington, was a breeder of *Rhododendron occidentale* hybrids in the 1950s. He was a devotee of the species, collecting his own material in the wild. Dr. Edward Breakey was President of the Tacoma Rhododendron Society. Between them a study of *R. occidentale* began which led to a number of publications in the USA. Dr. Breakey co-authored an article on *Rhododendron occidentale* with Leonard Frisbie in the 1955 Rhododendron and Camellia Yearbook.

R. occidentale SM232 'Leonard Frisbie', a wild selected form registered by Smith and Mossman in 1971. Photo: Tim Walsh.

Leonard wrote in 1967, "My first field trip was to South West Oregon, Curry County, and the experience was more of an emotional shock than anything else. Intellectually it was a blank. There were so many azaleas, all crowded into thickets, millions of fragrant flowers. Nothing in my former experiences had prepared me for this. It was a bit frustrating to an inexperienced plant collector who had ambitions to accomplish something definite. But it was an essential beginning, and it had to happen in just about that way. It taught me that I knew little, valuable information—this when one faces a big task, and I was convinced that my *R. occidentale* survey was going to be neither easy nor short. I also realized that if I were to learn about the azalea I would need to pursue it intellectually, not emotionally" (Frisbie 1967).

R. occidentale 'Frank Mossman'. Photo: Dick Cavender.

Their work inspired others to take an avid interest in *R. occidentale*:

Britt Smith and Frank Mossman developed an intense passion for *R. occidentale*, making many trips in the 1960s to the wild for 15 years or more. Dr. Frank Mossman, whose significant work with azaleas and rhododendrons spanned several decades, passed away on November 2, 2009. He was a doctor of ophthalmology from Omaha, Nebraska. After his discharge from the army in 1945 his employment options were limited, with many doctors returning from the military. Luckily he secured a residency in Portland, Oregon, where he worked for eight years before setting up a private practice in Vancouver, Washington.

During the first years in Portland, he developed his interest in rhododendrons, and started growing and propagating them. Britt Smith spent most of his career with the Boeing Company. Over the years Britt and Frank visited *R. occidentale* in the wild many times; one of the areas where they found the most unusual forms was on Stagecoach Hill, California. Their selection and registration of 'Humboldt Picotee' is a great example of a form of *R. occidentale* found there.

R. occidentale SM502 'Humboldt Picotee'. Photo: Ken Cox.

Early in their search for *R. occidentale*, Frank Mossman and Britt Smith met Jimmy Smith and his wife, who had a small nursery in Brookings, Oregon. There were plants of *R. occidentale* growing all around the area and Jimmy was quite interested in them. One of his acquaintances was a logger who told him of a *R. occidentale* growing at the edge of a forested area, bearing flowers which were completely yellow. The logger would neither bring Jimmy a truss nor tell him exactly where that plant was growing. Not long after that Jimmy moved house and they lost touch with him and also the link to that plant.

Frank chaired an ARS Annual Convention in Portland in the early 1970s where one of the guest speakers was H. H. Davidian, from Edinburgh. Dr. Davidian believed the observed large variation in *R. occidentale* flowers was due to interspecific and not intraspecific variation. When Frank took him on a trip to the occidentale habitats, he managed to convince Davidian that it was indeed intraspecific variation that produced the large floral variation.

R. occidentale SM042. Photo: Bob Dunning*.

The Smith/Mossman numbering system works as follows: Designations SM1, SM2, etc., were assigned to species plants as they were found during the first year of exploration. The second year designations SM101, 102 etc., were assigned in the order which they were found. In the third year, SM201, SM202, SM203, etc., so in the sixth year numbers SM501, SM502, SM503 etc. were assigned.

The detailed and carefully kept notes from the expeditions of Smith and Mossman are much admired and are a treasury of information. In fact they can still be used today to locate plants of *R. occidentale* with the SM reference number.

Tom Tatum was a real plantsman and an expert on mushrooms. He was on call with hospitals in his area to make identifications in mushroom poisoning cases. He was a good friend of both Dick Cavender and Frank Mossman; the three of them made several "occidentale hunting" trips together. As far as we know, Tom was the first person to successfully grow vireyas in North America. Dick Cavender registered two of Tom's occidentale collection, 'Tatum's Yellow Standard' and 'Tatum's Deep Pink' both of which were found by Tom in the

R. 'Tatum's Deep Pink'. Photo: Dick Cavender.

Stagecoach Hill Azalea Reserve in the early 1970s. The latter was for many years one of the best pink flowered *R. occidentale*. 'Tatum's Yellow Standard' is now extinct in the wild.

Eugene R. German (known as Gene German) was a member of the Noyo Chapter of the American Rhododendron Society, which meets in Fort Bragg, California. In the 1970s and in the 1980s, on a Saturday, about a week or two before the plant hunting expeditions of Britt Smith and Frank Mossman, Gene German would organize *R. occidentale* plant hunting expeditions. After meeting in Fort Bragg, they travelled east on Comptche Ukiah Road and then in a southerly direction on Flynn Creek Road.

R. 'Tatum's Yellow Standard'. Photo: Dick Cavender.

On property owned by a lumber company, Gene German and companions would explore the *R. occidentale* in the upper reaches of the Albion River. Continuing in a southerly direction on Flynn Creek Road they would hike across the road and then down the gully to Flynn Creek. On the other side of the creek is *R. occidentale* GG 1. All of Gene's discoveries are numbered and prefixed GG.

R. occidentale GG1 at Flynn Creek. Photo: Mike McCullough.

Carl A. Deul from Northridge, California, discovered a heat tolerant form of *R. occidentale*. There is a form of *R. occidentale* which grows in the San Jacinto Mountains near Idyllwild, California, which seems to be much tougher than the forms growing in the coastal areas of Northern California. Several people in the East and South have been growing this form from seed and have found it more tolerant to their conditions than any other form

R. occidentale (Idyllwild 1321). Photo: Mike McCullough.

that they have tried. Perhaps this is the heat tolerant *R. occidentale* people have sought after. The Southern California Chapter of the ARS has also found this form of *R. occidentale* much more tolerant to dry air than any other form they have tried. It grows in canyons or boggy areas at elevations above 1370 m (4500 ft) that are heavily wooded with cedars. Their roots often run below boulders where precious moisture is preserved. The air is very dry and the relative humidity is often below 10%. Summer showers are few and far between; temperatures often go as high as 33° C (91° F). The flowers are almost pure white, about 6 cm (2.4 in) across and the characteristic yellow blotch is almost non-existent. The leaves are lanceolate and up to 11 cm (4.3 in) in length.

Bob Dunning moved to Maple Valley in 1978 and has been a volunteer and board member of Lake Wilderness Arboretum since 1997. When Britt and Jean Smith decided to sell their home in Kent, Washington, and downsize, the Kent property was to be developed, meaning the loss of any plants left in the ground. A deal was struck with the developer allowing some of the Smiths's *R. occidentale* azalea collection to be relocated to Lake Wilderness Arboretum, formerly the South King County Arboretum near Maple Valley. Bob Dunning and his friend Dan Bailey worked tirelessly for four years to achieve the movement of the collection (Dunning 2000). Frank Mossman also donated part of his collection to the arboretum. This part of the arboretum is now called the Smith-Mossman Western Azalea Garden which holds over 200 plants, the largest collection of *R. occidentale* selections in the world.

Dick (Red) Cavender is the owner of Red's Rhodies Nursery. On Red's first vacation with his wife Karen they went on a road trip to the Oregon Coast; during the trip, they drove by a flowering shrub growing by the side of the road. Red

R. 'Maggie Brown' (A Frank Mossman hybrid). Registered by Dick Cavender in 2008 and introduced by Briggs Nursery in 2009. It is named after a granddaughter of Frank Mossman. Photo: Dick Cavender.

Dr. Frank Mossman at the Smith Mossman Garden in 2007. Photo: Bob Dunning*.

pulled over and got out to examine the flowers—they were white and fragrant with a clove-like scent. This turned out to be *R. occidentale*, and so began the Cavenders' love of rhododendrons and azaleas. Red's Nursery business started as a hobby that got out of control. Red loved to hybridize to obtain new and improved varieties of *R. occidentale*, his favourite azalea. One of Red's ambitions was to produce large double flowers on *R. occidentale*. In 2006 he registered the double flowered wild selection of Smith and Mossman, found on Crescent City Flats, California in 1966, as 'Crescent City Double'.

Mike Oliver is an engineer who became interested in rhododendrons, especially *R. occidentale*, when he moved to Oregon in 1980. In addition to searching for and collecting cuttings from unusual and attractive forms he has started intraspecific hybridizing. Mike's passion was to produce a pure yellow *R. occidentale* and he often started with SM 30, which is still grown in the USA and has the most yellow on all five petals. For a number of years, he has contributed seed to the ARS seed exchange. Mike has been on many occidentale hunting trips in the wild along with Dick Cavender.

Mike McCulloch graduated from what was then San Jose State College (now San Jose State University) in 1970 with a BA in Social Science (a combination of history, political science, economics, sociology, and anthropology) and a teaching minor in philosophy. A few years after

R. occidentale SM028-2 'Crescent City Double'. Photo: Ken Cox.

R. occidentale SM030 'Crescent City Gold'. Photo: Jim Inskip.

R. occidentale (P027 Patrick's Point 3806). Photo: Mike McCullough.

graduation he was in charge of the garden supply department of a Grants Department Store in San Jose. The description of rhododendrons in the Sunset "Western Garden Book" interested him. In May of 1975, he saw a mention in the San Jose Mercury about a rhododendron show being held in San Mateo by the San Mateo Chapter of the American Rhododendron Society, so he went and hasn't looked back since then!

R. occidentale (Siskyou 3901). Photo: Mike McCullough.

For a period of over 30 years Mike McCulloch has explored a geographical range extending from central Oregon to San Diego, California, and has discovered many forms of *R. occidentale*. Mike continues to this day visiting every spring and again in the autumn to collect seeds that he has either pollinated or tagged. He tells me that sometimes it is the work of the two-legged pollinator that is most successful. Every year Mike sends details of his road trip with photos of himself and his companions, and of course the *R. occidentale* they have seen.

R. occidentale **Mutants**

Over the years a number of *R. occidentale* mutant or pistillate forms have been found.

In 1974, H.J. Slonecker wrote an article in the ARS Bulletin on "Pistil Pete" and "Pistil Packin Mama" having been found at Myrtle Creek. Smith and Mossman discovered "Miniskirt" 70 miles (113 km) away at O'Brien, Oregon. The flowers are very small, only 9-12 mm (04.-0.5 in) across (Peterson, Steffen 2010).

A pistillate form of *R. occidentale.* Photo: Dick Cavender.

R. occidentale SM157 'Mini Skirt'. Photo: Dick Cavender.

R. 'Washington State Centennial'. Photo: Harold Greer.

Propagation

Seeds, cuttings, air or ground layers and grafting are all possible means of propagation. Seeds are the easiest but the slowest method of propagation; seeds can be obtained from the ARS seed list each year from wild collected sources, as the USA is not a signatory of the Nagoya Protocol. Cuttings can be difficult but it is the one way of accurately reproducing a particular plant. Layering is a slow process and is very successful, but lots of patience is required. Grafting is another good method but a plentiful supply of stocks is necessary.

In the wild *R. occidentale* can tolerate a high pH in soils or water. In the serpentine soils where *R. occidentale* grows, the pH of up to 8.5 is high, not because of calcium content but because of the magnesium and iron content. Experiments in the USA have used *R. occidentale* as grafting stocks onto which were successfully grafted Rhododendron scions (Slosson Reports 1998, 1999).

R. 'Exquisitum'. Photo: David Millais.

R. occidentale hybrids

R. 'Jock Brydon'. Photo: David Millais.

It was the importation of *R. occidentale* to the UK in 1850 that has ultimately given us the large flower size on our Knap Hill and Exbury hybrid deciduous azaleas. They are a useful addition to any garden as they are late flowering and scented. Many have wonderfully coloured leaves in the autumn. Equally, there are fine Dutch and Belgian hybrids too, e.g., 'Irene Koster' and 'Exquisitum' from Koster's Nursery in Holland.

Hybridisation using *R. occidentale* in the USA has occurred much more recently; in fact it started nearly a hundred years after Waterer began his hybridising in the UK. A fine example of an American hybrid, registered by Frank Mossman, is *R.* 'Washington State Centennial'.

Another hybrid, perhaps more familiar to us in the UK is *R.* 'Jock Brydon'. This is a *R. molle* subsp. *molle* × *R. occidentale* hybrid developed by Dr. Clausen and introduced by the Beneschoen Gardens at Myrtle Creek, Oregon.

Where to see *R. occidentale* in the USA

If you should be fortunate enough to be on the West Coast of the USA at the right time of year, then here are a few of the places where you can see *R. occidentale*:

California:

Arcata-Azalea Reserve is a 30 acre (12 ha) tract near Arcata that was set aside as a State Park for the preservation of the Western Azalea.

Stagecoach Hill Azalea Reserve is a must, especially if you can only visit one place. The variations within this species can be seen at first hand.

R. occidentale 'Stagecoach Peppermint'. Photo: Jim Inskip.

R. occidentale 'Stagecoach Frills'. Photo: Bob Dunning*.

Oregon:

Brookings Azalea State Park is devoted almost exclusively to the care and preservation of *Rhododendron occidentale*. Brush and competing plants have been removed giving the azaleas a chance to develop at their best.

Harris Beach State Park is just north of Brookings. Many azaleas can be found in this area; unfortunately, widening and straightening the highway has resulted in the loss of many azaleas.

Washington:

Lake Wilderness Arboretum is in Maple Valley, South East of Seattle. In addition to a focus on North West native plants, the Arboretum is home to the Smith Mossman Western Azalea Display Garden.

Where to Find *R. occidentale* in the UK

Many of the hybrids of *R. occidentale* can be seen in public gardens in the UK and are readily available from garden centres and specialist nurseries for you to have and enjoy in your own gardens. The Dutch hybrid 'Irene Koster' is a great example of a readily available hybrid. The characteristics from its *R. occidentale* parentage are quite clear, as shown in the above photo. *R. occidentale* is sold commercially in the UK but its availability is limited. *R. occidentale* SM 028-2 'Crescent City Double' is also available in the UK.

To grow *R. occidentale* in UK gardens, humus rich, acid soil with a pH of 6.5 or less is needed and adequate, but not necessarily copious amounts of water for it to thrive. Humidity does appear to be an issue both in cultivation and in the wild; wild growing plants in coastal regions, with higher humidity, are taller than those growing inland where the humidity is lower. *R. occidentale* will grow in full sun or partial shade but as it is a late flowering species, typically June, extreme heat will cause the flowers to collapse. Planting near water sources such as streams, ditches or ponds will improve the relative humidity near the flowers and extend the flowering period significantly. Normally in cultivation in the UK it will grow to approx. 1.5 m (5 ft) in 10 years, but its growth will be much more vigorous if planted in damp areas. *R. occidentale* does need an open well ventilated aspect to prevent the occurrence of powdery mildew from late summer onwards. In the wild, *R. occidentale* can survive through winters in southern Oregon and northern

R. 'Irene Koster'. Photo: Polly Cooke.

California where it is covered in snow for several months, so it is a hardy plant and our UK winters should not have a detrimental effect on this species. It is unlikely that *R. occidentale* will tolerate alkaline soil in this country, as the alkalinity is due to the calcium content, whereas in the US the alkalinity is due to the magnesium and iron content of the mafic soils.

It is the view of Mike Oliver that *R. occidentale* also needs the correct mycorrhiza to prosper: "Ericaceous plants need the association of the mycorrhiza *Hymenoscyphus ericae* to prosper at all. If the strains of this in the west coast of the USA and in Europe are compatible with *R. occidentale* they will grow, but if the strains available are not compatible, they will not grow. It should be noted that another ericaceous plant, *R. macrophyllum,* grows in the west but is unable to grow in the south-eastern USA" (M. Oliver, pers. comm.). Clearly further investigation is needed here in order to confirm if the geographical limitations we see are caused by mycorrhizal association or by some other mechanism.

R. occidentale grown from wild collected material (Data.rbge.org.uk/living/19741728A). Photo: RBG Edinburgh.

R. occidentale 'Stagecoach Cream' (Data.rbge.org.uk/living/19750138A). Photo: RBG Edinburgh.

Regrettably there aren't many collections of *R. occidentale* in the UK but you may find a few plants in some public gardens in England. There are two collections that I know of in Scotland. Glendoick Gardens have a collection and you will notice that Ken Cox has contributed some great photos for this article. The Royal Botanic Garden Edinburgh also holds a good sized collection.

In his book published in 1995, H. H. Davidian records that "in 1975 Mr A. Tatum sent six named clones of *R. occidentale* to RBG Edinburgh"(Davidian 1995), including 'Stagecoach Cream'. You can see from the data accession details given under the photo, that this plant was introduced in 1975. The photo was taken in 2013.

As you have seen there are incredible variations in the flowers of *Rhododendron occidentale* growing in the wild. These are all natural, as there are no other deciduous azaleas at all growing in the region. It is entirely due to the eye for detail of all of the plant hunters mentioned above that we have such a varied selection of this species to admire. You will have noticed that the flowers in some photographs are white with a yellow blotch which is typical of *R. occidentale*. It is the small differences in each of these that the plant hunters have noticed, recorded and collected seed from for propagation and further study.

There is one more variant that I must share with you. I have only seen it in this photo from Ken Cox, SM303- gorgeous isn't it!

R. occidentale SM303. Photo: Ken Cox.

If you are interested in seeing more photos of *R. occidentale*, then you should go online to www.smith-mossman.net You will find an extraordinary photographic resource compiled by Bob Dunning.

* The photos credited to Bob Dunning marked * have been reproduced, with consent, from Bob's website: www.smith-mossman.net Two of these, *R. occidentale* SM042 and 'Stagecoach Frills' are Bob's scans of Britt Smiths original slides taken before the birth of digital photography. These photos have been digitally enhanced by Barry Cooke.

RBGE kindly gave permission for the reproduction of their photos providing that the accession data was included.

Acknowledgments

With many thanks to Dick (Red) Cavender, Polly and Barry Cooke, Ken Cox, Bob Dunning, Harold Greer, Mike McCulloch, David Millais, Molly Nilsson, Mike Oliver, Pacific Horticulture, Sally Perkins, Royal Botanic Gardens Edinburgh and Tim Walsh.

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Jim Inskip is a member of the Wessex Branch Committee of the Rhododendron, Camellia and Magnolia Group. He is interested in all deciduous azaleas but his main focus is with Ghent Azaleas. His hobby is the propagation and study of deciduous azaleas.

Jim was awarded the A. J. Waley Medal 2019 for his work with deciduous azaleas, especially the Ghent azaleas. This is an award, made jointly by the Royal Horticultural Society and the Rhododendron, Camellia and Magnolia Group, to an individual who has made a valued contribution to Rhododendrons.

The Nagoya Protocol: the Legal Framework and Challenges Ahead

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London, UK

Rhododendron neriiflorum, Salween-Mekong Divide, North-west Yunnan. Photo: Russell Beeson.

(Reprinted from the RHS Group *Rhododendrons, Camellias & Magnolias 2018*: 84-89.)

Introduction

In 2017 the number of countries to have ratified the Nagoya Protocol[1] reached 100, following a steady trickle since it entered into force in 2014. The Protocol is an international agreement designed to harmonise approaches to the utilisation of genetic resources and the sharing of the benefits which result. Although reaching this stage represents a significant achievement, the focus now is on the implementation and practicalities of Nagoya. How does this international

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[1] A convenient short-hand for the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (https://www.cbd.int/abs/text/default.shtml)

agreement affect the laws of individual countries? What are its implications for governments, businesses and individuals? Perhaps most importantly, does the Protocol represent a solution to the problems it is trying to solve, or just another layer of red tape. Addressing these questions in just a few pages is difficult, but this article aims to provide a glimpse of some of the answers—particularly in the context of plant collecting and conservation—with the caveat that in many cases they are, at least so far, not entirely clear.

The Background to the Nagoya Protocol

The roots of the Nagoya Protocol can be traced back to the late 1980s, when work began on creating a treaty dealing with three main concepts: the conservation of biological diversity, the sustainable use of its components and the sharing of benefits arising from such use. As a result, at the 1992 "Earth Summit" in Rio, the Convention on Biological Diversity (or CBD) was opened for signatures and entered into force at the end of 1993.

Amongst the provisions of the CBD is Art. 15, Access to Genetic Resources, recognising the sovereign rights of states over genetic resources within their territory and encouraging states to facilitate access to them, but in such a way that access is granted on mutually agreed terms and with prior informed consent, the aim being to allow "source" countries to negotiate a fair deal with entities seeking to access and use "their" resources. The meaning of genetic resources is set out in the CBD as "genetic material of actual or potential value,"[2] with genetic material defined as "any material of plant, animal, microbial or other origin containing functional units of heredity." Emphasis is also placed on the sharing of the results of research and development and the benefits arising from the utilisation of the genetic resources. The Nagoya Protocol follows on from these provisions of the CBD, its role being to set out a structure and binding framework for implementing the CBD's third objective.

Six years after drafting work was initiated, in 2010 a final version of the Protocol was adopted in Nagoya, Japan. In July 2014, the threshold of 50 ratifying states was reached and the Protocol came into force 90 days later.

The Nagoya Protocol – Key Provisions

The objective of Nagoya is made clear in Article 1: the fair and equitable sharing of the benefits arising from the utilisation of genetic resources[3]. Also addressed is the issue of traditional knowledge[4], following from provisions in the

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[2] Article 2 CBD, mirrored in Art. 3 of the EU Regulation.

[3] See also Art. 3 Nagoya Protocol

[4] Art. 3 Nagoya Protocol

CBD aimed to protect knowledge, innovations and practices of indigenous and local communities relevant to the conservation and sustainable use of biological diversity and to promote the sharing of benefits arising from the utilisation of such information[5]. In this article, the focus is on Genetic Resources, but many of the issues discussed apply similarly to traditional knowledge.

The Protocol goes on to set out obligations on parties (i.e., the entities—usually countries—which have ratified the Protocol), requiring them to take steps to ensure that the Nagoya objectives are met. With this in mind, the Protocol can be seen as one of several layers of law. At the very top, there is the CBD. Then comes the Protocol, adding more clarity and detail to the general aims of the CBD. The Protocol only imposes obligations on parties to the agreement, who then need to implement their obligations by introducing their own laws, which represent yet another, "lower" layer of legislation.

The obligations the Protocol imposes on parties cover three main areas: access obligations (requiring parties, should they decide to regulate access to their genetic resources, to establish clear rules on what users need to do to be granted access)[6], benefit-sharing obligations (requiring parties to put in place measures to ensure that benefits arising from the utilisation of genetic resources are shared with the provider)[7] and compliance obligations (requiring parties to promote compliance with the above-mentioned access and benefit-sharing obligations by users within their jurisdiction)[8].

For those concerned about the impact of Nagoya on conservation efforts, Article 8 offers some hope, requiring that parties to the Protocol promote and encourage research which contributes to the conservation and sustainable use of biological diversity, including through simplified measures on access for non-commercial research purposes.

The Protocol also establishes an administrative structure on which the regime depends. Parties are required to designate "national focal points" and "competent national authorities."[9] The purpose of national focal points is to provide information on how to obtain prior informed consent and establish mutually agreed terms. The role of the competent national authorities is, where appropriate, to grant access to resources and to issue written evidence that the relevant access requirements have been met. Information on parties' designated focal points and competent authorities is then published so that anyone wishing to access genetic resources can readily find who they should contact.

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[5] Art. 8(j) CBD

[6] Arts. 6 and 7 Nagoya Protocol

[7] Art. 5 Nagoya Protocol

[8] Arts. 15, 16, 17 and 18

[9] Art. 13 Nagoya Protocol

Lapponica rhododendrons, Beima Shan, North-west Yunnan. Photo: Russell Beeson.

Furthermore, the Protocol brought about the existence of the Access and Benefit-Sharing Clearing-House (ABSCH) for sharing information relating to access and benefit-sharing, including details of focal points and competent authorities. The Clearing House also serves as a database of information relating to what genetic resources are accessed where; when a country grants access to its resources, the ABSCH will publish details of the permit and also publish an internationally recognised certificate of compliance, which users can then use to demonstrate their compliance.

Implementing Nagoya – the EU and UK level

As mentioned above, the Protocol relies on ratifying parties implementing their own laws. In order to understand what rules are applicable to organisations and individuals in the UK, it is necessary to look at the legislation which lies one level below the Protocol.

In the case of the UK the situation is complicated by the fact that the EU, as well as the UK, is a party to the Protocol. The EU has therefore introduced two Regulations—which automatically become part of UK law— implementing the

Provisions of the Protocol[10].

Just as the Protocol left a degree of freedom for parties as to how to implement their obligations, so the EU law allowed EU Member States some flexibility (e.g., as to what penalties should be imposed to enforce compliance). In the UK, these "gaps" have been filled in by national legislation[11]. So, for entities in the UK, it is the detail of the EU Regulations, taken together with the UK Nagoya Regulations, which set out the rules by which users must abide.

For anyone contemplating using or accessing genetic resources, a key provision in the EU Regulations is Article 4 of Regulation 511/2014: Obligations of Users. This provision requires users to exercise due diligence in relation to genetic resources they utilise, verifying that they have been accessed in accordance with whatever access and benefit-sharing requirements apply and that benefits are to be shared based on mutually agreed terms. As part of this due diligence obligation, users must seek a certificate issued by the ABSCH, confirming their compliance, or, where no such certificate is available, providing detailed information on the genetic resources themselves, when, where and from/via whom they were accessed, any relevant rights relating to access and benefit-sharing, any access permits involved and any mutually agreed terms.

Further, the above due diligence information must be transferred together with the genetic resources (as well as being retained for 20 years), to ensure the information travels with the genetic resources along the "value chain." Wherever genetic resources are used along the chain, users are subject to the due diligence obligations set out in Article 4. Where multiple genetic resources are involved, and where each may be used in different ways and then passed on to another user, the potential administrative burden is enormous.

Importantly, the provisions of the EU law implementing Nagoya are not retrospective; they only apply to genetic resources accessed after the entry into force of the EU Regulation[12]. However, organisations wishing to rely on prior access would be advised to keep relevant material as evidence.

A question on the minds of many entities dealing with material from abroad will be "Do my activities fall within the scope of the Protocol?" For enlightenment, one might turn to the definitions section of the EU Regulation[13], where two

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[10] Regulation 511/2014 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0511) and Commission Implementing Regulation 2015/1866 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R1866)

[11] The Nagoya Protocol (Compliance) Regulations 2015/821 (www.legislation.gov.uk/uksi/2015/821/pdfs/uksi_20150821_en.pdf) and The Nagoya Protocol (Compliance) (Amendment) Regulations 2015/1691 (www.legislation.gov.uk/uksi/2015/1691/pdfs/uksi_20151691_en.pdf)

[12] Art. 2(1) Regulation 511/2014

[13] Art. 3 Regulation 511/2014

important definitions are set out:

> *"user" means a natural or legal person that utilises genetic resources or traditional knowledge associated with genetic resources;*
>
> *"utilisation of genetic resources" means to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology as defined in Article 2 of the Convention;*

The concept of "research and development" therefore appears key, but what counts as research and development (and are both needed or would one of the two suffice)? These terms are not defined by the Regulation, leaving significant ambiguity as to the scope of the obligations. It is at least arguable that basic research falls within the scope of Nagoya and seems relatively clear that using collected plants for breeding to create new plant varieties would also bring Nagoya into play[14]. What about taxonomy or the mere collection of materials for conservation purposes? In both cases, there is potentially a research component; taxonomy facilitates effective classification of organisms, which brings value, and conservation ultimately preserves material which may be of use to subsequent research. At the same time, the Commission Guidance[14], which is not a binding document, indicates that just handling and storing biological material—and even describing its phenotype—will fall outside the scope of the EU Regulation. Commentators continue to wrestle with this point: a grey zone remains.

For those wishing to access genetic resources with no intention of "use" (e.g., those wishing to collect seeds and simply sell the plants), there is less ambiguity; such activity will fall outside the scope of Nagoya—it is hard to argue there are either research or development components here. Yet if collectors want to sell-on their material to "users," any such users will, now Nagoya is in force, need to comply with their obligations of due diligence. As such, they will have to obtain their materials either from collectors who can supply the requisite information, or else go directly to the source. Further, collectors whose work falls outside the scope of Nagoya will still have to comply with existing national rules, such as permit requirements (e.g. covering the sale of propagated plants).

The obligations on users will depend on *where* any relevant genetic resources are sourced; the measures put in place by the relevant provider country will determine what anyone seeking to access resources under the Protocol must do. To further

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[14] This is supported by the EU Commission's Guidance document on Nagoya: 2016/C 313/01 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016XC0827%2801%29)

Rhododendron adenogynum, Tianbao Shan, North-west Yunnan. Photo: Russell Beeson.

complicate the situation, in many cases the applicable rules have not yet been worked out. These are still early days for Nagoya and countries are still in the process of implementing provisions. This issue is exemplified by China, one of the world's so-called "megadiverse" countries[15] and a rich hunting ground for, amongst others, enthusiasts of rhododendrons, camellias and magnolias. As of November 2017, although China has made progress on implementing Nagoya, systems to facilitate the granting of prior informed consent and agreement of mutually agreed terms had yet to be put in place. Similarly, so far there is no mechanism to allow for the issuing of compliance certificates at the ABSCH[16].

Practical Guidance for Plant Collectors

For individuals or organisations involved in plant collecting, the new regulations on sourcing genetic materials raise practical issues which, now that the EU Regulation is in force, have to be considered. At the outset, it is important to firstly define what activities are being proposed and, secondly, to determine whether they fall within the scope of Nagoya.

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[15] Conservation International

[16] China's Interim National Report on the Implementation of the Nagoya Protocol (https://absch.cbd.int/countries/CN)

If plants or seeds are being collected purely for personal use or purely for conservation, without plans for research or the development of new varieties, the Nagoya Protocol does not apply. As mentioned above, existing permit regulations will still apply.

In circumstances where any material collected for conservation purposes may be subsequently used in other ways—for example, for a breeding programme within a botanic garden—that subsequent use will be governed by Nagoya and, as a result, the relevant user obligations will need to be complied with. If the subsequent user is to do this, they will either need to be satisfied that the relevant genetic materials were sourced in compliance with Nagoya requirements on access and benefit sharing (either by a certificate of compliance or sufficient information on how and under what terms the materials were obtained), or they will need to contact the source country and negotiate suitable terms. Either way, they will need to be in possession of information on where and when the resources were accessed. This will inevitably have to come from the collector. Thus, collectors will encounter difficulties transferring the genetic resources to subsequent users if they do not have detailed records for each of the relevant resources. If there is any likelihood of subsequent use (in the sense of research and/or development), it will therefore be prudent to maintain a database of collected resources and associated information.

At the other end of the spectrum, where materials are collected for purposes which clearly fall within the ambit of Nagoya, the collector will be under a direct obligation to comply with the EU Regulation.

Where collectors' activities are subject to the Nagoya Protocol, the next step will be to ascertain, from the ABSCH, whether the country from which the relevant materials are to be sourced is a party to the Protocol. If not, there are no additional obligations with which to comply but, again, the collector must have regard to whatever national permit regulations are in place. As an example, the UK has chosen not to impose collection requirements on users under Nagoya. Similarly, a country may be a party but have not yet put in place the relevant legislative provisions. To determine what regulations are in place in a given country, again, the ABSCH is the source of information. Thus, in relation to access and benefit sharing provisions for the UK, the ABSCH notes that no provisions have been put in place. If information is lacking, the relevant country's national focal point should be contacted. Where enquiries meet with no response, the Commission Guidance indicates—somewhat enigmatically—that it is up to users to decide whether or not to access or use the relevant genetic resources[17]. The implication seems to be that the due diligence requirement will have been met.

As for Mutually Agreed Terms, these are by their nature flexible; the Protocol and EU Regulation are not prescriptive and, ultimately, they can take the form which

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[17] See footnote 14, above, para 3.2

most suit the parties. They could, for example, be purely financial, or they could be based on the supply of products resulting from the genetic resources utilised. Inevitably, both parties have to agree on the relevant terms, but the requirement for Mutually Agreed Terms permits a creative and open-minded approach.

Challenges and Impact

Promoting awareness of Nagoya and understanding of the obligations it imposes represents a major challenge. In the case of small entities in particular, resources are limited. Apart from the administrative burden of compliance—which will likely be significant—determining whether the EU Regulation (and Nagoya) applies to any given organisation or individual requires careful consideration. Further, just knowing the position under UK law is not sufficient; users must be familiar with the requirements of provider countries.

Until the requisite access provisions have been put in place by provider countries, the full impact of Nagoya is likely to be hard to assess. A key question is whether source countries will impose measures in such a way that, as per Art. 8 of Nagoya, conservation is facilitated (for example through the imposition of simpler requirements for those conducting non-commercial research). From a UK perspective, although the scope of the EU Regulation is not entirely clear, it is arguably widely applicable. The next few years should reveal how provider countries choose to implement Nagoya and how users cope—or struggle—with the compliance regimes.

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

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(Reprinted from *J. American Rhodo. Soc.* 73: 131-133.)

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 rhododendron society 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 (reprinted in this RI volume), 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 pretour, 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 American Rhododendron Society, 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 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 (see photo

In project “Insect Mobile,” insects are caught in an open, forward-facing net attached to the roof of the cars. Data will be in the form of insects.

next page).

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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Rhododendron Pollination: Looking beyond First Impressions

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In Europe and North America bumblebees appear to be the prime pollinators of rhododendrons. Is this true and does it apply to all rhododendrons? There has been very little research on this topic and if we are interested in protecting threatened rhododendron species, more research on this intergeneric relationship might be useful, as we do know that these insects themselves have been under threat for years from land clearing, pesticides (see https://www.npr.org/sections/thesalt/2017/08/14/542895824/popular-pesticides-keep-bumblebees-from-laying-eggs) and even in the way we garden. For example, in Britain and Ireland where data on bumblebee occurrence is more readily available, there are 25 species of native bumblebees. Three species have already become nationally extinct, five are now designated UK Biodiversity Action Plan species in recognition of their precarious situation, four more are scheduled for inclusion, and 15 have undergone major range contractions (http://www.bumblebeeconservationtrust.co.uk). If this is also occurring in areas where native rhododendron species are more common, the question is how essential are bumblebees to rhododendrons in those areas? Endemic bumblebees are found primarily in higher altitudes or latitudes in the Northern Hemisphere, although they are also found in South America where a few lowland tropical species have been identified.

Are Bumblebees the Prime Pollinators?

There have not been many studies on what animals actually visit rhododendron flowers although it is generally accepted that the most conspicuous are bumblebees. Stout (2007a,b) has made it quite clear that just because an animal visits a flower, it does not mean that it is pollinating it. Many insects go in and out but in order to pollinate, the animal must be large enough to rub against the flower's anthers and accumulate pollen. Among insects, only bumblebees and wasps did this in her study of *Rhododendron ponticum* in Ireland. The other species visiting were just seeking nectar.

When studying *R. semibarbatum* pollination in Honshu, Japan, by the bumblebees *Bombus bonshuensis* and *B. ardens,* Ono *et al.* (2008) found that the plants were visited by the males of *B. ardens* more frequently than the workers of *B. honshuensis* and the former species also contributed to more effective seed production. A similar difference in pollination effectiveness was found by Gaku Kudo *et al.* (2011) in studying *R. aureum* in the snow fields of Hakkaido. He found that the emerging queens that visited the flowers early in the season after the snow cleared were far more effective pollinators than the bumblebee workers that emerged later in the season. These studies show that, although bumblebees may well be the prime pollinators of rhododendrons, the actual relationship between these insects and rhododendrons may be complex.

An Opportunity That Should Not Be Missed.

Fig. 1. *Bombus terrestris.*

Australia and New Zealand are a particularly interesting region for studying the relationship between bumblebees and rhododendrons. Excluding the two vireya species that occur in isolated populations in the mountains of Queensland, there are no native bumblebees or rhododendrons in Australasia. Rhododendrons, however, have been introduced into gardens in New Zealand and into the southern temperate regions of Australia, and more recently, bumblebees have been introduced into both countries. In the case of Australia, only one species, the European *B. terrestris* (Fig. 1), has been introduced, but this species occurs only in Tasmania where it has recently become widespread. It is thought that the origin of this introduction was one queen illegally introduced to the island around 1992. On occasion, individual workers have turned up on the mainland, apparently in boxes of raspberries from Tasmania.

With these facts in mind, two questions arise. What animal is pollinating rhododendrons in the absence of bumblebees and where the bees have been introduced, have they again become the main pollinators of the introduced rhododendrons? No focused research has been undertaken to answer either questions but there is some anecdotal information.

New Zealand

New Zealand now has four species of introduced bumblebees. Two, *B. subterraneus* and *B. hotorum,* are restricted in their distributions to the areas around Christchurch on the eastern side of the South Island. The other two, *B.*

terrestris and *B. ruderatus,* are found throughout both islands. It is thought that these bees were introduced so that they would pollinate clover, but there are also extensive rhododendron gardens throughout the two islands. Unfortunately, there was little information on rhododendron pollination in New Zealand before the introduction of bumblebees and with two of the species now spread throughout the country, we have lost the opportunity to learn there about how pollination occurred before the arrival of bumblebees.

Tasmania

There have been earlier studies in Tasmania, however, that provide some information about pollination in the absence of bumblebees, although bumblebees have now spread throughout the island. Andrew Higston (2006) has led research on the impact of bumblebees on the native flora of Tasmania and he has expressed considerable concern that bumblebees could stimulate the occurrence and range expansion of introduced European plants, and particularly *R. ponticum,* there. The spread of *R. ponticum* in the British Isles and Ireland has caused economic damage, and it is now beginning to spread along the west coast of Tasmania. *R. ponticum* was not recorded as naturalised in the late 1990s in Tasmania but according to Matthew Baker of the Tasmanian Herbarium (Hingston 2006), "large numbers of seedlings have recently been seen at several locations in western Tasmania. John Tooth of the Rhododendron Association of Southern Tasmania has also noticed that the percentage of fertilised flowers in tall *Rhododendron* species with non-tubular flowers, such as *R. ponticum,* has increased from approximately 15% to around 85% since the introduction of bumblebees."

This observation is confirmed by Maurice Kupsch, the Curator of the Emu Valley Rhododendron Garden in Burnie, located in the northwest corner of the island. This area has recently seen the arrival of *B. terrestris* as it migrated from the Hobart area to all corners of the state. He wrote (pers. comm). that "We find them a bit of a menace really as they are so efficient and pollinate so well that this makes for a lot of seed formation—in the big leaf rhododendrons particularly—which means that the plants should ideally be deadheaded and, as our bushes are now quite large and our volunteer workers are few, you can see the problem."

The Australian Mainland

The Australian Mainland gives us ample opportunity now to examine rhododendron pollination in the absence of bumblebees, and there are two scientific issues of particular interest. One is the conservation problems that would arise if *B. terrestris* or another bumblebee species was established on the mainland. The very high pollination efficiency of bumblebees on agricultural crops is resulting in considerable pressure from the Australian agricultural industry to allow for the introduction of bumblebees into mainland Australia. This has been resisted to date by the government, however, partly because where this has occurred, they have reduced the availability of nectar, especially in *Eucalyptus*, for certain native bird species, and this change might have a significant, long-term impact on the native fauna and flora of the continent.

Given the absence of bumblebees in mainland Australia, what species are then pollinating the rhododendrons? There are many large rhododendron gardens on the mainland of Australia, particularly in the southeast. Although there is a complete absence of bumblebees there, there is an abundance of the introduced honey bee (*Apis mellifera*), but this species does not seem to pollinate rhododendrons. From my observations on Vancouver Island, BC, Canada, I have rarely seen honey bees visiting rhododendrons, and the usual visitors to these flowers are bumblebees and sometimes wasps. Honey bees are abundant in my garden but their activities are confined to the flowers of other genera such as lavender (*Lavandula*) and *Deutzia* that attract large numbers of both honey bees and bumblebees.

Wattle birds (*Anthochaera*, a genus of birds in the honeyeater family Meliphagidae) seem to be the most likely Australian native bird to be the pollinator, but we lack any systematic studies to determine if they are the principal player or whether another animal group is playing this role.

Thailand and India

Fig. 1. *Bombus eximius.*

In one study in Thailand, Kjellsson *et al.* (1985) have shown that the large flowers of *R. lyi* are pollinated by *B. eximius* (Fig. 2), a large species that is uncommon but widely distributed throughout east and south Asia. Glen Jamieson (pers. comm.), on the other hand, has observed sunbirds family Nectariniidae, 132 species in 15 genera; counterparts to two very distantly related groups, the hummingbirds of the Americas and the honeyeaters of Australia) feeding on *R. arboreum* and *wallechii* in Sikkim. In this case, the large size of the beak would suggest that they are seeking nectar but also acting as pollinators.

Vireyas

Vireyas and bumblebees do not overlap geographically in the wild and there is limited observational information on what species are naturally pollinating them but butterflies, moths, bats and birds seem to be the prime candidates (Stevens 2017). It has also been observed that many vireyas are capable of self-pollination.

Francis Crome (pers. comm.) has pointed out that in the tropics, many plants are pollinated at night and one cannot draw any definitive conclusions until the role of night flying moths and bats, for example, have been studied. This would apply particularly to the white vireyas.

The Role of Butterflies

I am grateful to Don Hyatt for bring to my attention the excellent research of Mary Jane Epps (Epps *et al.* 2015) on wing fertilization of *R. calendulaceum* by large-winged butterflies. This research shows that the prime insect fertilizing this azalea is a large-winged butterfly and not a bumblebee. The research raises an interesting question: Does this method of fertilization apply to most of the rhododendrons in the *Pentanthera* and *Azaleastrum*? In these groups the stigma tends to extend well beyond the anthers. Both groups seem to occur in warmer climates where large wing butterflies are found. On the other hand, in examining many photos of rhododendrons, I found that the stigma is usually below or level with the anthers in the rest of this genus.

Co-Evolution of Bumblebees and Rhododendrons

Irving and Hebda (1993) have written about the evolution of the genus *Rhododendron,* but not about the evolutionary relationship of *Rhododendron* and other ericaceous plants such as the heathers, cranberries and similar genera with the genus *Bombus* (Fig. 3). There are a number of reasons to believe that that rhododendrons and bumblebees may have co-evolved. Firstly, both groups naturally occur in the Northern Hemisphere in Eurasia and North America but are absent from Africa, India and Australasia and much of the lowland tropics. The exception is that bumblebees occur in the Southern Hemisphere only in South America where there are no rhododendrons. This suggests that bumblebees may have migrated south along the cooler mountain backbone of Central America when the Panama Isthmus closed.

Fig. 3. *Bombus polaris* in Taiwan.

Both genera are circumpolar and occur at high latitudes and high altitudes. In fact, the circumpolar distribution of rhododendrons in the Sub-Arctic suggests that they evolved under those conditions and subsequently spread south, at least in Asia (Irving and Hebda 1993). This colder-climate origin is also suggested by the development of flower buds in the year before flowering, a common feature of Arctic and alpine plants and an adaptation to a short growing season. Evolutionary theory assumes that plants and animals evolved from the simple to the more complex. Many of the rhododendrons of colder latitudes and higher altitudes have small, simple flowers. One can imagine that they could, over time, evolve into some of the larger rhododendron flowers of the milder climate forests on the southern slopes of the Himalayas.

Bumblebees have a considerable advantage over other pollinators in cold climates as they are one of the few insects that can significantly raise their body temperatures almost to that of humans. Active bumblebees have a thorax temperature of 35° C (95° F). This means that they can function when the outside temperature does not rise much above 5° C (41° F) during the day. After a very cold night, they will be closer to ambient temperature but as soon as day breaks, they can disconnect their wings, vibrate their wing muscles to generate a high thoracic temperature (King and Buchmann 1995) and then be off to visit flowers to obtain the necessary nectar to maintain their body temperature and, in doing so, pollinate the flowers. They can also apparently use this mechanism to open closed pollen sacs in some plants by producing high frequency pressure waves. To aid in maintaining this temperature, bumblebees living in sub-Arctic or alpine habitats are covered in body "hair." The corollary of this is that in warmer climates they tend to have fewer body hairs and in hot climates, they cannot survive as they have a maximum temperature tolerance of 44° C (111° F). This correlates with their absence in the natural distribution of vireyas throughout tropical SE Asia, as although vireyas occur in the cooler elevations on mountains, bumblebees cannot occur in or transit the tropical areas between the cooler mountain habitats.

A Need for Untidy Gardens

The information described above is based on scientific studies but regardless, there is an important conservation role for gardeners in protecting bumblebees and the general biodiversity in our gardens. The last few decades have seen a steady trend to "sterilize" our gardens. This has involved heavy, continuous use of pesticides and fine homogenous shredded bark mulch in an effort to reduce disease in our favourite plants and reduce the need to fight back the weeds. I should point out that a thick layer of course mulch consisting of ground up branches, twigs and leaves can make a suitable bee habitat, so some mulches are alright. A well-tended fine mulched garden beds may look great, but the habitats for many beneficial insects and other animals can be enhanced by leaving some areas looking a bit more "untidy" and pesticide free. To a large extent, bumblebees establish their small nests in the ground and prefer a dry friable substrate, such as occurs in compost piles or in mouse holes. Others will build their nests at the base of a hedge or in an old wood pile. This does not mean that these features should be part of the rhododendron beds themselves but rather ideally be present somewhere in a garden. If tree branches fall, rather than clear them all away, shred or pile some up in a corner where they are out of the way so they can act as cover and/or nest sites for insects and other animals such as toads and snakes, both of which are lovers of slugs and snails and which will help to protect your garden plants.

Sometimes one can find small bumblebee nests when digging in loose debris and care should be taken to cover the nest up right away so that the queen and larvae are not killed. This is particularly important in the fall so over-wintering beneficial insects are not killed (see https://savvygardening.com/6-reasons-not-to-clean-up-your-garden-this-fall/)

If you wish to do a little more to encourage the presence of bumblebees, build or purchase small nest boxes and secrete them in protected areas near the ground (see http://www.bumblebee.org/nestboxes.htm). Another way to encourage bumblebees would be to plant other flowering plants that are attractive to these bees and extend the food season outside the flowering time for rhododendrons. There are many published lists recommending such plants for each district. (See https://www.fs.fed.us/wildflowers/pollinators/animals/bees.shtml, http://beefriendly.ca/25-plants-for-bees-in-your-garden/ or https://www.wildflower.org/collections/collection.php?collection=xerces_bumble.) I have personally found that lavender is a major attraction. It flowers throughout the summer and during hot weather is completely covered with feeding bumblebees. We need to learn more about the role that bumblebees play in the lives of rhododendrons and hopefully, better adjust our gardening practices to encourage their survival.

Conclusion

Our enthusiasm for the plants in the genus *Rhododendron* should extend to the study of the organisms that this genus depends on or helps in their survival. For example, each year, rhododendron experts visit different areas of Asia to study the genus in the wild, but sometimes there are also bumblebee experts travelling in the same regions. A joint expedition where both plants, especially rhododendrons, and their pollinators can be identified by experts would allow us to learn a lot more about the ecology of rhododendrons. Questions that might be answered sooner are what is pollinating the very large flowers of Maddenia, and what are the pollinators of unusual rhododendron flowers such as those of *R. spinuliforum*? In the warmer areas where bumblebees do not occur, is the pollination of vireyas taken over by nectar feeding birds, moths, or other specialized insects with very long tongues?

Another area of research that would be of interest is the relative importance of flower colour in rhododendrons in determining the quality of nectar and pollen they provide to pollinators. In dahlias bumblebees are attracted differently to flowers of different colours (Blooms for Bees 2017).

Rhododendrons are a fantastic genus to grow and admire, but they are not the only organisms in a garden. A broader biodiversity approach to gardening might give us more insight into the lives of both plants and animals in our gardens and result in greater understanding and enjoyment, especially in our efforts to protect endangered species, whatever they are.

Further information

For the average gardener who wishes to learn a little more about bumblebees, the paperback "A Sting in the Tale: My Adventures with Bumblebees" (Goulson 2014) is a very readable overview of the life history of bumblebees and their ecological and economic importance. It also deals with some of the conservation problems and difficulties. Although written in Britain, it does cover many issues of international importance.

To identify American bumblebees in your garden, "Bumble Bees of North America" (Williams *et al.* 2014) is informative, well-illustrated and contains maps of the distribution of each of the 46 species north of Mexico. It contains keys that will help to identify individual species. Lists of local species are very useful in reducing the choices one needs to make in the process of identification. There are usually local charts with coloured illustration of the species and also sources on the web with additional illustrations.

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Hybridising Rhododendrons

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Photos by author

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I just can't wait to see the flower open! When you see the first bloom opening on that new seedling, you are the first person to see the very first flower from the unique combination of genes. It is truly thrilling!

It all started innocuously some 40 years ago when I sprinkled a few seeds from a rhododendron seedpod from a cross I had made in my own garden, not fully realising the consequences of my actions. Over the next ten years or so I tried several more crosses. Rhododendron seed is very fine, and in a full seedpod there are thousands of seeds

How do you make a cross then between two hybrid rhododendrons? The two main sexual organs involved are the male stamens which contain the pollen producing anthers and the female stigma to the seed-bearing ovary. The plant that carries the pollen is termed the pollen parent (father) and the receiver of the pollen is termed the seed parent (mother). Everyone has a different method of crossing flowers; mine is as follows. Having chosen the parents, I take a flower from the pollen parent on a freshly opened flower making sure that the pollen is available. The pollen ripens before the flower opens and is only available for a short time (one or two days at most). I then hold the flower base in my finger tips and remove the petals and the stigma. I then take the pollen bearing anthers to my chosen mother flower which has been prepared by stripping all flowers off the truss except for one which will be the pollen receptor. I choose a flower that is just about to open, i.e., that is one which you know has not been visited by any pollinators. The stigma is receptive to pollen just before opening and for two or three days afterwards. The next step requires a great deal of care to avoid self-pollination. With a sharp pair of scissors, I carefully remove the petals which exposes the stigma and anthers of the seed bearer and very, very carefully remove the pollen bearing anthers. It is vital that the stigma from the mother plant is not contaminated by any pollen from the plant's own anthers or the cross is lost. Once any pollen is wiped across the stigma the plant's internal mechanism prevents any further fertilisation. Once the cross is made, there is no necessity to cover up the exposed stigma. The resulting cross is the product of the seed produced in the seed-bearing (mother) plant and will contain varying degrees of the attributes of both parents yet is recognizably different from each. Finally, you will need to label your cross as "Rhododendron A ✕ Rhododendron B" with "Rhododendron A" being the mother or seed-bearing parent

The unique privilege you have in breeding your own plants is the excitement watching a flower open for the very first time and seeing a flower develop into a specimen which is completely new to horticulture. You are the very first person to see and admire it (or not!). These first blooms are the most exciting part since every plant and flower will be slightly different. Of course, not all seedlings develop into great plants. Some indeed are very disappointing producing poor plants with poor habit or poor flowers (see Fig. 1 on next page). So, what are you looking for in breeding an outstanding rhododendron? The questions you need to ask are:

Is it better that either parent?
If not, is it better in different way?
Is the foliage good?
Is it disease free (particularly resistant to powdery mildew)?
Has it a good habit (is it good to look at)?
Is it hardy?
Does it flower young?
Is it floriferous?

It may be difficult to objectively evaluate your own "children." Are they better or sufficiently different from their parents? Are they some improvement over similar varieties? Are there faults in bloom or bush that suggest the compost pile should be their next destination? This is all part of the fun. If the seedlings meet the criteria, you may want to name, register and show them in competition. Only a very small percentage get this far, but it can be a very rewarding personal experience!

Out of 100 seedlings, only four or five may be worth keeping when compared against existing varieties (cultivars), perhaps 10-15 succumb to powdery mildew, probably 30-40 are nondescript and 5-10 have undesirable faults. This leaves about 30 plants that are too good to throw away and yet are not of sufficient quality to justify propagation and registration. What do you do with them? I give them away to friends and family but to be truthful, I should be ruthless and bin the lot.

All good hybrids in existence today, whether you have a goal or not, were all "chance" hybrids. Yes, you do increase your chances of producing a good hybrid with the trait you are desiring by careful selection of parents and back crossing,

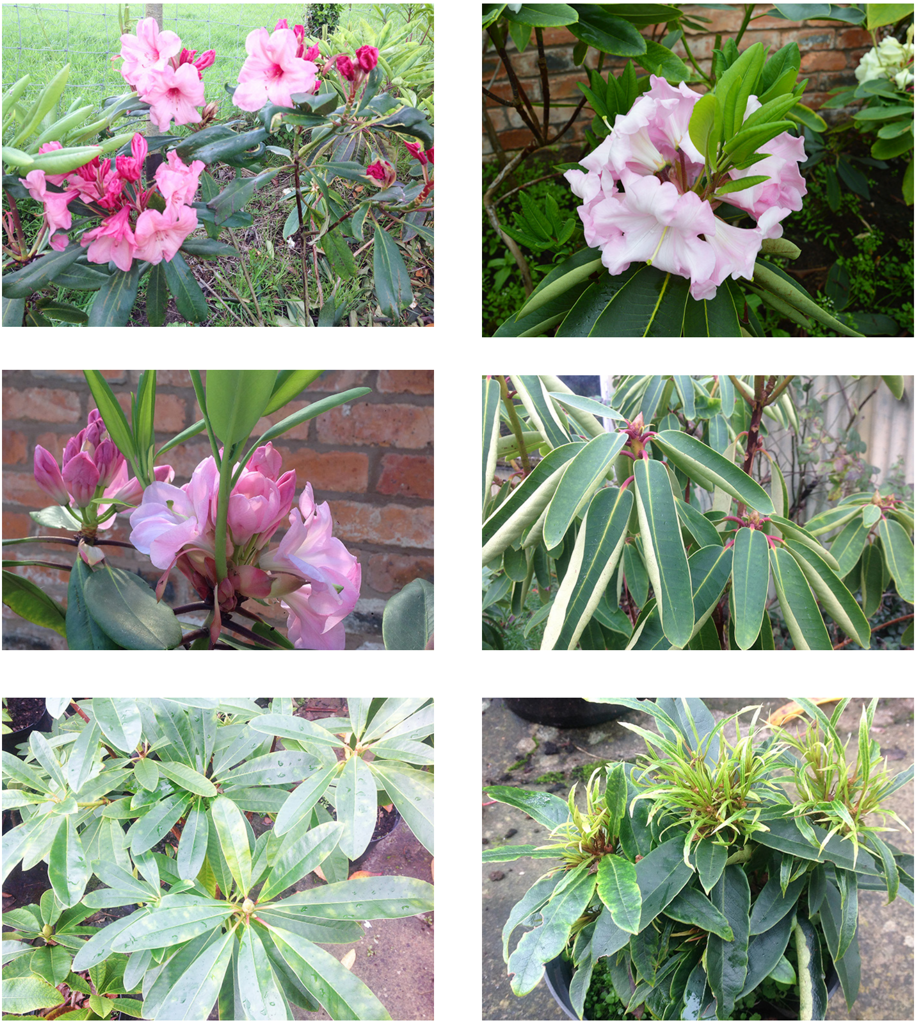

Fig. 1. There are several reasons to reject a seedling. A nondescript plant with poor foliage (top left); a seedling showing a new shoot growing through the flower (top right); a seedling where several growing side shoots hide the emerging flower (centre left); a seedling with unattractive up-curved leaves (centre right); an otherwise good seedling susceptible to powdery mildew (bottom left); a stunted 15-year-old plant displaying an unknown genetic mutation (bottom right. Photos by the author.

etc., but it is the combination of genes at the moment of fertilization that is still down to chance. I would suggest that having a goal is best carried out by large professional estates nurseries who have the staff, time and continuity to achieve a long-term objective. I am a private gardener, now retired from my profession, and my approach has been to select good quality parents but with complicated

Fig. 2. Rhododendron flowers from the same grex showing the huge variation in colour and form of seedlings when using complex progenitors. [The term grex (pl. greges or grexes; abbreviation gx), derived from the Latin noun grex, gregis meaning 'flock', has been expanded in botanical nomenclature to describe hybrids based solely on their parentage.]

parentage. In this way the seedlings can produce very diverse forms and colours (see Fig. 2). I make no apology for what appears to be my unconventional approach.

Practicalities of Raising Hybrid Seedlings

Raising rhododendrons (or azaleas) from seed is not particularly difficult providing that light, moisture and warmth are readily available. I sow my seeds in firmed sphagnum moss or a 50% mixture of peat and sterilised garden compost. Although I cover the seeds with a glass or plastic cover it is important that light is available as they need this for germination. The most important factor is to keep the mixture moist with high humidity and then you can expect germination in seven to about 21 days.

From seed I do not pinch back any of the growing shoots until the seedling forms its first flower bud(s). This is because a flower bud is more likely to form on a strong growing shoot rather than a weak side shoot encouraged by pinching back. Although pinching provides in some cases a more acceptably shaped plant, the flowering age can be put back a couple of years. As soon as a seedling forms a flower bud, I then nip out all other shoots to encourage the plant to produce as many shoots as possible. This is to ensure that if the flower is of acceptable quality, then the maximum number of side shoots is available to provide scions for propagation. It is important to remember that the plant you have produced is unique and it can take many years to increase the stock of your unique hybrid to enable distribution to all and sundry. Before the advent of micropropagation it could take up to 20 years for commercial growers to have sufficient numbers for effective dispensation. It is poor planning to have a fabulous plant and flower and then find there are only two or three side shoots obtainable

Once buds form, I take the plants into a greenhouse to prevent frost bud damage. To cherish them for many years and then lose a developing flower bud to weather is negligent. Then to aggravate matters, another year's wait is needed.

Good plants get better with age and some plants produce only a few flowers on young plants, only reaching their full complement after several years, so don't throw them away, just because the flowers are initially underwhelming!

Each spring, you will anxiously await the blossoms of old favourites, as well as the first blooms of your new seedlings. It won't be long before you are giving away plants to all your friends because you have run out of room.

Should there always be a goal when hybridising? This is the main point emphasised by most hybridisers, but as an amateur just having fun, I have ignored this advice. The broad aims of rhododendron breeding programs have changed little from those of the past. Improvements in flower and plant

Fig. 3. *Rhododendron* 'Sunspray'.

Fig. 4. Seedling *Rhododendron* 'Chris's Cream' held by its namesake (left), and close-up of flower truss opening for the very first time (right).

quality, plant hardiness, and disease resistance, particularly powdery mildew are actively being sought and this must start with the selection of good parents. But before we evaluate these, a note on my choice of parentage. All the books I have read emphasise that you should have a goal. In other words what are you trying to achieve and how to do you go about it? From seed to flowering in some plants can take two or three of years but with rhododendrons it can take up to ten years and this a very long time to wait for a result and a subsequent further evaluation and then continue further to select for the trait you are looking for takes many years. I see no argument against selecting progenitors to provide a random range of seedlings. It is just as likely to throw up something special as a deliberate attempt to achieve a specific characteristic.

Is it Better than Either Parent?

One of my most useful tools for deciding which parents to use has been Homer E. Salley and Harold E. Greer's book "Rhododendron Hybrids – A Guide to their Origins." This book is the standard guide to the parentage of some 4000 registered hybrid rhododendrons and is extremely valuable to rhododendron hybridisers and professional growers alike. Choosing parents is not an exact science, particularly choosing ones with

Fig. 5. *Rhododendron* 'Harwood Dale' ('Loder's White' **X** 'Thor') - one of the author's early unregistered hybrids.

Fig. 6. Offspring rhododendrons ‘Kenneth Hulme’ (bottom left) and ‘Barbara Hulme’ (bottom right) from unnamed parent seedling (top).

complex parents, as it is impossible to list the many millions of genetic influences available within a genus of over a thousand species. Some will be dominant and some recessive, varying from flower colour and form, leaf shape, susceptibility to disease etc. If we cross pollinate two rhododendrons without any knowledge of their genetic parenthood, it is like expecting to win the National Lottery every

Fig. 7. Unnamed seedling derived from *Rhododendron* 'Fagetter's favourite'.

time we purchase a ticket. So, you need to study the ancestors of a plant and have a basic understanding of plant genetics to decide. A good example is crossing a species red flower with a species yellow to produce an orange. This does not happen because the colour red is a dominant gene and you are most likely to end up with pink hybrids rather any orange flowers. Also, if red is a dominant gene and you don't want red flowers, don't use parents that have red flowers!

Another cross that produced a good set of hybrids was the use of an unnamed seedling crossed with an old (1946) reliable Dutch red hybrid with a black blotch called 'Kluis Sensation'. Much of the ancestry of this plant is unknown. Many of the seedlings were red but some, within the grex, produced these two "twin" hybrids which have been named 'Kenneth Hulme', for an ex director of Ness University of Liverpool Botanic Gardens and 'Barbara Hulme', his botanist wife. I have many unnamed seedlings, but the parent I used in this case, I thought, would produce an unusual combination of form and flower colour.

Is it Disease Free?

Rhododendron powdery mildew has caused serious disease on outdoor rhododendrons in Europe since about 1980, yet its identity and origins are still uncertain. It is a fungal disease of the foliage, stems and occasionally flowers and is the main pathogen affecting rhododendron in cultivation today but fortunately some clones are resistant. Unlike the above, any resistance to powdery mildew is not apparent until the plant is exposed to the pathogen. Many of my seedlings, despite choosing disease free parents, succumb to the disease and some more than others. These are obviously rejected as unworthy of propagation, but I do not cull them. I place them within the clones of selected seedlings to expose them further to the pathogen, so I can be confident that those plants that remain unaffected are indeed powdery mildew resistant. Rhododendron 'Virginia Richards' is one of the finest American hybrids raised in the Pacific Northwest but has one fault of being susceptible to powdery mildew. It has awards in the USA and UK. I purchased one of these plants some 20 years ago and the plant is now 4.6 m (15 ft) high. It has never flowered, loses most of its leaves every year and struggles to survive and with space at a premium, it may only be a matter of time before it is replaced. When the clone was selected for propagation in the 1960/70's, it may never have

Fig. 8. Author holding the Crosfield Challene Cup at the Main Rhododendron competition 2017, winning with three unnamed rhododendron hybrids.

been exposed to the pathogen due to the pathogen's scarcity, and then only appeared once the plant was in general cultivation. It is therefore important that we eliminate this disease by only introducing disease resistant plants and let those hybrids that are not resistant just fade away. There are made fine hybrids available, powdery mildew free, that have superseded them.

Is it Hardy?

This is a difficult one for me. Most hardy rhododendrons will survive temperatures down to -15° C and by choosing parents that are hardy one hopes that their offspring too will indeed be cold resistant. I believe I am safe to presume that my hybrids

Fig. 9. One of the winning unnamed seedlings from the Crossfield Challenge Cup 2017.

will survive down to at least this temperature. We live in the Uk with an equable climate and it is therefore almost impossible to evaluate this criterion, particularly now with such mild winters.

To those who would follow my path, a caveat. Choosing parents, crossing the plants and sowing the seed is the easy part. Ten trays of 300 seedlings per tray does not occupy a large space but when this expands to 3000, ten-year-old seedlings in pots, as in my case, you need considerable space to grow these plants on? I have a large garden but because of calciferous soil, I have kept most of my plants in pots. Associated with all this is the repotting every year, the treating each spring and autumn with nematodes to combat vine weevil and the effort of watering in dry conditions. All this takes time and dedication over many years. Having said all that, the rewards are enormous. The huge effort required is totally worthwhile.

Colin Mugridge has won many awards for his hybrids including first prizes at Ness Gardens, Harlow Carr, and Rosemoor, and "Best in Show" at Ness. In 2017 he was awarded the prestigious Crosfield Challenge Cup at Rosemoor for three of his hybrids. An historic collection of his hybrids is to be established at the new RHS garden in the North West at Bridgewater near Salford, Manchester.

Hidden Botanical Treasures of Japan

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(Reprinted from *Rhododendron Species 2019*: 33-44, the Rhododendron Species Botanical Garden annual journal.)

When you are asked to name a rhododendron from Japan, my guess is most of you would first think of *Rhododendron degronianum* subsp. *yakushimanum*, also known as a "yak." Their showy flowers and attractive foliage have many fans around the world, including myself. However, did you know that there are nearly 100 *Rhododendron* taxa to be found in Japan, including all the recognized subspecies and varieties? That is about a tenth of the genus *Rhododendron*. Japan is a country about the size of California, but the diversity of plants that occur there is absolutely incredible.

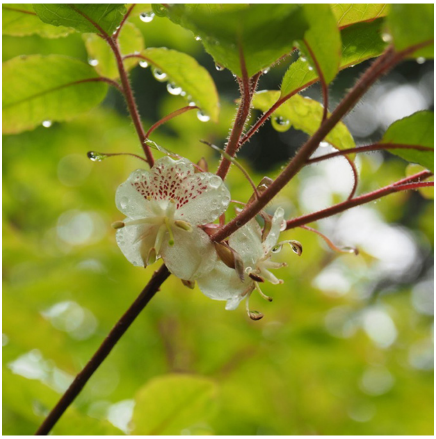
Japan consists of over 6500 islands. There are three major climate zones in Japan: a mild summer continental climate (Hokkaido and a small part of the inner area of Honshu) where the climate is similar to the Northeastern USA; a hot summer continental climate (northeastern Honshu) where it resembles the climate of the southern part of the American Midwest, and a subtropical climate (the rest of Honshu including Tokyo and Osaka, and much of Kyushu and Shikoku). There are countless plants that are endemic to Japan, including some of the rhododendrons that are discussed in this article.

Below, I will introduce those rhododendron species that may not be well known in western countries but have unique characteristics. They may not have the showiest flowers, but their uniqueness, such as the taxonomical isolation and the fact that many are critically endangered species, is interesting enough to be given attention.

Rhododendron semibarbatum

Rhododendron semibarbatum is the sole species that belongs in subgenus *Mumeazalea*. It is considered an isolated species within the genus *Rhododendron* due to the fact that it has five dimorphic (unequal) stamens. The species name comes from Latin: "semi" means half, and "barba" means bearded, so this is a "semi-bearded rhododendron." The name comes from the partially bearded, unique stamens on this species. It is a deciduous shrub that is 1 to 2 m (3 to 6 ft) in height. *Rhododendron semibarbatum* is endemic to Japan and native to

R. semibarbatum fall foliage. No photo credit.



R. semibarbatum. Botanical Gardens, Graduate School of Science, The University of Tokyo.

Southern Hokkaido, Honshu, Shikoku, and Kyushu (Yaku Island). It tends to be found at the edge of deciduous forests or on sunny slopes, at low elevations from 300 to 1400 m (985 to 4590 ft). It is considered a rare species in Japan.

The shiny leaves are alternate; however, they appear to be whorled at the end of branches as the internodal spacing gets closer towards the tips. Ovate to elliptic leaves are 2.5 to 5 cm (1-2 in) long and 1 to 2.5 cm (0.4-1 in) wide with mucronate tips and minute serrations on the margin. The leaf margin is covered in short hairs. Sometimes leaves have a tint of red or purple, especially when they are newly emerged. The upper surface of the leaves has scattered hairs, and the lower surface has the presence of glandular hairs along the mid rib. Its petioles (5 to 15 mm, 0.2-0.6 in) and new stems are glandular-pilose. The leaves turn yellow to reddish brown in fall.

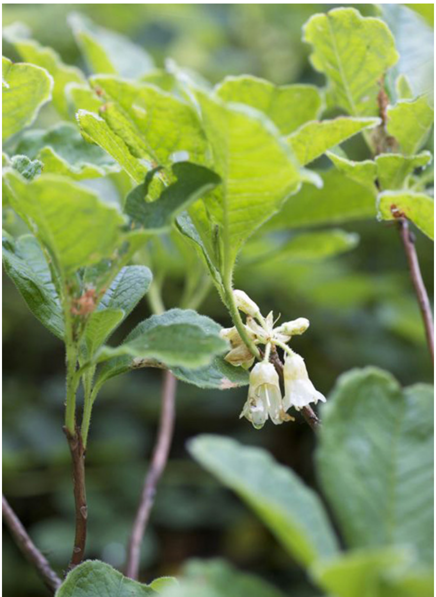
The flowers are not very showy, and they are usually hidden under the current year's leaves. The inflorescence is 1 cm (0.4 in) long and 1.5 cm (0.6 in) wide, and solitary from the lateral buds on the previous year's growth. Rotate funnel-shaped flowers are white (sometimes with a tint of pink or yellow) with reddish-purple spots at the base of upper corolla. Its recurved petals are not fused together, unlike all other azaleas with the exception of *Rhododendron vaseyi* and *Rhododendron canadense*–which are also taxonomically isolated azalea species. The flowers are glabrous externally but pilose on upper inside. One unique fact about this plant is that it has five dimorphic stamens. The two upper stamens are pilose and typically sterile, and are half of the length compared to the lower three stamens that are curved. Pedicels are 5 to 7 mm (0.2-0.27 in) long and covered in glandular hairs. The saucer-shaped calyx is small, up to 5 mm (0.2 in) long, also with glandular hairs. The Japanese name for *Rhododendron semibarbatum* is Baika Tsutsuji, which means plum-flowered azalea. This is because the flowers resemble those of plum flowers. In fact, most people would not recognize the blossoms as rhododendron flowers. It blooms from mid-June to mid-July in the mountains of Japan.

We recently planted *R. semibarbatum* in the garden along with our *Rhododendron ovatum* collection. They are placed near a *Davidia involucrata* (dove tree), but away from the dense shade so they will get good fall color. The soil there had poor drainage, so sand was added to correct the problem. With a fresh coat of mulch, we hope to see them thrive in this location. *R. semibarbatum* is extremely hardy and reported to survive in the harsh east coast climate of North America. We don't have an extensive *R. semibarbatum* collection at the Rhododendron Species Botanical Garden (RSBG), but I hope to obtain seeds from the wild the next time I visit Japan, so we can increase our accessions.

Rhododendron nipponicum

Rhododendron nipponicum is considered one of the most primitive species in the genus *Rhododendron*. It is endemic to Japan and grows at 900 to 1300 m (3000 to 4250 m) in woods and thickets on the western side of northern Honshu from Akita prefecture to Fukui prefecture, where heavy snowfall is present. It grows with *Rhododendron multiflorum* (*Menziesia multiflora*) and *Rhododendron tschonoskii* in the wild. *Rhododendron nipponicum* has the largest leaves of any azalea. Although it belongs in subgenus *Pentanthera*, it is the sole species that belongs in subsection *Viscidula*. There are no close relatives to *R. nipponicum*. This deciduous shrub grows to 1 to 2 m (3 to 6.5 ft).

The alternate leaves are gathered at the end of branchlets and are 5 to 12 cm (2-4.7 in) long and 3 to 6 cm (1.2-2.4 in) wide. They resemble the foliage of *Rhododendron schlippenbachii*, although the leaves on *R. nipponicum* are typically much larger. Young shoots are covered in glandular hairs, but they become eglandular as they age. The obovate leaves and petioles are coarsely pilose, and the apex of the leaf is slightly truncate. The leaf margin is entire and is covered in bristly hairs. The petiole that wraps the stem is extremely short,



R. nipponicum. Photo: Botanical Gardens, Graduate School of Science, The University of Tokyo.

and with the cuneate leaf base, some might consider as lacking. *Rhododendron nipponicum* has extremely attractive, reddish brown, peeling bark as it matures. In fall, its leaves turn orange to crimson.

The nodding flowers are seen at the base of the current year's growth, which makes them rather difficult to notice especially if the plant is small. The creamy white, tubular-campanulate flower is 1 to 2 cm (0.4-0.8 in) long and 0.8 to 1 cm (0.3-0.4 in) wide, and may be flushed pink at the top of the corolla. It is in fact a very unusual flower shape for an azalea. There are five to ten flowers borne on a single terminal bud. The inside of the corolla is covered in short hairs. The pedicel is 8 to 20 mm (0.3-0.8 in) long and covered in dense, glandular hairs. The calyx is five-lobed and triangular with an acute tip, 2 to 3 mm (0.08-0.12 in) long, and has glandular hairs on the outer surface. *R. nipponicum* has ten unequal stamens, and they do not exceed the length of corolla. The base of each filament is covered in hairs. The ovary is heavily glandular. *R. nipponicum* blooms from July to August, but I have seen them re-bloom in the fall oftentimes here at the RSBG.

In my experience, *R. nipponicum* is a rather difficult species to grow, not to mention that it is one of the favorite foods of rabbits. Most of our *R. nipponicum* collection is planted on a slight slope just below our Visitor Center, but we are slowly losing them one by one, even though they are planted in well-drained soil. Perhaps it is the heat that they dislike in our climate. *R. nipponicum* is hardy to -23° C (-10° F). This is another species that I hope to collect in the wild when I return to Japan in the fall. Seeing a mature *R. nipponicum* with its stunning peeling bark in its native habitat is something I look forward to!

Rhododendron uwaense

Rhododendron uwaense is a newly discovered species from Japan. It was found and named in 1984. The species name comes from Uwajima district in Ehime Prefecture in Western Shikoku, where this species was discovered. It is a member of subgenus *Azaleastrum*, section *Azaleastrum*, which includes *Rhododendron ovatum*, *Rhododendron honkongense*, and *Rhododendron leptothrium,* for example. What is interesting is that the closest relative of this species, *R. ovatum*, occurs in China and Taiwan, making *R. uwaense* a geographically isolated species. *R. uwaense* occurs in the eastern and northern limit of section *Azaleastrum*. The only location in which it is known

R. uwaense. Photo: NPO Morikara Tsuzuku Michi.

to occur is in Uwajima District in Ehime around 200 m (650 ft) above sea level, although the exact location is not made public for the protection of the species. The plant is extremely rare in Japan and considered an endangered species on the IUCN Red List. In 2015, the sole remaining population of *R. uwaense* was reported to have been damaged by deer, and therefore, the conservation of this species is critical. In the wild, it grows in evergreen forests on hillsides with *Rhododendron kaempferi*, *R. weyrichii*, and *R. dilatatum*, as well as evergreen trees such as *Castanopsis cuspidata* and *Quercus glauca*. It reaches 2 to 3 m (6 to 10 ft) in height, but a 5 m (16 ft) tall specimen has been recorded in the wild. This species has high horticulture value due to the fragrant flowers, evergreen foliage, and a decent cold hardiness when compared to other members of section *Azaleastrum*. Japanese botanists have successfully crossed *R. uwaense* and *R. degronianum* subsp. *yakushimanum,* so that could bring some interesting results.

The soft leathery-textured evergreen leaves are ovate-lanceolate with acute tips. They are alternately arranged but they appear to be whorled at the end of each branch as the internode spacing gets closer. The leaves are 2 to 5.5 cm (0.8-2.2 in) long and 1 to 2.5 cm (0.4-1 in) wide. The mid-vein on the upper surface has short hairs but is otherwise glabrous. The lower surface is glabrous. The petiole is approximately 1.2 cm (0.5 in) long. It produces fragrant, rose-colored flowers with dark red blotches from end of April to early May in Ehime prefecture, where it is known to occur. Each lateral bud produces a single flower. The rotate shaped flowers with split petals are 1.8 to 2 cm (0.7-0.8 in) long, and 2.5 to 3 cm (1-1.2 in) across. The saucer-shaped calyx is very showy and reaches 7 to 8 mm (0.25-0.3 in) in diameter and up to 4 mm (0.15 in) long. The pubescent pedicels are 8 to 12 mm (0.3-0.5 in) long and covered heavily in short, stipitate glandular hairs. It has five stamens similar to the rest of the species in section *Azaleastrum*, but the two, short, upper stamens are sterile. The ovary has dense glandular hairs.

RSBG does not have *R. uwaense* in its collection. We hope to coordinate with botanical gardens in Japan to obtain the seeds of this rare species. This species would probably be semi-hardy in the Pacific Northwest climate.

Rhododendron boninense

This species is endemic to Tokyo prefecture. Not the Tokyo on the mainland, but the adjacent islands which are located 1000 km (620 mi) directly south of Tokyo in the Pacific Ocean. They are known as the Ogasawara archipelago, or Bonin Islands, and they consist of 30 tropical islands that are considered part of Tokyo prefecture. *Rhododendron boninense* is found only on Chichijima, or "Father Island," on sunny rocks. There is a single specimen left that still grows in the wild, but Koishikawa Botanical Garden, which is adjacent to the University of Tokyo, has been working on ex-situ conservation of twelve endangered species endemic to Ogasawara archipelago, including *R. boninense*, since 1987.

It has been reported that this species is extremely difficult to grow outside the Ogasawara archipelago due to the lack of laterite (clay that is rich in iron and aluminum) that naturally occurs in the region. It belongs in subgenus *Tsutsusi*, section *Tsutsusi,* and the closest relative of this species is *Rhododendron scabrum* which also is found in Japan. The species name "*boninense*" comes from the word "Bonin" the other name for the Ogasawara archipelago. In fact, there are several genera that occur in the region with the same species name, including *Vaccinium boninense,* that are also endemic to the same location. The Ogasawara archipelago has roughly 400 native plants, and 150 of those are endemic to the location. *Rhododendron boninense* is an evergreen azalea with a mature height of 1.5 to 2.5 m (5 to 8 ft).

R. boninense. Photo: Botanical Gardens, Graduate School of Science, The University of Tokyo.

The alternate leaves of *R. boninense* are oblong-lanceolate and are 3.5 to 6 cm (1.4-2.4 in) long and 1 to 1.5 cm (0.4-0.6 in) wide, with petioles that are 0.5 to 1 cm (0.2-0.4 in) long. The margin is entire. The texture is thick and leathery. The branches, petioles, and lower surface of the leaves, especially along the midrib, are covered with dense adpressed hairs that are brownish in color.

The funnel-campanulate shaped inflorescence is 4 to 5 cm (1.6-2 in) across and 2.5 cm (1 in) long. The pure white, five-lobed corolla is dissected to about half of the length. Inside, the corolla is pilose, but the outer surface is glabrous. Two to three flowers are produced from a single terminal bud. The calyx is strigose and about 2 mm (0.08 in) long. The pedicel is 4 to 6 mm (0.15-0.24 in) long. There are seven to ten stamens with a strigose ovary. It blooms in April.

There are several reasons why *R. boninense* is a critically endangered species. Typhoons and other natural disasters (such as drought and changing climate) are directly related to this species being threatened. The roots are washed off and branches are broken from the heavy storms. *R. boninense* has also suffered from the attacks of gall mites and goats. Naturally, the need of conservation of this species is well-recognized in Japan.

Rhododendron tschonoskii

Rhododendron tschonoskii occurs in Japan (Hokkaido, Honshu and Kyushu) as well as the southern Korean peninsula, but much of the population occurs in northern Japan. This mostly deciduous azalea is very compact, and its mature height only reaches 1.3 m (4 ft) tall. There are three varieties recognized in Japan:

var. *tschonoskii*, var. *tetramerum* with tubular flowers, and var. *trinerve* with its larger plant parts. Due to its compact form and tolerance of pruning, this species is often used for bonsai. It is a member of subgenus *Tsutsusi,* section *Tsutsusi,* to which all the evergreen azaleas from East Asia are allocated. However, *R. tschonoskii* is monomorphic, which means it has one set of leaves for the entire growing season, unlike the dimorphic evergreen azaleas that produce both spring leaves (larger, deciduous) and summer leaves (smaller, persisting through winter, giving the plant its "evergreen" feature).

The Japanese name, "Kome Tsutsuji," means "Rice Azalea" acknowledging the small white flowers that resemble grains of rice. *Rhododendron tschonoskii* resembles *Rhododendron tsusiophyllum* in the shape of the foliage and flowers, but *R. tsusiophyllum* has a three-locular (chambered) ovary whereas *R. tschonoskii* has a four- to five-locular ovary. In addition, *R. tsusiophyllum* has anthers that dehisce vertically whereas the anthers of *R. tschonoskii* open by pores.

Rhododendron tschonoskii var. *tschonoskii* (Kome Tsutsuji): The branchlets, petioles, and leaves on both surfaces (especially midrib) are heavily covered in long, adpressed, brown, strigose hairs. Elliptic leaves are 0.5 to 2.5 cm (0.2-1 in) long and 0.5 to 1 cm (0.2-0.4 in) wide. The underside of the leaf has four to five somewhat prominent lateral nerves.


R. tschonoskii var. *tschonoskii.* No photo credit.

The single, terminal flower bud produces one to four flowers that bloom in early to mid-summer. White, sometimes flushed pink, broadly tubular-funnel shaped flowers are 0.6 to 0.8 cm (0.24-0.31 in) long and 0.5 to 1 cm (0.2-0.4 in) wide. The corolla is dissected about the half to two-thirds of the length into five lobes, rarely four lobes. The outer surface of the corolla is glabrous whereas the inside is densely pilose. The pedicel is 0.2 cm to 0.6 cm (0.08-0.24 in) long. The saucer shaped calyx is minute and softly strigose. The five stamens are slightly longer than the corolla and hairy on the lower half. The ovary is also softly strigose.

Var. *tschonoskii* occurs in South Korea and in Japan from Hokkaido to Kyushu on the eastern side, on rocky slopes from 1500 to 1800 m (4900 to 5900 ft). It grows to 1 m (3 ft) tall. The fall color of

Table 1. Comparison of the three varieties of *Rhododendron tschonoskii.*

	var. *tschonoskii*	var. *tetramerum*	var. *trinerve*
leaf size (LxW)	0.5-2.5 cm x 0.5-1.0 cm	1.0-2.0 cm x 0.4-0.8 cm	1.5-4.5 cm x 0.7-1.5 cm
vein	4-5 less prominent	not prominent	3 prominent
pedicel length	0.2-0.6 cm	0.2-0.4 cm	0.4-1.0 cm
# flowers per bud	1 to 4	1 to 3	3 to 8
flower size (LxW)	0.6-0.8 cm x 0.5-1.0 cm	0.5-0.7 cm x 0.5-0.6 cm	0.7-1.0 cm x 1.0-1.2 cm
flower shape	broadly tubular-funnel shaped	tubular-campanulate	broadly tubular-funnel shaped
color	white, some flushed pink	white flushed pink	white
lobes	4 to 5	4	4, rarely 5
stamens	exceed the corolla	do not exceed the corolla	exceed the corolla

R. tschonoskii is extremely attractive, turning orange to red-brown in autumn.

Rhododendron tschonoskii var. *tetramerum* (Choji Kome Tsutsuji): Known as "Choji Kome Tsutsuji" (meaning *R. tschonoskii* with small Choji, or clove-like, flowers), this plant has white to flushed pink, four-lobed flowers, rarely five-lobed. Tiny tubular-campanulate flowers are only 5 to 7 mm (0.2-0.28 in) long (and 5 to 6 mm (0.2-0.24 in) wide. The lobes are only 2 to 3 mm (0.8-0.12 in) long, which makes them shorter than the corolla tube. The pedicel is 2 to 4.5 mm (0.8-0.18 in) long. There are four stamens that do not exceed the length of the corolla. Its branches crawl on the ground so the overall size is much


R. tschonoskii var. *tetramerum.* No credit credit.

smaller, only up to 0.5 m (1.6 ft) tall. This species has the smallest flowers and leaves among the varieties of *Rhododendron tschonoskii*.

The leaves only reach 1 to 2 cm (0.4-0.8 in) long and 0.4 to 0.8 cm (0.16-0.32 in) wide. There are no prominent lateral veins. Both surfaces of leaves are covered with adpressed, short-brown hairs.

It occurs with trees such as *Pinus pumila* and *Abies veitchii* in the central part of Honshu, on sunny, rocky slopes in subalpine and alpine regions from 1800 m to 2800 m (5900 to 9000 ft). I consider var. *tetramerum* as an alpine form of *R. tschonoskii*. It blooms from July to August in its native habitat in Japan. This variety is recognized in Japan; however, some references that I found in English literature include this variety in var. *tschonoskii*.

Rhododendron tschonoskii var. *trinerve* (Ookome Tsutsuji): Similar to var. *tschonoskii*, its leaves and flowers are slightly larger in size. In fact, "Ookome Tsutsuji" means "Large Rice Azalea." It grows from 1 to 1.5 m (3 to 5 ft) tall with a well-branched structure. It occurs on the western side of central to northern Honshu where heavy snowfall is recorded. It grows on the edges of thickets of *Abies veitchii* and *Fagus crenata* or in subalpine regions on the western side of central Honshu (Akita to Shiga prefecture) from 700 m to 2200 m (2300 to 7200 ft).

R. tschonoskii var. tetramerum. No photo credit.

There are three prominent lateral nerves on the lower surface, compared to four to five less prominent lateral nerves on var. *tschonoskii*. In fact,"trinerve" means three nerved. The leaves are 1.5 to 4.5 cm (0.6-1.75 in) long and 0.7 to 1.5 cm (0.28-0.6 in) wide, which make them the largest leaves among the three varieties. Both the surface of the leaves and the margin have adpressed hairs.

Its white, broadly tubular to funnel shaped flowers are 5-8 mm (0.2-0.3 in) long and 1 to 1.2 cm (0.4-0.5 in) wide with four lobes (rarely five lobes) and four stamens (five stamens if five lobed). The lobes are 4 to 6 mm (0.16-0.24 in) long, which make them longer than the corolla tube. A single bud produces three to eight flowers. The length of the stamens exceeds the corolla. The pedicels are the longest compared to the other two varieties, reaching 0.4 to 1 cm (0.16-0.4 in) long.

R. tschonoskii is one of the hardiest evergreen azaleas and reported to be hardy to -15⁰ F (-26⁰ C). It grows well in morning sun or partial shade in well-drained soil, but if planted at a young age it is best to place a cage around it for protection from rabbits.


R. tschonoskii var. *tetramerum.* No photo credit.

Rhododendron tsusiophyllum

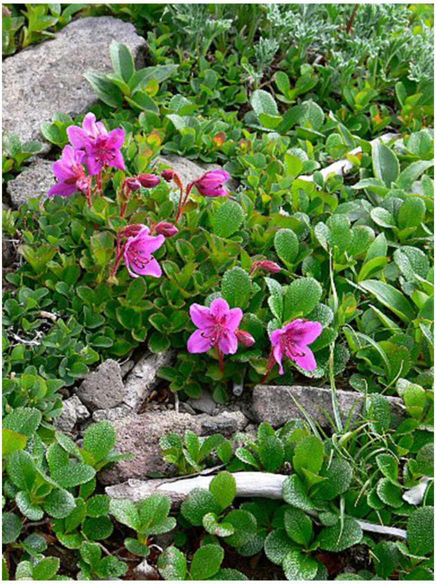
Rhododendron tsusiophyllum is a dwarf evergreen azalea that is native to the island of Honshu in Japan. It grows in eastern Honshu from Kanagawa to Saitama, as well as adjacent islands such as Mikura Island of Tokyo prefecture. The height of a mature plant is only 20 to 60 cm (8-24 in) tall. In the wild, it occurs on rocky slopes, where it has a prostrate growth habit. It was formerly considered as a different genus, *Tsusiophyllum tanakae*, due to the three-locular ovary and anthers that dehisce vertically. However, Japanese botanists reduced this monotypic genus to *Rhododendron* in 1956. A DNA study completed by Japanese botanists supports this placement. It is now a member of subgenus *Tsutsusi,* section *Tsutsusi*, which contains all the evergreen azaleas from East Asia.

Rhododendron tsusiophyllum branches out well, and the stem and monomorphic leaves are heavily covered with long, adpressed rust-colored hair, which is attractive up-close, giving an overall silky-brown impression to the plant. Alternate, obovate leaves are 7 to 10 mm (0.28-0.4 in) long and 4 to 6 mm (0.16-0.24 in) wide. They are thick in texture and have entire margins with hairs. When the leaves mature, they lose some of the hair on the upper surface; however, the lower surface retains the rusty-colored adpressed hair, especially along the veins. The petioles are inconspicuous.

Its pink buds open to white, tubular-campanulate flowers, which are also thick in texture and 8 to 10 mm (0.32-0.4 in) long with a 6 mm (0.25 in) tube. The inflorescence is one to four flowered. The corolla is shallowly dissected into four to five lobes. The pedicels are very short (1 to 3 mm, 0.04-0.12 in) but with heavy rust-colored hairs. The calyx is inconspicuous. The petals are pubescent externally. The five stamens have hairs on their lower half. The ovary is densely strigose with a glabrous style. It blooms from June to July in Honshu, Japan.

The RSBG has a single accession (from 1976) of *R. tsutsiophyllum* that is only 60 cm tall. This dwarf species grows well for us in the Pacific Northwest in well-drained soil and bright shade. It is another species suitable for bonsai.

Rhododendron camtschaticum



R. camtschaticum. No photo credit.

This unique rhododendron is one of two members of subgenus *Therorhodion.* In fact, *Rhododendron camtschaticum* was considered as a different genus in the past, as *Therorhodion camtschaticum*. This species has gone back and forth between the two genera; however, it is now placed in genus *Rhododendron* although it is not related to any rhododendrons outside this subgenus. It occurs in the USA (S. Alaska and Aleutian islands), Japan (N. Honshu and Hokkaido), and the Russian Far East. There are two subspecies that are recognized: subsp. *camtschaticum*, and subsp. *glandulosum* with narrower corolla tubes.

R. camtschaticum is a prostrate, deciduous shrub that grows up to 20 cm (8 in) tall. It spreads by underground suckers. It prefers windy conditions in subalpine and alpine zones with cool summers.

Another member of the subgenus, *Rhododendron redowskianum,* is perhaps really just a compact form of *R. camtschaticum* with shorter and narrower leaves. However, *R. redowskianum* occurs only in Manchuria, not in Japan. Both *R. camtschaticum* and *R. redowskianum* share an interesting characteristic, which is that the flower buds are produced on the current year's growth, not the previous year's growth as with other rhododendrons.

Rhododendron camtschaticum subsp *camtschaticum*: The elliptic to obovate leaves are 2 to 5 cm (0.8-2 in) long and 1 to 2 cm (0.4-0.8 in) wide. Stems and leaves on both surfaces are covered in mostly eglandular hairs, but glandular hairs can also be found. The margin is entire and also fringed with eglandular hairs. The leaves are sessile, meaning they lack petioles. The fall color can be yellow, orange, or red, and is quite stunning.

The corolla sits on erect, hairy pedicels that are 1 to 5 cm (0.4-2 in) long. The rotate or funnel-shaped flowers are 2 to 2.5 cm (0.8-1 in) long and 2.5 to 3.5 cm (1-1.4 in) across. It is one to three flowered. The corolla is rose-purple or pink-purple with red tones, but rare white specimens also exist. The upper three lobes have dark reddish spots and are fused together at the base, but the lower two lobes are not. The outer surface of the corolla is pubescent and the margin is fringed with hairs. It has a large, oblong calyx, which is very distinct and leaf-like, and is 0.8 to 2 cm (0.3-.8 in) long and with glandular hairs. Ten stamens that are not equal in length can be found, and they do not exceed the length of the corolla. It blooms from July to August in Japan. This subspecies occurs in Japan (Hokkaido and Northern Honshu), Russia (south and east of Kamtschatka, and Kuriles Islands), and USA (Aleutian Islands and southern Alaskan coast).

The Japanese name for this plant is "Ezo Tsutsuji", which means "Hokkaido Azalea". It was named after the location where this species was first discovered in Japan.

Rhododendron camtschaticum subsp. *glandulosum*: This subspecies has a leaf margin with glandular hairs, whereas subsp. *camtschaticum* has mostly eglandular hairs. The corolla tube is somewhat narrower and is glabrous, unlike subsp. *camtschaticum*. The corolla margin does not have hairs. It grows only up to 10 cm (4 in) high.

This subspecies is known to occur in the foothills of the Kigluaik Mountains, which are located on the western tip of Alaska, and also in Siberia.

Rhododendron camtschaticum prefers areas with cool summer where the roots do not get hot. At the RSBG, they are planted at the bottom of the alpine garden where they have afternoon shade. Another patch grows at the top of the garden where it is quite exposed, but to our surprise, it seems to be quite happy and blooms every year. I have heard of the use of *R. camtschaticum* as a groundcover in northern Germany as it grows marvelously there. Now that is an extremely choice groundcover, I would say!

Accessions in the Collection of the RSBG:

Rhododendron semibarbatum

1975/077	Wakehurst.
2016/288	RSF seed.

Rhododendron nipponicum

1973/193	University of British Columbia Botanic Garden.
1999/425	YK#0355, Kurashige. Grown from wild-collected seed from Tanigawa-dake, Gunma, Honshu, Japan, 3640'.
2017/332	RSF seed.
2017/345	RSF seed.
2017/360	RSF seed.

Continued on next page.

Rhododendron tsusiophyllum

1976/353	Suzuki.

Rhododendron tschonoskii

1977/211	Caperci.
2010/057	Ishizaki. Grown from wild-collected seed from Mt. Hisawa, W Gunma, Japan, 1000 m.
2014/043	Ishizaki. Grown from wild-collected seed from Gunma, Japan.

Rhododendron tschonoskii* var. *trinerve

1998/034	YK#0367, Kurashige. Grown from wild-collected seed from Mt. Makihata, Niigata, Honshu, Japan, 2115’.
1998/116	YK#0367, Kurashige. Grown from wild-collected seed from Mt. Makihata, Niigata, Honshu, Japan, 2115’.
1998/189	YK#0367, Kurashige. Grown from wild-collected seed from Mt. Makihata, Niigata, Honshu, Japan, 2115’.
1998/256	YK#0367, Kurashige. Grown from wild-collected seed from Mt. Makihata, Niigata, Honshu, Japan, 2115’.

Rhododendron camtschaticum

1973/054	University of British Columbia Botanic Garden.
1977/080	Granston.
1977/624	Berg, W.
1999/033	Sinclair. Red Form.
2016/259	RSF seed.
2016/276	Sinclair.
2016/293	Sinclair.

The RSBG currently does not have *R. uwaense* or *R. boninense* in our collection. Clearly, we need to work on acquiring wild-collected seeds of all the species listed above so we can increase the representation of these species.

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