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Contents

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From the Editor

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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 second issue of *RI* consists of two parts: Part 1 continues with submissions from countries having rhododendrons societies, while Part 2 initiates the reprinting of articles from the world's rhododendron societies or organisations that are deemed to have international relevance, and as such, should be more widely distributed.

The reason for Part 1 here is that in *Rhododendrons International* Vol 1 (2016), the article on the American Rhododendron Society (ARS) mentioned that there were chapters of that society in a number of other countries, specifically Canada, Denmark, Finland, India, Scotland, and The Netherlands, and so a decision was made not to also include in that volume articles from the national societies in those countries, in part because of space limitations (the volume was already very large, consisting of three parts) but also because some of the rhododendron activities in these countries were already partially described in the ARS article. While intentional at the time, it was however recognized that this did a disservice to the consideration of rhododendron-related activities in these countries, and so the plan was that in Vol. 2, the histories of rhododendron organisations in these other countries would be included. The exception was with Sweden, which although it also has an ARS chapter was included in RI Vol 1, as it had both a rhododendron society that was associated with the ARS (the South Swedish Rhododendron Society) and one that was not associated (the West and East Divisions of the Swedish Rhododendron Society). So, RI Vol. 2 has articles, in alphabetical order, from Canada, Denmark, Finland, India, Scotland, and The Netherlands.

Rhododendrons International Vol 2: Part 2 includes three articles modified slightly from those printed initially in *The Rhododendron*, a joint publication of the New Zealand Rhododendron Association and the Pukeiti Rhododendron Trust, and later in the journal of the American Rhododendron Society. It also includes two articles from *Rhododendrons, Camellias and Magnolias*, a publication from one of the RHS Groups. In future issues, I will search in publications for other worthwhile rhododendron articles deemed to be of international significance, and will also welcome submissions from authors of such material that I might not be aware of.

Maintaining a National Collection of Vireya Rhododendrons

Louise Galloway and Tony Conlon
Edinburgh, Scotland

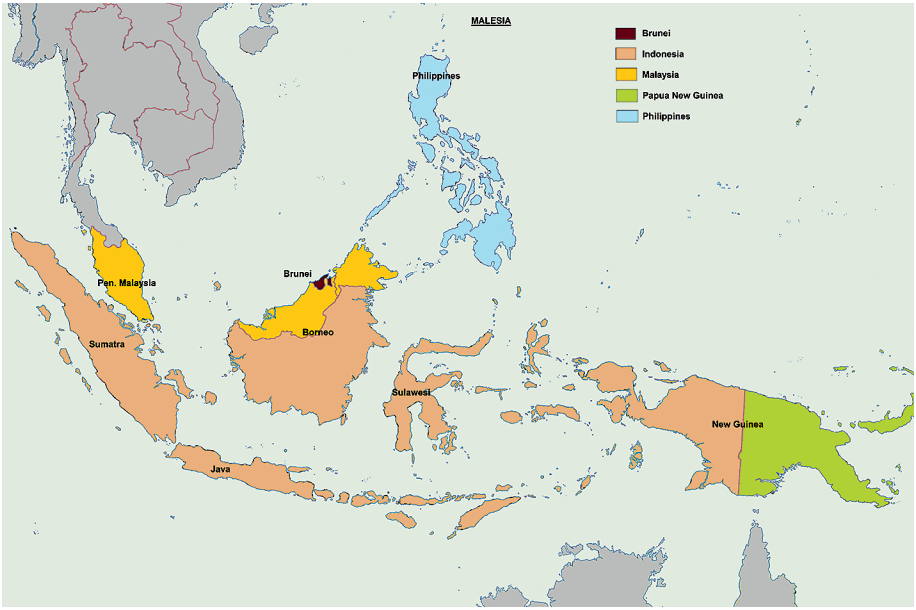
(Reprinted from Rhododendrons, Camellias & Magnolias *2017, 116-125.)*

Louise Galloway

Tony Conlon

The Royal Botanic Garden Edinburgh holds the largest cultivated collection of Vireya rhododendrons in the world, comprising two-thirds of the three hundred or so species currently described in the wild. Where possible, we keep multiple collections of each species, wild collected in different localities across their distribution range to give us a wider genetic diversity and varied

Rhododendron 'Princess Alexandra', growing epiphytically in the montane tropical glasshouse, dates back to 1865 and is one of the few hybrid Vireyas in the collection at the Royal Btanic Garden Edinburgh. Photo by Simon Begg.



The biogeographical region of Malesia is the principle habitat for *Rhododendron* species of subgenus *Vireya*.

material for scientific research. Each plant is given a unique accession number on arrival at the garden which it will keep for its lifetime, enabling us to ensure that specific collection and horticultural information stays with that plant, all of which is kept securely on our database.

Due to habitat loss, many species in the wild are threatened or endangered and this collection acts as an *ex situ* conservation resource, providing a safeguard of genetic material and protection for vulnerable species. We aim to keep three plants of each accession; if we don't have sufficient wild collected material we will take cuttings when the plant is big enough—having only one is risky, if it is damaged or dies it would be lost from the collection. If plants are particularly threatened we will keep more than the standard and in the past we have sent material back to southeast Asia. This regime has resulted in a large collection of over 3000 individual plants either on public display or within our research glasshouse.

What is a Vireya?

The term Vireya refers to rhododendrons of subgenus *Vireya* (Argent, 2006) or section *Vireya* (Craven et al, 2008), depending on which of these authorities is followed. Although there are several determining factors which render a

The moss forest at c.2000m on the Arfak Mountains, Bird's Head Peninsula, West Papua in Indonesia, is typical habitat for Vireya rhododendrons. Photo by Sadie Barber.

Vireya distinct from other members of genus *Rhododendron*, generally speaking Vireyas are defined as rhododendrons with scales whose seeds have a long tail at each end (Argent, 2015). They are distinct from many other *Rhododendron* groups in their incredibly diverse floral structure and foliage characteristics, differences which may relate to their distributional range and pollinators. Historically they have been called "Tropical" or "Malesian" rhododendrons; however, their distribution range, although predominantly within southeast Asia, extends into India, China, Nepal and northeast Australia.

The majority of Vireya *Rhododendron* species originate from the region of Malesia, a biogeographical area of southeast Asia lying between the Tropic of Cancer at 20°N and the Tropic of Capricorn at 15°S, and from about 95°E to 160°E longitude. This area encompasses Malaysia (consisting of Peninsular Malaysia and Sabah and Sarawak, the northwest third of the island of Borneo); the Philippines; Indonesia (including the islands of Sumatra, Java, Bali, Sulawesi, the Moluccas (or Spice Islands), Kalimantan (the southeastern two-thirds of the island of Borneo) and the western half of the island of New Guinea), and Papua New Guinea (the eastern half of the island of New Guinea and its outlying islands).

This region has a wet equatorial climate and varied topography, with mountains reaching almost 5000 m on some of the islands. The habitat consists of montane tropical mossy cloud forest where Vireya rhododendrons generally grow as epiphytes in trees but, when competition is reduced, they can also be found growing terrestrially on peat, sandstone, limestone, basalts, ultramafics (ie soils with a high mineral content) and in bogs. Species generally occur above 1000 m but some can grow right down to sea level, and the higher altitude species can be recorded at almost 5000 m.

History of the Collection at RBGE

The collection held at Edinburgh began in the 1950s with just a handful of Vireyas, collected on expeditions as unusual exotics of interest, although not necessarily a priority.

We still have an accession alive today of *Rhododendron zoelleri* Warb originally collected in New Guinea, which was received from Leiden University Botanic Garden in the Netherlands via the Dutch botanist Prof CGGJ van Steenis in 1955.

Rhododendron zoelleri is one of the oldest Vireya accessions in the National Collection. Photo by Tony Conlon.

Royal Botanic Garden Edinburgh has a long-standing research interest in the family *Ericaceae* but this was primarily concerned with the hardier rhododendrons. It was not until the late 1960s that two members of staff, the scientists Dr Paddy Woods and Dr Bill Burtt, were sent to bring back Vireya material from the Malay Peninsula, Borneo and New Guinea. From the 1980s (and to this day) the majority of Vireyas at the RBGE

Dr George Argent alongside part of the National Vireya Rhododendron Collection in the Research Glasshouse at the RBGE. Photo by Simon Begg.

have been collected and actively researched by world-renowned Vireya expert Dr George Argent.

The Vireyas have always been grown in the same glasshouse; they started as a small collection on one bench and have slowly taken over thirteen more, now nearly filling the entire 34 m x 12 m space, aside from some of our other high altitude ericaceous plants such as *Vaccinium*, *Diplycosia* and *Dimorphanthera*. Our public display glasshouse—The Montane Tropics House—was built in 1974 and underpins the scientific research and horticultural/conservation collections.

Dr Argent was one of the first scientists at RBGE to recognise the importance of getting horticulturists involved in collecting in the field and he has given many horticulturists the opportunity to see first-hand where the plants they are looking after grow. This provides excellent training for staff, practically demonstrating the range of skills required: keeping living material alive whilst on expedition, the importance of taking good field notes, the aftercare of collected specimens and their eventual display. This opportunity should not be underestimated as it instils passion and insight and has helped to make the collection what it is today.

The current collection is representative of most of the main island locations where Vireyas occur, with a significant number of the original accessions coming from Papua New Guinea. The collection is still on the increase, with relatively recent expeditions (some now led by RBGE horticultural staff) specifically looking for Vireyas, the most recent being carried out in 2009 and 2011 to New Guinea and Borneo. (The newly described *Rhododendron stanleyi* S.James & Argent from Mt. Yule, Central Province, Papua New Guinea is one of the latest additions.)

The unique strength of the collection, aside from its diversity, lies in its comprehensive wild collection information, data which is essential for scientific research for core and visiting scientists, and population monitoring. From a horticultural perspective, the more information gathered about where and how a plant was growing: altitude, growing medium, light levels and associated plantings for example, the easier it becomes to assimilate those conditions and cultivate and create natural-looking landscapes for public display.

The Vireya collection gained Plant Heritage (NCCPG) National status in 2007. Many species can be seen all year round on public display in our montane Tropical Glasshouse and "behind the scenes" tours can be arranged for the true enthusiast. However, due to strict access and benefit sharing restrictions, we are only able to supply a very limited amount of species to other botanic gardens or institutions for research and regrettably, none to private individuals.

Collecting wild material is becoming more challenging due to loss of natural habitat, political instability/personal safety and increasingly time-consuming paperwork and regulations. A collecting trip can take up to two years to prepare for to ensure that all documentation is in place, and even then there is no guarantee that live material will be granted permission for export back to the UK. When undertaking any collecting overseas it is essential that the rules set out by the Convention of Biological Diversity (CBD) and, since October 2014, the Nagoya Protocol are followed. Unless prior and informed consent has been given by the country of origin, plant material cannot be distributed to third parties.

Maintenance & Cultivation

Maintaining a collection of Vireyas is not difficult as long as the growing conditions are right. Vireyas are montane tropical woody shrubs, ranging in size from tiny sub-alpine plants to small trees, growing mainly as epiphytes (although they may also grow terrestrially) and consequently when grown in the UK they need to be grown under glass. Although they may come from diverse habitats (lowland subtropical forest to cloud forest to high alpine screes), over the years we have found an environmental regime which suits most species. Allowances can be made for individual plants within the glasshouse, for example by supplying additional lighting for very high altitude species such as *Rhododendron anagalliflorum*. Only truly lowland species such as *R. niewenhuisii*, which grows along lowland streams in Borneo, are grown in more tropical conditions with a night minimum temperature of 18°C.

Two plants of *Rhododendron intranervatum* display the effect of low temperatures (left) on foliage. Photo by Tony Conlon.

Temperature

Many of the species in the collection grow at higher altitudes (above 1000 m) in their native habitat and because of this the night temperatures in the glasshouse can be allowed to fall to around 8° C. However, in the tropics, although low night-time temperatures may be experienced at higher altitudes, due consideration should be given to the fact that that daytime temperatures can rise quickly once the sun has

risen, to well over 20° C during the day. Currently we have a night-time house temperature of 10° C and day temperature of 15° C, with venting set to commence at 18° C. This ideal is not always achievable in the depths of a Scottish winter. An easy indicator that plants are being grown at too low a temperature is that the leaves will redden, reverting back to green when the temperature is sufficient once more. Conversely, prolonged periods of high temperatures can adversely affect the overall health of Vireyas and should be avoided if possible.

Fine and coarse bark mixed with horticultural charcoal create a perfect free-draining compost for Vireya rhododendrons. Photo by Tony Conlon.

Compost

Due to the epiphytic nature of many of the species in the collection, we tend to use a very open compost, in fact very similar to pot grown orchids (which can often be found growing in the same natural habitats), consisting of potting bark (3–15 mm) with added horticultural charcoal (5–15 mm) at a ratio of roughly 70 litres of bark to 3 or 4 litres of charcoal. Larger grade barks and chopped cork oak can also be introduced into the mix to create a more open mix.

Rhododendron christii is an ideal species to grow epiphytically using bark and sphagnum moss. Photo by Tony Conlon.

Pots

Most of the RBGE collection is now grown in plastic pots or half pots or pans, with a recent increased use of aquatic pots and baskets to further aid drainage and good air movement around the roots, which can be particularly useful in the winter. Plants

are generally re-potted on a 3-year cycle but this can be done annually when the plants are younger. Cork barks and tree fern root sections can also be used for some of the more epiphytic species. Take a section of bark and place some sphagnum moss onto the bark as a base layer, the roots can then be gently teased out flat in order to be surrounded by the moss; the plant can then be tied on to the bark gently but securely using fishing line. Once established on the bark, the plants can stay *in situ* for a number of years, often for the lifetime of the plant.

Rhododendron anagalliflorum thrives on the damp, gravel-covered benches. Photo by Simon Begg.

Watering

Daily watering is required in the summer, delivered overhead to reflect the typical daily tropical downpours experienced in the wild, with additional damping down of benches and floors on the hottest of days to keep the humidity high, which is generally maintained around 70%, using a spray nozzle or lance. Watering can be reduced to about once a week in the winter in order to accommodate the reduction in growth, the colder temperatures and lower light levels found at higher latitudes. In Edinburgh we have soft water so we don't have to worry about calcium build-up; it has a pH of around 6.5–7 which suits the requirements of the Vireyas. The pots stand on gravel benches which are covered in a woven groundcover fabric such as Mypex® to suppress weed growth.

Feeding

Although as a general rule, Vireyas do not need large amounts of food, it can be helpful in maintaining healthy plants and to this end a general balanced weak liquid feed (NPK 1:1:1) is applied at half strength every 3–4 weeks over the summer months. As many species continue to flower over our winter period, if plants look hungry, a very mild feed can be given at any time of the year.

Propagation facilities within the research glasshouse for seed-raising (left) and cuttings (right) help to ensure a supply of back-up plants. (Note the use of *Pinguicula* as an effective sciarid fly control.) Photos by Simon Begg.

Pruning

Pruning can be carried out at any time but is not done systematically and is generally used to maintain shape as Vireyas can often be straggly and grow in a random fashion.

Propagation

Semi-ripe stem or tip cuttings are generally taken in the autumn or spring depending on requirements and the available material, and kept in a closed case with bottom heat (21° C) in a mix of propagating bark (2–7mm) with a handful of medium grade vermiculite or perlite. The cuttings should be watered/misted daily as required. Cuttings will root within 1–3 months but can require up to six months before plants are strong enough to pot on. Seed can be sown from mature capsules directly on to the surface of a small propagating bark (2–7mm) or growbark (0–6mm) which has been sterilized using boiling water. This is then covered with glass or a plastic bag to create a stable microclimate. Light is needed for germination so the seed should not be covered. The pots can be placed in a case with bottom heat if available. Seedlings once germinated will often sit for a year and these tend to be kept in a more open case for a further year until they are ready to be potted on.

We have an ongoing programme of propagation which hopefully ensures the survival of the collection for future generations and further research programmes.

Lighting/Shading

Considering the high light levels experienced in the tropics, particularly at higher altitudes, additional lighting can be beneficial in the northern

The diversity of flower forms among Vireya rhododendrons held in the National Collection
(From left to right) Top row: *Rhododendron anagalliflorum, R. blackii, R. christii.*
Second row: *Rhododendron ericoides, R. himantodes, R. jananicum* ssp. *kinabaluense.*
Third row: *Rhododendron javanicum, R. lamrialianum, R. leptanthum.*
Fourth row: *Rhododendron malayanum, R. meijeri, R. meliphagidum.*
Bottom row: *Rhododendron phaeochitum, R. stenophyllum* ssp. *angustifolium, R. suaveolens.* Photos by Sadie Barber.

Vireya rhododendrons are the most dramatic species in the genus, bringing exotic colours, form, fragrance and textures not found among the temperate species. (Top left) *Rhododendron javanicum;* (Top right) *Rhododendron gardenia;* (Bottom left) *Rhododendron herzogii*; (Bottom right) *Rhododendron crassifolium.* Photos by Tony Conlon.

hemisphere, particularly in the winter in order to compensate for the generally higher tropical light levels found in nature. However, it should be remembered that some species grow in cloud forest and in the midst of the forests themselves where light levels can be much lower and therefore consideration must also be given to extra shading. This is particularly true in the spring and summer (when new growth can be susceptible to scorching) in northern climes where the further north one is, the longer and higher the light levels can be in the summer.

Deadheading

Deadheading is also recommended so that energy is not diverted to fruit production, unless, of course, seed is required. This can also encourage repeat flowering in some species. Deadheading is also incredibly beneficial to dislodge any pests that hide and feast on the growth just below flowers.

Rhododendron aurigeranum, from New Guinea, has been much used in hybridising. Photo by Tony Conlon.

In our experience, the Vireyas are generally pest free if well monitored; however, some pests can cause problems if left unattended. The most common are mealy bug, aphids and vine weevil, which can distort leaves and flowers and reduce the overall health of the plant. Vine weevil can be particularly damaging to cutting material and young plants, often killing them outright, but can be kept at bay with bi-annual treatment using nematodes. Chemical use is kept to a minimum and used as a last resort, the preferred option being a programme of integrated pest management, using bio-control where possible, along with good husbandry and hygiene—good strong healthy plants are less susceptible to pests and diseases.

Growing Vireyas at Home

A small, compact hybrid would be the best Vireya to start with if you are interested in growing vireyas at home, ideally in a conservatory or greenhouse but an east or west-facing windowsill is fine.

Vireyas are less tolerant than other houseplants of the dry atmosphere more

prevalent in the home setting, especially over the winter if you have the central heating on, but can be placed on a small water-filled gravel tray to increase humidity—take care not to overfill the tray so the pot is not sitting in water. They require a free-draining compost and prefer to dry out a little between each watering; they will generally not tolerate standing in water as they can be prone to root rot, especially if high temperatures are maintained (ie over 25°C).

In many situations Vireyas could be grown outside from May to September and brought in for the colder months.

Give a weak, balanced feed regularly whilst the plant is in growth and any time of year if it looks "hungry"—if the leaves look paler than usual. Re-pot every one to two years, younger plants may need potting-on every year, as they mature this can be reduced, Vireyas do not like to be over-potted so if you place your rootball into the new pot you should aim for a 2.5 cm (1 inch) gap all around the plant to the edge of the pot to be filled with new compost.

Troubleshooting

Check for pests regularly as this will affect the overall health of your plant, Vireyas can be susceptible to mealy bugs and aphids and sometimes scale, treat early by physically removing the pests if possible, only use a pesticide as a last resort.

If your plant starts to have a greyish look about it or begins to lose texture, the chances are you have a root rot problem. Unfortunately, even if you catch this early on, it may be too late, and propagation may be the only way to keep the plant going. Take cuttings and rehydrate them in water for a couple of hours before treating with rooting hormone and potting into a fine bark/perlite mix and placing in a propagator with some bottom heat.

Conclusion

If given the correct conditions, many Vireyas are easy to grow and with the right care can give you an excellent show of flowers throughout the year.

Some of the more unusual but relatively easy plants that may be available are *Rhododendron rugosum*, *R. jasminiflorum* and *R. rousei* but hybrids are generally more robust plants and often flower more uniformly and for a longer period. The hybrid 'Lucie Sorensen', for example, is a very floriferous free-flowering cultivar. Vireyas are sometimes best grouped as quite often only half the plant or even one branch can be flowering at any one time.

The best time to see the RBGE Collection is from March to April. The Vireyas are on display in one of our ten public display glasshouses, along

with other members of the *Ericaceae* family (*Agapetes, Diplycosia, Dimorphanthera, Gaultheria* and *Vaccinium*) and other plants from southeast Asia, grouped to create as naturalistic a planting as possible; a small slice of southeast Asia in Scotland.

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Louise Galloway is Glasshouse Supervisor at the RBGE with joint responsibility for managing staff and curating the collections. During her career, she has been part of several plant hunting expeditions to SE Asia and most recently Tanzania to bring back living material to RBGE for scientific research.

Tony Conlon is the horticulturist responsible for Vireya Rhododendrons at the RBGE.

Editor's note: This article was reprinted with the same wording as published initially. It needs to be pointed out, however, that many others disagree with the systematics for vireyas that the author's mention, with many recogniizing that vireyas are in subgenus *Rhododendron* section *Schistanthe*, based on a more recent scientific article that the authors failed to include (Craven et al. 2011).

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Notes from the International Rhododendron Registrar 2016

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(Reprinted from Rhododendrons, Camellias & Magnolias *2017, 155-158.)*

Although the number of new registrations emanating from Japan is never very large, they often comprise rather special and unusual plants. Amongst them this year is what I believe is a first for our records—a hybrid involving *Rhododendron tsusiophyllum*. This was bred and registered by Masaru Hatori and involves a *tsusiophyllum* × *indicum* hybrid backcrossed to *R. tsusiophyllum*. It has been called 'Akabana-Hakone' and produces numerous small, red, tubular-campanulate flowers in late June to early August, on a small-leaved, wide-spreading bush, recorded as 30 x 40–60cm after 25 years. *Rhododendron*

Rhododendron 'Akabana-Hakone' is the first *R. tsusiophyllum* hybrid to be registered. Photo by Masaru Hatori.

tsusiophyllum typically has flowers pink in bud which fade to white on opening, and whilst now placed in section Tsutsusi, was formally treated in its own genus, *Tsusiophyllum*.

Rhododendron 'Monika Heger'. Photo by Karl Hübbers.

There have been 93 other registrations to date this year and the names of 29 other species have been mentioned in their parentages. There are no prizes for guessing the most used species; this remains the ever-popular *Rhododendron yakushimanum* (*R. degronianum* subsp. *yakushimanum*) and the only other species to be mentioned more than once are *R. brachycarpum*, *R. fortunei*, *R. dichroanthum* and *R. kiusianum*. The range across the spectrum of the genus is also familiar, with 63 elepidotes, five vireyas and two other lepidotes, fifteen evergreen azaleas and nine deciduous azaleas. This year also sees the continuing trend for fewer plants being named in North America (29 this time), but more coming forward for registration from Europe which has contributed 56 new names to the Register. A significant proportion of these on this occasion have come from the Czech Republic, where Michal Severa has undertaken quite a tour de force in drawing together the details of a wide range of plants raised over the last few decades at the Silva Tarouca Research Institute for Landscape and Ornamental Gardening. These have been derived from crosses made by a number of breeders, most notably Alena Nekolová and Ivo Tábor, and represent a mixture of new evergreen azaleas and elepidote hybrids.

Regular readers of these notes will recall my enthusiasm for double-flowered rhododendrons and at least three more have emerged in this year's crop of new registrations. Two derive from the breeding work of Shigeo Saitō in Japan and involve *Rhododendron yakushimanum* hybrids with double-flowered variants of both *R. degronianum* subsp. *heptamerum* and *R. brachycarpum*. 'Ai' was registered by Yoshiaki Takagi, whilst 'Keijun-no-mai' came to us from Masaki Asami. Both have deep pink buds, which in the case of 'Ai' open to an unmarked bright pink and have flowers with 10–15 lobes. In 'Keijun-no-mai', however, the deep pink buds also open to deep pink, but the outer lobes shade out to almost white and the flowers are very tightly double, with up to 50 lobes, the

central ones small and tightly clustered in the centre. Both have leaves with a dense indumentum below which is brownish on mature leaves, but paler when young. The third double is 'Monika Heger', registered by Julia Westhoff on behalf of its German breeder Klaus Heger, who has named it after his wife. This is a hybrid between the *R. parmulatum* selection 'Ocelot' and the double-flowered 'Weissenburg', the latter deriving its double-flowered character from 'Whitestone', whose parentage is sadly not recorded, but which was crossed with a dwarf *R. yakushimanum* to produce 'Weissenburg'. The flowers are held in loose ball trusses and open from deep pink buds to a pale yellow, with deep pink margins, the ten fully petaloid stamens have a more extensive development of the deep pink colour and are loosely clustered in the centre of the flower.

Other new registrations which caught my eye included the diminutive 'Little Lotsky', a vireya cultivar bred by Andrew Rouse in Australia from a cross involving *Rhododendron macgregoriae*, *R. rubineiflorum* and *R. anagalliflorum*. It is a little poppet, making only 20 x 25cm in fifteen years and bearing out-facing, tubular-funnel-shaped, white flowers with contrasting pink stamens and pink pedicels. "Lotsky" was the registrant's name for his daughter when she was a young girl.

From the list of North American additions, I particularly liked Don Wallace's 'Marshmallow Magic', a striking picoteed flower held in good domed trusses, the strong purplish-pink edges contrasting with a white ground and with a greenish-yellow glow in the dorsal throat. This is a complex elepidote hybrid raised in California, involving 'Naselle', 'Malemute' and 'Yellow Rolls Royce' on the seed parent side, crossed with a 'Wizard' × 'Polka Dot' derivative.

Rhododendron 'Little Lotsky'. Photo by Andrew Rouse.

Rhododendron 'Marshmallow Magic'. Photo by Don Wallace.

Jim Barlup's new hybrids *R.* 'Wind Dancer' (left) and *R.* 'Night Melody' (right). Photos by Jim Barlup.

There were also a further fifteen new registrations from Jim Barlup, all plants with good-looking trusses, of which I was particularly taken by 'Wind Dancer' ('Cimarron Sun' × 'Capistrano'), which has essentially white flowers with a large dorsal blotch of red spots; 'Night Melody' ('Purple Twilight' × 'Black Widow') with tight trusses of almost blackish-red flowers with contrasting white anthers; and 'Rose Dancer' ('Violet Mist' × 'Plum Passion'), also with

tight trusses, this time of reddish-purple to reddish-pink flowers, with a strong blackish spotted blotch, wavy-edged lobes and contrasting whitish stamens and style.

Of the European additions I would pick out Karl Hübbers' 'Hania' ('Rosilac' × ('Peucine' × 'Desert Gold')) whose very open-faced, seven-lobed flowers are of a delicate pinkish-yellow, opening from darker pink buds and having a dark red, deeply set blotch. These are of course all personal choices and there are many other fine plants amongst this year's crop of registrations.

The past year has seen a variety of additions and improvements to the database, including the addition of the probable ploidy level (chromosome number) of over 120 widely grown cultivars, as established through flow cytometry, work which had earlier been published by Perkins *et al.* in the 2012 Yearbook. I have also been working through the individual cultivar accounts in Jozef Heursel's 1999 work *Azalea's*, which is a mine of information on evergreen azaleas cultivated in Europe, and as a result I have been able to add many new entries to the Checklist and additional information to existing entries. This coming year should also see a significant step forward in our coverage of another group of evergreen azaleas, the Satsukis. Whilst we have had some coverage of these, derived from sources such as Galle's *Azaleas* (1987) and various editions of the Japanese Satsuki Azalea Dictionaries, it has been frustrating that much additional information has evidently been listed in the Dictionaries, but I have been unable to translate the Japanese text. I am delighted to say that

Karl Hübbers' recently registered *Rhododendron* 'Hania'. Photo by Karl Hübbers.

the RHS has now agreed to fund a translation of significant parts of the text and this work is currently being undertaken by Yoko Otsuki in Oxford. Yoko has previously assisted us in checking the consistency of the transcriptions of many of the epithets applied to these cultivars, and it is exciting now to look forward to having better information on parentages, raisers and dates. She will also be supplying us with data on a large number of new cultivars which have appeared for the first time in the most recent edition of the Dictionary.

There are also two developments on the administrative side of registration which need to be brought to the attention of any prospective registrants.

In order to comply with legislation we have had to revise our registration form to include information about what we do with your "personal data"; in other words, your name and address. For any living individual we need to explicitly request permission to list their name and address on the database and to use it in reports. In fact in recent years we have never made public any more than an abbreviated address and whilst the new requirements do make the registration procedure a bit more complicated (and the form gets even longer!), we hope that all future registrants will feel comfortable in giving their formal permission for the use of this data. It would materially diminish the value of the Register and Checklist if we had to start filling accounts with "data withheld" notices when it came to listing this sort of information. There is nothing new we are going to do with this data, nothing to fear from its inclusion with information about the plants concerned. No such strictures apply to deceased individuals or to nurseries or those involved in such commercial undertakings, but registrants will also be asked to ensure that any other individuals they mention on the form have also given the relevant permissions. This all means that if you have old copies of the form saved up for future registrations, then please get rid of them and get hold of the new version!

The second administrative element is to say that the RHS is working on producing a fully electronic registration form that can be completed and returned on line. This is proving quite complex to devise, as we are trying to come up with a form that will service all our eight International Registers, but if all goes well we should have this in place later this year. In whatever form they arrive, I am always pleased to hear about any additions or corrections to existing accounts on the International Register and Checklist, as well as to receive any request to register new names.

Alan Leslie has been the RHS International Rhododendron Registrar since 1983 and was responsible for the compilation of The International Rhododendron Register & Checklist published by the Society in 2004. He is currently secretary to the ISHS Special Commission for Cultivar Nomenclature and a member of the IUBS International Commission for the Nomenclature of Cultivated Plants.

A Project to Develop an *ex situ* Conservation Plan for Rhododendron Species in New Zealand Collections

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(Modified from The Rhododendron *4, 2016: 26-27, a publication of the NZRA and the Pukeiti Rhododendron Trust)*

An exciting recent development for *Rhododendron* in New Zealand is the initiation of the project "Develop-ment of an *ex situ* conservation plan for *Rhododendron* species in New Zealand." The project is being led by the author (and a project team, which is still under development), with Pukeiti Rhododendron Trust as lead sponsor, and in association with New Zealand Rhododendron Association. The purpose of this short communication is to describe the first stage of the project (data collection and analysis, and development of a proposed plan) and outline how collection holders can be involved, if they wish to do so.

Rhododendron species conservation is a topical issue, following the recent international conservation assessments of the genus (Gibbs et al. 2011; Argent 2015) in which 715 of 1215 species were deemed to have some form of conservation problem. These species are referred to as Red List species and are assigned to a Red List category based on an assessment of the status of the population and the level of risk in the wild (assessment criteria are found in Gibbs et al. 2011). Categories are, with decreasing level of severity: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, and Least Concern (for species deemed to have no conservation issue). Following a conservation assessment, *ex situ* conservation is the approach where species are conserved in cultivated collections (Blackmore et al. 2011; Rae 2011), with Target 8 of the Global Strategy for Plant Conservation stating that 75% of Red List species should be in cultivation

R. sanguineum subsp. *sanguineum* var. *haemaleum,* with some magnolia leaves (at Edinburgh Botanic Garden), a Least Concern species from China that is not yet located in cultivation in New Zealand.

R. hyacinthosmum (at Edinburgh Botanic Garden), a Least Concern species from Papua New Guinea, which is found at a few sites in New Zealand.

by 2020 (IUCN 2011; Sharrock et al. 2014). A recent analysis found that 56% of Red List *Rhododendron* species are in cultivation, although some have very limited representation (MacKay & Gardiner 2016); it is important to know which Red List species are in cultivation and to propagate and distribute those that are in limited locations. Knowing that New Zealanders are keen plant collectors (NZRA 2003), with New Zealand collecting expeditions often gathering different material to that of Northern Hemisphere expeditions, New Zealand collections may be of interest for *Rhododendron* conservation.

The overall aim of the project outlined in this article is to develop an *ex-situ* conservation plan for *Rhododendron* in New Zealand, with national coverage, and which will include elements such as:

- Identification of priority species for propagation, focussing on rare species (those assessed as threatened in their native habitat by the conservation assessments (Gibbs et al. 2011; Argent 2015)), or, those held in limited collections in New Zealand.

- Identification of key collection sites in New Zealand, and identification of priorities for further collection development at a national scale.

- Determination of collection roles, for those collections that wish to participate in the project. For example, certain collections may agree to hold certain sections of the genus that suit their climate zone.

- A proposed programme of propagation and dispersal among participating sites.

Achieving these outcomes relies on data—knowledge of which species are in which collections, where, how many, and of what source (wild-collected material being particularly important, to represent the wild species (Blackmore et al. 2011; Rae 2011))—so data collection and analysis is the main activity of this first phase of the project. The author has an existing database on *Rhododendron* species, built up over several years, which contains data such as: species in commercial trade in New Zealand over several years, species in about 20 New Zealand collections (including contributions from several Pukeiti and NZRA members); species in cultivation at Edinburgh and Kew in 2013 and 2015 (RBGE 2013, RBGK 2015); species in cultivation in about 1400 botanic gardens world-wide as recorded by Botanic Gardens Conservation International in 2013 and 2015 (BGCI 2015); the presence

R. suoilenhensis, a Red List species (Data Deficient) from Vietnam, for which there is wild-collected material in New Zealand.

R. taxifolium, a Red List species (Critically Endangered) from the Philippines, for which there is wild-collected material in New Zealand.

of wild-source accessions in New Zealand or in the international collections that were examined; the conservation assessment for each species (Gibbs et al. 2011; Argent 2015); and geographic origin and taxonomic data for each species (Chamberlain et al. 1996; Fang et al. 2005; Gibbs et al. 2011; Argent 2015). These data provide a strong basis for analysis; however, they do not cover all New Zealand collections, and there are other international collections that would strengthen the international part of the analysis.

To this end, the research team will be working with five to seven additional New Zealand collections, and two international collections to expand the data set (gathering data on presence of species, and the source of the accessions). The new combined data-set will be analysed with respect to presence in collections of Red List species, groups of species from relevant geographic origins, and groups of species from the various taxonomic groups within *Rhododendron*. The distribution and characteristics of collections will also be analysed, to determine those collections which contain the aforementioned groups of species. From this analysis key sites and species in New Zealand will be identified.

An important element of the analysis is that privately owned collections (where owners have provided us with unpublished collection data) are not named in the aggregate analysis, and will not be named in any publications or reports. (Publicly owned collections may be named, with agreement from the collection owner. Collections which have publicly available online databases will be appropriately cited in any publications.) Because the aggregated data set has many components, individual collections are not "visible" in the data summaries that are generated by the analysis. Collection holders should also note that collections will only be identified in the data set by a code number, and the codes will not be disclosed beyond the research team (even members of the project team who have contributed data may not know the code assigned to their own collection). For those collection holders who require a more formal arrangement in relation to data, a Memorandum of Understanding has been developed—this would be signed by the Head of Institute of Agriculture and Environment at Massey University (to represent the author as holder of the database) and the collection holder. Should it transpire that your collection contains important species that the analysis indicates should be propagated, the author will contact you and seek your permission for any further action in that regard.

Returning to the analysis, once that is complete the knowledge gained will be combined with a literature search on best practice for *ex situ* conservation; the two components will be used to propose an *ex situ* plan for *Rhododendron* in New Zealand (containing the elements described in paragraph three), which will be published in due course. This first phase of the project will be conducted from late 2016 to about

mid 2018; for much of that time the project will involve "behind the scenes" work by the author and the project team as the data gathering and analysis takes place. As the project progresses there will be several opportunities for collection holders to be involved if they wish to participate. Some of these include:

- Collection holders contributing data on their own collection;
- Using their expertise to identify plants in other collections and assisting the owner with documenting and reporting the collection;
- Noting and reporting wild-source plant material;
- In due course (once priorities have been identified), gathering propagation material and propagating priority species, and assisting with dispersal of that plant material to designated sites.

The New Zealand project will get underway from October 2016, and the author would be pleased to hear from any collection holders who are interested in participating. We of the project team think this is an exciting project, which we hope will make a useful contribution to conserving *Rhododendron* species in cultivation, and we look forward to working with you on this initiative.

Postscript: While the project described here focuses on New Zealand, our approach to development of an *ex situ* conservation plan could also be applied in other countries. Key elements are (i) development of a national data-set of species, (ii) preliminary analysis of national holdings in relation to species in cultivation world-wide (e.g. MacKay et al. 2017) and (iii) use of the analysis to target additional data gathering and to develop an *ex situ* strategy (which is our current project). We encourage others to analyse *Rhododendron* collections in their own countries; with the ultimate aim of developing an international programme for *ex situ* conservation for *Rhododendron*.

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A Summary of Twenty Years in the Field Searching for Wild Rhododendrons

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(Modified from an article published in The Rhododendron *4, 2016: 18-23, a publication of the NZRA and the Pukeiti Rhododendron Trust)*

One of my responsibilities as Curator of the Rhododendron Species Botanical Garden (RSBG) is to build and develop the plant collections, primarily, the *Rhododendron* species collection. This provides me with opportunities to travel to some of the most remote, difficult and beautiful wild places on the planet since the majority of species *Rhododendron* occur in the mountains of southeastern Asia and south into the islands of the Indian and south Pacific oceans. The areas with the greatest concentrations of species are also those areas that have been the most thoroughly explored by the early plant hunters such as George Forrest and Frank Kingdon Ward, as well as by modern plant hunters in the late twentieth and early twenty-first centuries. These are well travelled regions with names familiar to all who study such things—Yunnan, Sichuan, Tibet, Taiwan, etc. Although most of the rhododendrons native to these regions have probably been "discovered" and are now well-known and widely cultivated, we are still finding new species even in these well-documented regions.

I have been lucky to have travelled widely in these regions during the course of my career and have learned a great deal from these experiences. Over the past few years, however, I have been focusing on some of the "fringe" areas of "rhododendron-country," i.e., regions away from the primary hunting grounds that contain far fewer species and of which we often have very little knowledge. A small sample of these would include places like Vietnam, Arunachal Pradesh in NE India and the provinces of Guangxi, Anhui and Guizhou in China. The

R. titapuriense.

rhododendrons native to these regions are relatively little-known and many have not been introduced into cultivation. In addition, many of these poorly documented species are rare and extremely vulnerable to extinction due to their tenuous existence as very localized and isolated populations that are under extreme pressure from human activities. Indeed, many are restricted to a single mountain.

For the purpose of this article, I will not discuss the many interesting areas and the plants found in them that have been well-documented in the past, such as Yunnan, but will instead focus upon some of the rhododendron highlights from the "fringe" regions of rhododendron distribution. In Arunachal Pradesh in the Indian Himalayas, for example, probably well over a dozen new species have been found in the past 15 years or so, including several big-leaf species in the Falconera and Grandia subsections. Most of these have yet to be scientifically described and named although a massive tree species recently found by Ken Cox has been named by him as *R. titapuriense*. This species has pure white flowers and a dense reddish-brown indumentum on the lower surface of the leaves. It is quite distinct from any other species and seems to inhabit only a single valley. It grows to around 100 ft (30 m) in height and may be the largest-growing rhododendron in the world. Another new big-leaf has been named *R. mechukae* A.A.Mao & A.Paul (2013) and is listed as critically endangered, with a small population limited to the type locality. A few other new big-leafs have also been found recently, as well as some interesting lepidote

species. It may be many years before we have enough information on these new species to have proper descriptions and names.

Several exciting new species have recently been introduced from Guizhou and Guangxi Provinces in SW China, including a few members of subsection Fortunea which will almost assuredly become widely-grown and well-known garden plants as they are dispersed more widely into cultivation. Among these are *R. glanduliferum* with very large, somewhat hairy leaves and large, white or pink, fragrant flowers in mid-summer, as well as its close relative *R. magniflorum* that appears to be *glanduliferum* on steroids, reportedly having much larger foliage and flowers. A few years ago while exploring in the southern Chinese Province of Guangxi, we also managed to find the long known but never introduced *R. faithiae,* which is known from only two extremely isolated mountains. This species has large smooth foliage with a cordate leaf base and an undulate margin and is somewhat similar in appearance to *R. hemsleyanum*

R. glanduliferum. Baravalla.

R. glanduliferum PW#041.

(native far to the north in Sichuan). Like this species, *R. faithiae* should have large fragrant white flowers in summer.

Another enigmatic species, this one native to northern Vietnam and adjacent southern Yunnan, has been called *R. hemsleyanum* affinity, *chihsinianum*, and *serotinum*. Its proper label still awaits the work of a botanist but, based on the suggestion of David Chamberlain, we have been calling it *R. serotinum*. Of course, it looks nothing like the "classic" *serotinum* that has been in cultivation for decades**,** but the name serves the purpose for the time being. The old, long cultivated forms of *serotinum* do not have any wild-collected data attached to them and, at least in the forms that we have grown at the RSBG, appear to simply be late-blooming hybrids of *R. fortunei* subsp. *discolor*. From basic morphological features this new introduction also appears to have affinities with *hemsleyanum*, a species endemic (as far as is currently known) to Emei Shan—several hundred miles (even further in kilometres) to the north in Sichuan. It differs from this well-known species in having a narrower leaf and a much more vigorously upright habit, almost fastigiate. It is a remarkably strong grower, with long extension growth, often flushing twice in a season. The new foliage is blue-green and the large fragrant white flowers are very

similar to those of *hemsleyanum*, even appearing at the same time of the year, early summer. The flowers of the new introduction, however, are almost half again as large as those of *hemsleyanum*.

Only a few of the plethora of new species in subsection *Fortunea* that have recently been named by Chinese botanists (see the *Flora of China* 2017) have been introduced into the west. Among these, we are cultivating the species *R. maoerense* and *yuefengense* at the RSBG, both from the Maoer Shan in southern China. The former has very lovely foliage of shiny green with a reddish-purple flush on the petioles that often extends onto the mid-ribs. It is obviously close to *R. fortunei* but with quite distinct foliage and much deeper colored flowers earlier in the season. Like that species it is an easily cultivated and vigorous species which will need some space in the garden.

The second new species we are cultivating from this southern Chinese mountain range is the stunning, dwarfish *R. yuefengense*, a relative of the rare *R. platypodum* and, probably, *orbiculare*. *R. yuefengense* has striking foliage quite similar to that of *platypodum* but a bit smaller and less leathery (still amazingly thick and firm). The leaves are suborbicular in shape and quite thick and leathery**,** with smooth surfaces and a short and wide, flattened petiole. It has pinkish bell-shaped flowers that hang from an upright, racemose inflorescence in early summer. The flowers are produced at a very young age, often even on a three-year old seedling and the plant has shown remarkable hardiness considering its native latitude. This species differs from *platypodum* primarily in its much smaller stature and in having glabrous stamens. Its native range is also quite disjunct from that of *platypodum* which is known only from the Jinfo Shan of southern Sichuan. *R. yuefengense* is relatively

R. maoerense P1120341.

R. yuefengense P1020503.

slow-growing and dwarfish in cultivation**.** The species *platypodum* itself has only recently been introduced from the wild. It is similar in foliage to its obvious close relative *yuefengense* differing in its larger leaves, more vigorous, upright habit and deeper colored flowers quite a bit earlier in the season. It remains quite rare both in its native habitat and in gardens.

Within this same group of seemingly closely related species, the true *R. cardiobasis* (formerly *R. orbiculare* subsp. *cardiobasis*) has finally been introduced into cultivation from the Dayao Shan of Guangxi Province in southern China. This is in contrast to recent introductions that have been widely circulated of what was thought to be this taxon from the Maoer Shan, a bit further to the north which also have rounded "*orbiculare*-type" leaves but with flowers typical of *R. fortunei*. These should be named as a new subspecific taxon under the species *R. fortunei,* while the true *R. cardiobasis* (collected from the type location in the Dayao Shan) should be reinstated as a separate species and not placed within *R. orbiculare,* a species which is native far to the north in Sichuan on the other side of China. Plants grown under the name *R. cardiobasis* have been floating around for years but they always lacked data and appeared to be garden-origin *R. orbiculare* hybrids of one sort or another. So far in the garden,

this new introduction is proving to be a much more vigorous grower than *R. orbiculare*, with a very different, much more upright habit. The foliage is much less leathery than that of *orbiculare* or *fortunei* and a very different shade of green.

Two more new species from subsection Fortunea grown at the RSBG are relatively widespread taxa that are well known to science but seem simply to have never been properly introduced and were apparently not in cultivation until the 1990s. The closely related species *R. huanum* and *davidii* occur in a similar range across southern Sichuan and into northeastern Yunnan and adjacent northeastern Guizhou. They are separated primarily by calyx size (large and usually cupular on *R. huanum*, quite small and rim-like on *davidii*). Also, *davidii* generally has larger and firmer leaves and a more upright inflorescence, flowering earlier in the season. In cultivation, both species are forming well-shaped rounded shrubs with attractive smooth green leaves. The new growth and foliage of *R. huanum* is particularly attractive as it emerges a glossy olive-green with bright, red-purple perulae and petioles. The flowers of these two fantastic introductions are what really grab your attention however, being a strange (for this subsection) lilac or reddish-purple with darker nectar pouches. The color reminds me of some of the better forms of the early blooming species *R. ririei* more than anything else. The poise of the flowers adds to their charm, with *davidii* bearing a much more upright inflorescence while the flowers of *R. huanum* hang from their long pedicels to display the large and brightly colored fimbriated calyces most effectively. Like most members of this very garden-worthy subsection, these two species are quite amenable in cultivation. I would recommend light shade in most climates. They are not as vigorous or large as some of their giant cousins, and are easily accommodated in most gardens. Currently, *R. huanum* is much more common in gardens, although it is still relatively rare.

R. platypodum. Glendoick, first flowering.

Finally, I have been focused

R. huanum DSC03723.

on some of the enigmatic "outlying" species in subsection Taliensia. These species, including *R. roxieoides*, *dachengense* and *shanii*, are little-known relatives of those famous but difficult alpine species such as *R. proteoides*, *pronum*, *bureavii*, *lacteum* and *roxieanum*, all native far to the west in the high mountains adjacent to the mighty Himalayas. I have been very intrigued as to the origins and very existence of these widely disjunct, extremely isolated "relict" species.

Several years ago Jens Nielsen managed to finally locate a small population of *R. roxieoides* in the wild jumble of mountains and canyons of eastern Chongqing Province. It was a stunning find of a plant with fantastically indumented, shiny foliage and deep pink flowers. Then, in 2012, after years of searching, my friends (including New Zealand native Tom Hudson) and I finally located the rare and enigmatic *R. dachengense* in the remote mountains of Guangxi Province, China. The very existence of this dwarf and prostrate member of subsection Taliensia in the low elevation subtropics of southern China was more than enough to grab, and firmly hold, my attention. The plants were growing on vertical cliffs and some of the plants were several feet across and must have been ancient. The small elliptic leaves were coated beneath with a very dense red-brown indumentum, and the plant had the same prostrate

and creeping habit as the familiar species *R. forrestii* subsp. *forrestii* (previously var. *repens*). The species was quite common in that particular location and I wondered how widespread the population was. I carefully worked my way up the cliff for the next several minutes, looking for variations and anything else I could learn about this long-searched-for species of which we knew so little. It was my fourth attempt at finding the species and I was going to make the most of my time with it! That turned out to be the only population of this incredibly rare species we would find although there must be more of it about on the mountain, hopefully growing in even more inaccessible locations. My thoughts were swirling—how did this species end up in this incredibly isolated location? What were its closest relatives, both geographically and taxonomically, and was this one of the "original" species or just an enigmatic and outlying small population that had adapted to local, geologically temporary conditions and that was now probably fading out of existence?

I began researching other "outlying" and little-known, seemingly remnant species in the genus *Rhododendron*, specifically members of subsection Taliensia, many of which had never before been seen by western botanists and about which very little was known even in their native countries. The species *R. shanii* from the eastern coast of China, even further from its closest relatives than *R. dachengense*, was my next goal. What did this basically unknown species actually

R. dachengense P1040534.

R. shanii.

look like? Like *dachengense*, was it really a member of subsection Taliensia? If so, why were there so many highly disjunct species in this single subsection?

In the autumn of 2015 my friends and I finally tracked down the elusive *R. shanii*. It actually existed! Once I was able to examine the foliage I realized that it was definitely a distinct species. The leaves were quite large and rounded and quite deep green and shiny on top. They were covered with a thick, felted, deep brown indumentum beneath with unusual, perfectly round flower buds. In foliage and habit the species reminded me of both *R. lacteum* (western Yunnan and Sichuan) and *R. campanulatum* (Himalayas) and the overall impression that it made on us all was that it was a great stout beast of a plant. Having finally found both *R. dachengense* and *R. shanii,* I realized I was now more confused and curious than when I had started this quest several years earlier. What is the story of these outlying species? How did they get there and how have they managed to survive all of these millennia? Did I have the *Wollemia nobilis* of rhododendrons in my bag?

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Vireyas from West and East: Distribution and Conservation of Rhododendron section *Schistanthe*

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(Modified from The Rhododendron *4, 2016: 64-69, a publication of the NZRA and the Pukeiti Rhododendron Trust)*

VIREYA RHODODENDRONS, *RHODODENDRON* SECTION SCHISTANTHE, ARE NATIVE TO the Asian mainland, South East Asia, the top of Australia, and as far eastwards as Bougainville and the Solomon Islands. The approximately 400 taxa in the subgenus are not evenly spread across that range, with high concentrations being found in some geographical areas. What is the nature of the distribution and how does it relate to diversity and conservation of this group of plants? This article gives an overview of the distribution of section *Schistanthe* and highlights some of the interesting features.

The "centre" of vireya distribution is South East Asia and *Rhododendron* is one of the largest plant genera found in that region (Webb and Ree 2012). This region is of considerable biogeographical interest because of its complex geology (where at least three tectonic plates meet), with the flora being derived from eastern, western and gondwana sources—creating a significant biodiversity hotspot with a high level of endemism (van Welzen et al. 2005, Webb and Ree 2012). Such hotspots are of inherent conservation interest (Bickford et al. 2012); however, the vireya group is highlighted by recent conservation assessments (Argent 2015, Gibbs et al. 2011) which revealed that 201 of the 400 taxa assessed were under threat or were Data Deficient (the latter indicating there is a conservation issue but there is insufficient data to quantify the assessment) (MacKay and Gardiner 2016). Thus 50% of vireya taxa are of conservation concern, and the problem is more acute than some other recently assessed genera (MacKay et al. 2010). A conservation assessment considers

Fig. 1. Area of distribution of vireya (white bubbles) and tropical non-vireya (orange bubble), with the van Steenis boundaries of the SE Asian floristic zone (aqua lines) and biogeographical boundaries within the SE Asian zone (red lines). Boundaries from Van Welzen and Raes (2011), vireya distribution from Argent (2015). Map from Google maps.

factors such as wild population size, extent of distribution, and a range of threat factors; taxa assessed as having a conservation issue are referred to as Red List taxa. The Red List categories, with decreasing level of threat, are: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Data Deficient and finally, Least Concern for taxa with no conservation issue. Criteria for the assessment can be found in Gibbs et al. (2011).

Furthermore, conservation action in *Rhododendron* is confounded by taxonomic complexity (Ennos et al. 2005) where species boundaries are often uncertain, and common species are not always clearly distinguished from Red List species. For example, a Red List taxon that is distinct would have a higher conservation priority than one that is not clearly distinguished from a common taxon. Indeed *Rhododendron* is a "big genus" (Frodin 2004), typified by a large number of taxa (more than 500) which are divided into groups, a large number of taxonomic queries, on-going active speciation, and frequent occurrence of natural hybrids (Argent 2015, Chamberlain 2003, Crutwell 1998, Danet 2011, Ennos et al. 2005, Milne et al. 2010). In "big genera," conservation decisions should be based on an understanding of the relationships between conservation taxa and their near relatives (Frodin 2004), an approach that has been employed in the New Zealand research programme

(Fayaz 2012, MacKay et al. 2010, MacKay et al. 2012, MacKay and Gardiner 2016). In addition, recent molecular studies indicate geographical factors in species relationships in vireyas (Brown et al. 2006, Craven et al. 2011, Fayaz 2012, Goetsch et al. 2011), so examining the spatial distribution of the subgenus will inform the understanding of this group of taxa.

One interesting aspect of spatial distribution is the biogeographical boundaries in the SE Asian region (see Fig. 1), which indicate locations where many species distributions stop or start and allow floristic regions to be defined (Raes and van Welzen 2009, van Welzen and Raes 2011, van Welzen et al. 2005, Webb and Ree 2012). The Van Steenis boundaries define the SE Asian floristic region, and this region covers most but not all of the vireya distribution. Within the SE Asian region other boundaries have been proposed such as the Merrill-Dickerson/Huxley, Wallace and Lydekker Lines. These boundaries divide the region into a western zone (Malayan Peninsula, Sumatra, Java, Borneo), a middle zone that is often called Wallacea (Sulawesi, Moluccas, Lesser Sunda), and an eastern zone (New Guinea and eastwards). The placement of the Philippines varies; the Wallace definition puts it in the western zone while the Merrill-Dickerson/Huxley definition puts it in the central zone. Other recent work on flora places Java and Philippines in the central zone rather than the western zone (van Welzen and Slik 2009, van Welzen and Raes 2011). Given that *Rhododendron* is one of the biggest plant genera in the region, how does its distribution relate to these zones?

Distribution data for 404 taxa (species, subspecies and botanical varieties) in *Rhododendron* section *Schistanthe* was examined using the geographic range information in Argent (2015) and each taxon was attributed to one or more mainland countries (e.g., *R. rushforthii* originates in both China and Vietnam), or one or more islands in the SE Asian region (e.g., *R. bagobonum* originates in Borneo, Philippines, Sulawesi and the Moluccas). As this examination of taxa considers the biogeographical distribution, the SE Asia taxa were organised according to island, or group of islands; countries were not used as these do not align with the biogeographical zones. The group of islands that constitute the Philippines were combined as these islands are in the same biogeographical zone; the islands in the Moluccas were combined in the same fashion.

To gauge the extent of overlap between vireya and non-vireya taxa, the distribution of "tropical" non-vireya taxa listed by Valder (1983) was also considered, with taxa cross-checked to Chamberlain et al. (1996), Cox and Cox (1997), and McGuire and Robinson (2009). Data were organised in a chart where each taxon was listed for the relevant origin (mainland country, or SE Asian island or group of islands) and then taxa for each origin were organised according the taxonomic section (Argent 2015) within section Schistanthe (detail not shown). These data were

Table 1. Geographic origins of 404 taxa (species, subspecies, varieties) from *Rhododendron* subgenus *Vireya* (Argent 2015) (now subgenus *Schistanthe*) showing number of endemic taxa and total number of taxa from each origin, as well as the total number of taxa and number of endemic taxa from each biogeographical zone. Aqua bars show the van Steenis boundaries to the Southeast Asian biogeographical region, while Red bars show the Merrill-Dickerson/Huxley, Wallace and Lydekker boundaries within the SE Asian region (Raes and van Welzen 2009; van Welzen and Raes 2011; van Welzen et al. 2005; Webb and Ree 2012). "Tropical" non-vireya taxa (Chamberlain et al. 1996; Cox and Cox 1997; McQuire and Robinson 2009; Valder 1983) are listed for areas within the SE Asian region. Total number of taxa is 404 but the numbers of taxa from each area will not sum to this number as several taxa have more than one origin. Similarly, the total for each zone is not the sum of the totals for the countries in each zone, as some taxa have more than one origin. (Zoom in to view the Table.)

Geographic origins moving from west (left side of the table) to east (right side of the table)

	North-west of the SE Asian floristic region							SE Asian floristic region: western zone				SE Asian floristic region: central or western zone depending on definition	SE Asian floristic region: central zone (Wallacea)			SE Asian floristic region: eastern zone		South of the SE Asian floristic region
	India	Nepal	Bhutan	China	Burma	Taiwan	Vietnam	Malayan Peninsula and southern Thailand	Sumatra	Java and Bali	Borneo	Philippines (all islands combined)	Sulawesi	Lesser Sunda	Moluccas (all islands)	New Guinea	further east	Australia
No. of endemic taxa	1	0	0	5	0	1	4	9	22	4	73	29	30	1	6	184	7	2
Total no. of taxa	3	1	1	12	3	1	8	12	27	9	79	32	37	2	12	190	12	2
Taxa found in this zone	18 total 18 confined to this zone							118 total 113 confined to this zone 5 not confined to this zone: *R. bagobonum*, *R. malayanum var. malayanum*, *R. malayanum var. piloisflium*, *R. orbiculatum*, *R. zollingeri*				32 total 29 confined to this zone 3 not confined to this zone: *R. bagobonum*, *R. javanicum ssp. schadenbergii*, *R. zollingeri*	46 total 39 confined to this zone 7 not confined to this zone: *R. bagobonum*, *R. javanicum ssp. schadenbergii*, *R. malayanum var. malayanum*, *R. malayanum var. piloisflium*, *R. orbiculatum*, *R. zwelleri*, *R. zollingeri*			197 total 196 confined to this zone 1 not confined to this zone: *R. zwelleri*		2 total 2 confined to this zone
"Tropical" non-vireya taxa	Many "tropical" non-vireya in this zone.							*R. moulmainense* *R. wrayii*	*R. irroratum ssp. kontumense* *R. korthalsii* *R. vanderbiltianum*			*R. subsessile*						
	van Steenis											Merrill- Dickerson/ Huxley	Wallace			Lydekker		van Steenis

summarised to show numbers of taxa and endemic taxa for each origin, and for each biogeographical zone in relation to the Southeast Asian floristic region (Table 1). Data were also mapped onto a map of the region, whereby each taxon was marked on each mainland country or SE Asian island of origin for that taxon (detail not shown) and those data were summarised on a map that shows the boundaries and the distribution range (Fig. 1). Figure 1 shows the extent of the distribution of section *Schistanthe* (white bubbles), the extent of the "tropical" non-vireya taxa (orange bubble), the boundaries of the SE Asian floristic region (aqua lines), and the boundaries within the region (red lines). Some fascinating patterns are revealed.

The map shows that the vireya distribution is disjunct with a large physical gap between section Pseudovireya and the other sections. Section Pseudovireya is the western-most group of vireya and is spread from Himalaya (India, Bhutan, Nepal), China, north Vietnam, north Burma, north Thailand and Taiwan—well outside the SE Asian floristic region. The next nearest vireya taxa are found about 900 km (560 miles) south in southern Vietnam; *R. triumphans* and *R. chevalleri*. These two

R. acrophilium.

R. apiense.

R. apoanum.

R. praetervissum.

taxa are spatial outliers; there is another gap of approximately 700 km (435 miles) to the south before the outer edge of the main distribution is encountered. Why are there such large gaps? How can one section of vireya be so remote from the rest? This pattern could fit with a mode of speciation where there was once a widespread ancestor, and over time various influences result in speciation in some parts of the range and extinction in other parts, leaving a gap in the distribution (Heads 2014). If this theory is accepted, which part represents the widespread ancestor and which part represents the later speciation? Some recent research suggests that *Rhododendron* is of laurasian origin and has radiated eastward from mainland Asia to

R. lamrialianum subsp. *gunsalamianum.*

R. leytense.

R. lanceolatum.

R. maxwellii.

SE Asia (Landis et al. 2013, Schwery et al. 2014, Webb and Ree 2012). If this is so, is section Pseudovireya the ancestor of the rest of the vireyas and is it the link between vireya and non-vireya? Some molecular studies indicate that Pseudovireya is "most different" from the rest of the vireyas and, of all the vireya sections, is "most like" non-vireya taxa (Brown et al. 2006, Fayaz 2012), but the analyses show difference, not lines of ancestry, so the nature of any evolutionary link remains unknown.

Curiosity about the link between vireya and non-vireya is further prompted by the fact that the geographical gap in the vireya distribution does not lack rhododendrons (Chamberlain et al. 1996, Cox and Cox 1997, McGuire and Robinson 2009,

Valder 1983); there are non-vireya taxa in the gap which come from a range of sections (e.g., 62 taxa, from 14 sections or subsections (Valder 1983)). In southern Vietnam are nine taxa from a mix of subsections Maddenia, Irrorata, and Taliensia, and sections Tsutsusi, and Choniastrum. Along the southern coastal parts of China are several taxa from subsections Maddenia and Argyrophylla, as well as nine taxa from subgenus Azaleastrum and six from subgenus Tsutsusi. Two taxa from subgenus Azaleastrum, eleven from subgenus Tsutsusi, and several others from subsections Maculifera, Pontica and Arborea are found in Taiwan. All of these are still outside the SE Asian floristic region, but six non-vireya taxa are found inside the region and within the main vireya distribution. One section Chionastrum taxon *R. leiopodum* (syn. *R. moulmainense*) and one from subsection Irrorata (*R. wrayii*) are found on the Malayan Peninsula, and two from subsection Irrorata (*R. korthalsii* and *R. irroratum* subsp. *kontumense*) and one from subsection Maddenia (*R. vanderbiltianum*) are found further south-east on Sumatra. *R. subsessile* (section Tsutsusi) is found on Luzon in the Philippines.

R. retivenium.

What is the relationship between non-vireya and vireya in these areas where they overlap? While it is tempting to think that the geographical proximity would make them more likely to be related, this is not necessarily so, as the work on temperate subsection Pontica shows (Milne 2004). Milne found that, because of relict distributions, certain taxa were more closely related to those some distance away than those nearby. It is also interesting that the non-vireya taxa listed by Valder (1983) are from 14 different sections and subsections of the genus, although about a third are from sections Chionastrum and Tsutsusi and subsection Irrorata, although this pattern may change as new species are still being discovered in this region (Cox 2013, Robinson 2008). Molecular research has the capacity to investigate relationships between vireya and "tropical" non-vireya rhododendrons but there has been limited comparison between these two groups. A study that included *R. subsessile* found that it was not closely related to the vireya group (Brown et al. 2006b). Another study which included *R. vanderbiltianum* (Goetsch et al. 2011) concluded it was intermediate between section *Schistanthe* and subgenus *Rhododendron*, which is intriguing as it was initially placed in section Pseudovireya (Chamberlain et al. 1996) but later changed to subsection Maddenia (Argent et al. 2008). This is a fascinating clue about relationships and more research is needed, but as yet nobody has examined a set of taxa that would answer the question of the connection between the two groups and

so it remains unknown.

Returning to the vireya distribution, the main area of the distribution starts in southern Thailand (within the SE Asian floristic region) where *R. longiflorum* and *R. malayanum* are found. These taxa occur further up the Peninsula than any others, but both are also found on other islands in the region. In total, twelve taxa are found on the Malayan Peninsula including *R. jasminiflorum*, a well-known taxon which is common in cultivation and a parent of many garden hybrids, and the less common and Red Listed *R. jasminiflorum* subsp. *oblongifolium*. In fact there are five subspecies of *R. jasminiflorum* and four were Red Listed: the previously mentioned *R. jasminiflorum* subsp. *oblongifolium*, *R. jasminiflorum* subsp. *chamaepitys* from Borneo, *R. jasminiflorum* subsp. *copelandii* from the Philippines, and *R. jasminiflorum* subsp. *heusseri* from Sumatra (Argent 2015). Are the subspecies distinct enough to warrant a high priority for conservation? Only *R. jasminflorum* subsp. *oblongifolium* has thus far been included in a molecular study (Fayaz 2012) where it was found to be distinct, so might the others also be distinct? Again one's curiosity is prompted.

The Malayan Peninsula is in the biogeographical western zone (west of the Merrill-Dickerson/Huxley Line) along with Sumatra and Borneo. The island of Borneo is the origin of the greatest number of taxa in this zone (79, with 73 endemic), particularly in the northern part (Sabah and Sarawak) which is geologically younger and more active than the other parts of the island (Hall 2012). Some of the more common taxa from Borneo that are in cultivation are *R. fallacinum*, *R. praetervissum*, *R. suaveolens* and *R. javanicum* subsp. *brookeanum*. Borneo is also the origin of the greatest number of Red List taxa in the western zone, including taxa such as *R. alborugosum*, *R. maxwellii*, *R. ericoides* and *R. baconii* (MacKay et al. 2016). A critical issue with many Red List taxa is that they are also scarce in cultivation. Effective *ex situ* conservation, where taxa are conserved in living collections on sites such as botanic gardens, relies on the presence of "enough" accessions of different wild sources, not vegetative clones, to genetically represent the taxon (Blackmore et al. 2011, Rae 2011, Maunder et al. 2001), although opinion varies on how many is "enough." For many *Rhododendron* taxa, there are insufficient holdings in world collections to achieve that representation. For example, the average number of records on the plant database at Botanic Gardens Conservation International for Red List vireya taxa in world collections was 0.9 (MacKay and Gardiner 2016), with origins varying from an average of 0 records for Red List taxa from the Moluccas to an average of 10 records for the one Red List taxon from Australia (MacKay et al. 2016). Any average number below three indicates that the taxon is not secure in cultivation (Lowe 1988). The only geographic origin for Red List vireya taxa that was above this level was Australia (*R. lochiae*), indicating that most Red List vireya taxa are poorly represented in cultivation (MacKay et al. 2016).

Red List taxa are also found in the middle biogeographical zone (Wallacea): on the islands of Sulawesi, the Lesser Sundas and the Moluccas. The total number of taxa found in this zone (46 with 39 endemic to this zone) is lower than the other zones, possibly because the islands are of variable geological origin and the zone is geologically younger than the other two zones (Hall 2012). A common taxon from this zone is *R. meliphagidum*, which is found on both Sulawesi and in the Moluccas, while *R. arenicola* is a Red List taxon from Sulawesi. The latter was Red List assessed as Vulnerable (Argent 2015) indicating a relatively high priority for conservation. However, Fayaz (2012) found a close relationship with the common taxon *R. lagunculicarpum* which might lessen the priority. If Java (nine taxa) and the Philippines (32 taxa) are allocated to the middle zone, some additional rare taxa are *R. album*, *R. javanicum* subsp. *teysmannii*, *R. taxifolium* and *R. acrophilum*.

Further east, and in the eastern biogeographical zone, is the island of New Guinea and several smaller islands further east again. New Guinea is a centre of diversity for vireyas with 190 taxa native to that island and 184 of those taxa endemic to the island. New Guinea is built from more than 30 plate fragments (Heads 2006), and some biogeographers believe the high level of geological activity is responsible for stimulating speciation on this island. Of the taxa found there, some are common and are found in several locations across the island (e.g., *R. macgregoriae, R. culminicola, R. commonae, R. rarum, R. christii*) and these taxa are also relatively common in cultivation. Conversely, some taxa are of limited distribution and 91 have been Red Listed (Argent 2015; Gibbs et al. 2011). *R. archboldianum* is one such Red List taxon from Papua New Guinea, while three well-known and more common taxa from that country are *R. gardenia*, *R. hellwigii* and *R. hyacinthosmum*.

The New Guinea taxa highlight two further conservation problems. Firstly, of the 91 Red List taxa from New Guinea, 67 (74%) are not in cultivation (MacKay et al. 2016) so *ex situ* approaches to conservation cannot presently be used. Overall 60% of Red List vireya taxa are not in cultivation (MacKay and Gardiner 2016). Should resources be spent on field work to obtain a genetically representative sample of each taxon, or should resources be used on those taxa that are already in cultivation? Secondly, of the 91 Red List taxa from New Guinea, 69 were assessed as Data Deficient (most of these, 49, are not in cultivation either), indicating a considerable deficit of knowledge about this group of taxa (MacKay et al. 2016). This trend is repeated for the whole subgenus, since of the 201 vireya taxa Red Listed, 113 were assessed as Data Deficient and 87 of those are not in cultivation (MacKay and Gardiner 2016). To what extent should resources be spent to undertake research on Data Deficient taxa? These unanswered questions illustrate the problem of priority setting in conservation (Oldfield 2010), which is a matter of on-going debate.

The vireya distribution continues east of New Guinea and twelve taxa are found

on islands as far east as Bougainville and the Solomon Islands. The distribution of vireyas then ceases and does not extend any further south-east, a pattern that is also observed in other Ericaceae (Heads 2014). Five of the eastern-most taxa are found on both New Guinea and the islands further east; and three of these (*R. armitii, R. superbum* and *R. konori)* are in cultivation. Another seven taxa are found only on the smaller eastern-most islands, with four of the seven present in cultivation. *R. loranthiflorum* is one of the more common taxa from this area (New Britain and Solomon Islands) while two Red List taxa are *R. goodenoughii* from Goodenough Island and *R. luraluense* from Bougainville.

Two taxa also "went south" and are found in Australia—*R. viriosum* Craven *sp. nov*. and *R. lochiae* F. Muell. These two are a classic case of taxonomic complexity and conservation—two closely related taxa where *R. lochiae* F. Muell. (syn. *R. notiale* Craven) was Red Listed while *R. viriosum* Craven. *sp. nov*. was not. At first glance these two taxa look similar but *R. viriosum* has a straight corolla tube and the ovary and style have hairs and scales, whereas *R. lochiae* has a curved corolla tube and the ovary and style have only scales (no hairs). Due to a most unfortunate taxonomic confusion (described in Craven 2002, 2003), much material in cultivation that is labelled as *R. lochiae* is actually the straight tubed *R. viriosum* Craven *sp. nov*. and not the curved tubed *R. lochiae* F. Muell. This highlights the importance of correct identification and labelling in collections—conservation is not achieved if accessions labelled *R. lochiae* turn out to be the wrong taxon—so each accession should be verified and labelled (Blackmore et al. 2011, Rae 2011). It also highlights the importance of using an integrated approach where morphological study is combined with molecular approaches (Blackmore et al. 2011, Coleman et al. 2000, Goodall-Copestake et al. 2005, Kozlowski et al. 2012, Leadlay et al. 2006). For example, Fayaz (2012) found that four accessions of *R. viriosum* did not group together in his study of DNA sequence data (suggesting variation among those accessions) and this was mirrored by morphological variation in the samples, even though they all keyed to *R. viriosum*. More research is needed to explain these results.

The same need for research is evident for many vireya taxa, from throughout the geographic range. Is Pseudovireya the link between vireya and non-vireya groups? Are there any close relationships between vireya and non-vireya from the same area? What should be done to find out more about the Data Deficient taxa? What of those rare taxa that are thought to be closely related to a more common taxon—could some conservation assessments be altered if more was known about relationships? Molecular research is very useful, but can also generate many new questions. For example, although some molecular studies show Pseudovireya to be the nearest group to non-vireya rhododendron (Brown 2006a, 2006b; Fayaz 2012), others put Discovireya in that position (Craven et al. 2011, Goetsch et al. 2011).

How can the differences in these results be explained? What additional data is needed? More research, of all kinds, (field studies, molecular lab studies, analysis of collections) is needed to better understand this group of taxa and their relationships.

Vireya rhododendrons are found from the Himalayas to the Solomon Islands and from Taiwan to Australia, and there are Red List taxa throughout that range. *Rhododendron* is a complex genus, and its conservation is made more challenging by the web of relationships between taxa and groups of taxa. There is so much more to learn about this group of plants!

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