

FIVE YEARS ON: A REVIEW OF THE NEW ZEALAND RHODODENDRON *EX SITU* CONSERVATION PROJECT:

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Time flies, and it is now five years since we set in place the strategy for the New Zealand *ex-situ* *Rhododendron* conservation project (MacKay 2022, 2021, 2020, 2019a, 2018a, 2018b, 2017). Readers may recall that we started this project because we believed that the collections in New Zealand could have a useful role in conservation of species. In June this year we reviewed the project strategy (PRT 2023), and further to that review I will outline the ‘why’, ‘how’, ‘what’ and ‘what next’ of the project and give you an overview of the strategy and progress to date.

Why?

The ‘why’ has two components. First, *Rhododendron* has a conservation problem. The international conservation assessments evaluate the situation of each species in its wild habitat and 726 of 1232 (59%) assessed taxa have some form of conservation issue (Gibbs et al. 2011; MacKay et al. 2018). Only 502 taxa were judged to not have an issue and were assessed as Least Concern. (Readers should note the abbreviations for the Red List categories given in the table below, as I will use them in the rest of this article.)

The 2018 Global Update (MacKay et al. 2018) reported that 903 of the 1232 taxa were in cultivation. Of the CR taxa, 27 are in cultivation globally (MacKay et al. 2018); nine are present in New Zealand collections including *R. auritum*, *R. subansiriense*, *R. griersonianum*, and *R. taxifolium*.

This leads us to the second part of the ‘why’ – the presence in New Zealand collections of a substantial number of taxa. ‘New Zealand’ holds about 538 taxa in cultivation (MacKay, Smith & Gardiner, 2017) which ranks us about 4th globally (MacKay, unpublished data), while the Pukeiti collection holds about 300 taxa. The presence in New Zealand of this range of species means that we have a useful role to play in international *ex-situ* conservation. This ‘New Zealand’ collection is held on a range of sites and the publicly accessible sites include Pukeiti, Dunedin Botanic Garden, Tannock Glen in Dunedin, and Heritage Park and Cross Hills gardens in the Manawatu region. There are many private collections too, including Sue and Lindsay Davies’ Omahuri collection in Palmerston North, the Gardiner/Kelly family Woodchester Garden in North Canterbury, and the Leonie Day collection in Dunedin.



R. auritum is a Critically Endangered species that is in cultivation in New Zealand.



Tannock Glen in Dunedin is one of the publicly accessible sites that contains an important collection.

The latter is the site of the former Dalebrook Nursery and contains many species of interest (three cheers to Leonie for her generosity in letting the project team study this collection and collect propagating material).

As well as having a substantial collection in New Zealand, we also have other features that are important for conservation. First, our relatively mild climate means that we can grow groups like *Maddenia* and *Vireya* outdoors, heated greenhouses are not needed, which gives us an advantage over many northern hemisphere collections. Second, is the principle of duplication. *Ex-situ* conservation is not secure if rare species are held on only one site, so it is desirable to duplicate important collections, and even better to achieve duplication in the southern hemisphere when (at present) most of the large collections are in the northern hemisphere (Hu et al. in press). The third feature is the New Zealand *Vireya* collection. *Vireya* is the highest global priority for *ex-situ* conservation (MacKay & Gardiner, 2017a) and, after the

Rhododendron Species Botanical Garden (RSBG) in the USA and Royal Botanic Garden Edinburgh (RBGE) (MacKay & Hootman, 2018; MacKay, unpublished data) we have one of the largest collections of that group. Given the high international priority, it is most important that the New Zealand *Vireya* collection is conserved.

*A small aside now – to provide the international context for our project. Plant conservation is managed internationally via the Global Strategy for Plant Conservation and its 16 Targets (<https://www.bgci.org/our-work/inspiring-and-leading-people/policy-and-advocacy/the-global-strategy-for-plant-conservation/>). Of particular interest are (i) Target 2 (Red List assessment) where the conservation assessments are made (Gibbs et al. 2011; MacKay et al. 2018) and which prioritise any *ex-situ* action, and (ii) Target 8 (achieve 75% of Red List taxa in cultivation) which directs that *ex-situ* action. Also at play is the Global Conservation Consortium for *Rhododendron* (<https://www.globalconservationconsortia.org/gcc/rhododendron/>), based at*

Edinburgh, which was formed after the conservation meeting held at Oak Spring Garden in Virginia in 2018 (MacKay 2018b). Our project operates within this context and the New Zealand project team maintains contact with relevant parties, particularly the two largest global collections, RBGE and the RSBG (MacKay & Hootman, 2018).

How?

So, how did we set things up for our project? The New Zealand project is a collaboration among Pukeiti *Rhododendron* Trust (PRT), Taranaki Regional Council (TRC), New Zealand *Rhododendron* Association (NZRA), Massey University (for my professional time) and the partner sites who are now involved. In addition, we have external collaborations with the Royal New Zealand Institute of Horticulture (for the Biosecurity work) and with Massey University and the New Zealand Institute of Plant & Food Research Limited (PFR) for research. Our objectives and operating protocols are outlined in a



R. sperabile var. *weihsiense* is a Vulnerable species that is grown at Dunedin Botanic Garden.



R. beanianum is a Vulnerable species that is grown at Tannock Glen in Dunedin.

written project strategy (PRT, 2023) which also contains a series of KPIs.

The core project team is myself, Graham Smith of PRT and retired director of Pukeiti, Andrew Brooker of Pukeiti and TRC, Sue Davies of NZRA, PRT and PFR, Doug Thomson of PRT and recently retired from DBG, and Peter Catt of PRT. The team also liaises with the PRT Trust Board, the TRC collections committee, the NZRA council, and Massey University and PFR.

What: project objectives

Our overall aim is to manage the 'New Zealand' rhododendron collection so that it contributes to global *ex-situ* conservation. In our strategy we state that the New Zealand project will develop:

- **A documented set of New Zealand collections:** which contains a wide range of species, that play to our cultivation advantage, with some but not total emphasis on Red List species, and with an emphasis on wild-sourced material.
- **Connections** to international networks and programmes.
- We will achieve the above through:
- **Collaboration** among a project team
- A **project plan** in 5-year increments,
- Building the '**New Zealand collection**': with a focus on species that are scarce or 'lost from view' in New Zealand, and the need to increase diversity of accessions,
- Developing a **national network** of collections to hold the above

'New Zealand collection'.

To enact these objectives, we have established a set of project activities and I will outline these in the next section. This will be followed by a brief outline of the current collaborations that are in play.

What: project activities

Our project activities fall into four categories: (i) search, propagate and distribute, (ii) the collections network and the national collection (iii) publication, communication, and external relations, and (iv) data and analysis.

Search

The first big challenge was to find out what we already have, hence the 'search'. The MacKay dataset now contains data from about 30 New Zealand collections and in the first phase of the project the team was busy contacting and visiting sites (public and private) where owners were prepared to share data with us. The dataset also contains data on nine of the largest global collections (see MacKay et al., 2018) and data from the Botanic Gardens Conservation International (BGCI) database (<https://plantsearch.bgci.org/>) which allows us to compare our holdings with those worldwide and focus our strategy. We are interested in the overall range of species held in New Zealand, but particularly any species that is held on three or fewer sites and therefore a high priority for propagation. For example, the vireyas *R. album* and *R. vaccinioides* are both

only on one site and have never been sold in the nursery trade so must be propagated with some urgency.

The 'three or fewer' criterion comes from the British plant collections (Lowe 1988, 1989) where the author said that of the three sites: at one place it had died, at the second place the name was wrong, and at the third place they meant to get it but never did. So, anything below three sites is a risk and I have used this as the yardstick for action.

Another important part of the context for New Zealand is that, because of our very strict import regulations whereby we cannot bring in a species that is not already here, we have to work with what we have already got. This means searching out species that are in few places and bringing them into more general cultivation – even more so if they are Red List species. Obviously Red List species would be a priority; however, Least Concern species (such as *R. canescens*) which are scarce in our collections are also a high priority in the search.

A particular part of 'search' is the Leonie Day collection in Dunedin, where 'search' is joined by 'identify' as the plants on that site were not labelled when Leonie took ownership of the property. (As already mentioned, because this property was the former site of the Dalebrook nursery, there are many species of interest there). Sue Davies leads this part of the project and after many site visits, she and her team has identified 97%



'Search' and 'identify' are two key activities at the Leonie Day collection in Dunedin. Here Sue Davies studies the specimen while Mark Joel writes the label and Marion (back to the camera) takes notes. (Image: Andrew Brooker).



R. vialii is a Vulnerable species that is grown at the Omahuri (Davies) collection in Manawatu.



R. meddianum is a Vulnerable species that is grown in the Woodchester collection in Canterbury.

of the 1379 rhododendron plants in that collection (our KPI was 75%), to about 190 species including about 70 Red List species. Her spreadsheet presently contains 42 ‘unknown’ and 12 identified to subsection only; given that these plants have been studied by Sue, Doug Thomson, Andrew Brooker and Mark Joel we conclude that those plants are a bit gnarly! One of them is even labelled as ‘mystery plant’! In October this year Steve Hootman will be visiting this garden with Sue (and Doug Thomson and Mark Joel) and we hope Steve will be able to help with some of those problematic plants.

Propagate

Our priority for propagation is any species that is found on three or fewer sites, and at present there are about 150 species in general propagation (seed or vegetative). Some propagation has been done at Dunedin Botanic Garden; however, the bulk of the work is done by Andrew Brooker at Pukeiti and Sue Davies at her Palmerston North property. Some of the species propagated include *R. coxianum* (CR) which is only at Pukeiti and has never been sold, *R. venator* (VU) which is on two sites and was last sold in the 1960s, and *R. serotinum* (LC) and *R. hellwigii* (LC) which are only at Pukeiti.

For the Leonie Day collection our KPI was to have propagated 50% of species with conservation or horticultural merit, and over the 2020-2022 period 140 species (73% of the species present) were brought into the propagation process. Not all

have succeeded though, and some will have to be done again; some are scarce in cultivation because they are really difficult to propagate. Of the 70 Red List species on that site 51 have been started in the propagation process; two of these are *R. exasperatum* (NT) and *R. alutaceum* var. *iodes* (DD) which have never been offered for sale in New Zealand. Common species of particular horticultural merit are also propagated; lovely forms of *R. megacalyx* and *R. arboreum* ssp. *zeylanicum* are presently in the propagation process.

Distribute

Having found and propagated species of interest, what next? Plants will be offered for sale through Plants for Members schemes, and in the last year or so hard to get species like *R. noriakanum* and *R. rugosum* have been offered through the Pukeiti plant list. Plants will also be distributed to partner sites, and Andrew Brooker was busy earlier this year on road trips with his ute packed to the gunnels with plants for distribution. This distribution is to build the national collection, more on that shortly.

Collections network

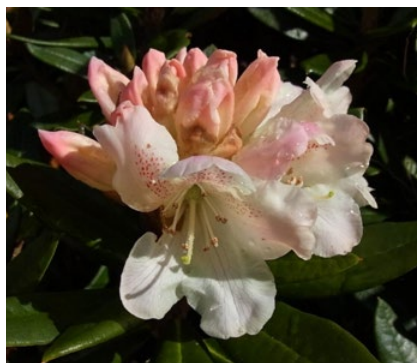
We set ourselves the KPI of achieving four partner sites in the project, and we presently have ten which are spread throughout New Zealand. Andrew Brooker is leading the management of the network and he has met with people at each site, outlined the project and taken plants to those places. Andrew will visit

each site once per year. To facilitate management, we have developed a Memorandum of Understanding which has been signed by representatives from each of the ten sites.

As you rhododendron enthusiasts will know, rhododendrons have a range of growth requirements and one site, such as Pukeiti, cannot grow them all as climatic conditions do not suit for many. The climatic matching, as well as the need for duplication, is one reason why the network is so important. Fortunately, we have those ‘fab four’ rhododendron experts (Lynn Bublitz, Alan Jellyman, Glynn Church, and Graham Smith) on hand to advise on suitable locations for each species.

The ‘national collection’

The collections network will house the ‘national collection’, but what do we mean by ‘national collection’? On one hand we wish to house all species that are in New Zealand, on suitable sites where they will be successful. On the other hand, there are some groupings that are of particular interest. The Vireya collection is one such group (which is also a global priority), along with Red List species (with priority to those presently on few sites), and then any species that is uncommon in New Zealand cultivation. For example, of the Red List species *R. annae* (NT) and *R. subansiriense* (CR) are on few sites and would be higher priority than *R. dichroanthum* (VU) and *R. smirnowii* (VU) which are both on many sites. Of the groups less common in New Zealand, the dwarf species are poorly represented



R. alutaceum is a Data Deficient species that is growing in the Leonie Day collection in Dunedin.



Plants being delivered to Eden Gardens, a partner site in the collections network. (Image: Andrew Brooker).



The Vireya *R. album* is a Vulnerable species that is only found in NZ in the Pukeiti collection. It has never been sold in the nursery trade.

in the current collections data, as are some of the *Pentanthera* species. Then there are a few outliers like *R. sikayotaisanense* (Not Evaluated) which is only at Pukeiti and was once sold in 1983. Forming of the 'national collection' is still a work in progress; however, we aim to eventually have each species on at least three sites.

The other aspect to the national collection is to achieve at least three different wild-sourced accessions of each Red List species as having diverse wild material in collections is a key principle of *ex-situ* conservation (MacKay 2019b). For the New Zealand project this is a work in progress as I have yet to do the detailed analysis. The current raw data suggests that for a few species we are okay; however, for most species we do not have the necessary wild accessions. This lack of wild accessions is a common problem (MacKay 2019b) and part of our action plan is to acquire more wild material. As with the network, the national collection is also a work in progress and we expect that it will be some years before we achieve a comprehensive national collection.

Here I draw your attention to the concept of the metacollection. This idea came from animal conservation in zoos, whereby the breeding and diversity of an animal species is collectively managed over many zoos, and this idea has been picked up by botanic gardens (Griffiths et al. 2020; Westwood et al. 2021). What we are doing in New Zealand will effectively be a metacollection,

which will allow us to manage the range of accessions and diversity over the set of participating sites.

Publication, communication, external relations

Another key part of our strategy is to tell people about what we are doing, and we have several KPIs for this aspect. We aimed to publish 2 articles per year – among the team we have published 41 since 2016 (these are listed in PRT 2023). Over the same period, we have given 5 international oral presentations (KPI = 3) and 10 domestic oral presentations (KPI = 5), to a range of industry and scientific audiences (these are listed in PRT 2023). In addition, there has been a project report sent to each PRT Board meeting since March 2017.

While we have done quite well on publishing and presenting, we did not do so well in external relations – but we can blame covid for that. We aspired to participate in international conservation and to develop the relationship with China via Professor Guan – these did not happen on our original timeframe. Gordon Bailey will be leading the China initiative and we hope to undertake this activity over the next year or so.

Data and analysis

Underpinning all of the above work is data and its analysis, as it is this knowledge which allows us to focus and prioritise. As well as the 30 New Zealand collections and the 9 international datasets,

my data contains a deep dive into the historical Pukeiti data, and similarly the historical Eastwoodhill data (MacKay 1996) – to find out which species have been present in the past. I also have a collection of some 250 nursery catalogues; along with another 50 or so contributed by members from throughout New Zealand. Some of these go back to the late 1960s and again they show which species have been sold in the nursery trade in the past.

The key question is “how many, of what, where...” as this guides the search and the propagation. For example, the historical data shows that *R. sanguineum* ssp. *sanguineum* var. *haemaleum* presently has zero collection listings, but it was sold in the past by NZRA in 1945 and by Dunedin Rhododendron Group in 1982 – so it could be out there somewhere, and it is on our search list.

A particular form of the 'data and analysis' activity is the Plant Biosecurity work. Importation of *Rhododendron* seed into New Zealand is only allowed if the species is listed on the Plants Biosecurity Index (PBI) which lists some 420 *Rhododendron* species. However, the Index is acknowledged to be incomplete (Carver et al., 2007; Dawson, 2009; Dickson, 2010). Indeed, my research suggests there are some 230 species that have been in New Zealand since before July 1998 when the present legislation was enacted but which are not on the PBI. For example, *R. fallacinum* has been here since



Although *R. canescens* ('Varnadoe's Phlox Pink' in this case) is a Least Concern species, it is only recorded in two collections in New Zealand and has never been sold in the nursery trade.



R. coxianum (we believe it is *R. coxianum* as Ling and I keyed it with the Davidian key) is a Critically Endangered species from India. In New Zealand it is only found in the Pukeiti Collection and it has never been sold in the nursery trade.



R. exasperatum is a Near Threatened species that is recorded on two sites in New Zealand and has never been sold.

1979 and *R. luraluense* since 1984 but neither is on the present PBI (in 2022 both species were declared ‘not new’).

The first step in solving this problem is to achieve (for each species) the statutory declaration of ‘not new’ (i.e., already in New Zealand) by the Environmental Protection Authority (EPA), under Section 26 of the Hazardous Substances and New Organisms (HSNO) Act 1998. Making a Section 26 application is complicated! With the assistance of Peter Catt, Andrew Brooker and Graham Smith, I have been trawling my way through old Pukeiti records (e.g., seed sowing notebooks, lists of plants in the nursery) to look for evidence of the presence of each species of interest. Heather Robson has been a stalwart here – she has transcribed some old Pukeiti documents, and I’ve lost track of the number of times she has assisted with finding and scanning Pukeiti Plant for Members lists.

Old nursery catalogues are also searched for evidence of sales offerings, while journals and newsletters were searched for any published items about each species. Each evidence document, if not available electronically which most of them are not, must be scanned at high quality for the evidence records. The body of data for each species is collated under the necessary headings within an EPA application form and the evidence documents are formed into an appendix. The first application, for 40 vireya species (a mere 338 pages long!), was approved

in July 2022 and those species were declared ‘not new’. Since then, four further applications have been made covering a total of 112 rhododendrons and these are at various stages of review by the EPA. (Our KPI for this activity was to achieve 100 species through the Section 26 process.)

One of the spin-offs of all this research will be the publication of two checklists (Vireya, and non-vireya) of species that are, or have been, in cultivation in New Zealand, along with the evidence for that presence. At the time of writing the Vireya checklist is in the final editorial stages and the temperate species checklist is presently under construction.

The Section 26 work is time-intensive and very detailed, and it could not have taken place without the collaboration with the Royal New Zealand Institute of Horticulture (RNZIH). I will outline this collaboration in the next section.

What: collaborations and research

Section 26

Shortly after we started our project and realised that we needed to tackle the PBI issue, a fortuitous meeting took place. I encountered Murray Dawson of the RNZIH at a meeting in Wellington and it turned out that he was tackling the same problem, but in relation to the full range of ornamental cultivated plants. It was obvious that we should collaborate, and this has been most productive. Murray had obtained some

\$450k funding from a combination of the Sustainable Farming Futures Fund of the Ministry of Primary Industries (MPI), Landcare Research and the RNZIH for his project “Taking Stock: Resolving New Zealand’s Cultivated Plants Problem”. His project had two key goals. First, to collate data on species in cultivation that were not on the PBI, to verify that each species name was taxonomically correct, and to register those species on the BiotaNZ database (<https://biotanz.landcareresearch.co.nz/>), which is run by Landcare Research and which is the official record for plant species that are present in New Zealand. The second goal of Murray’s project was to make Section 26 applications for a series of species which had the required body of evidence.

Through \$70k of subcontracts between the RNZIH and Massey University (for my professional time), I have been doing the Section 26 work for *Rhododendron* species, as I have already outlined. These Section 26 applications also met the requirements of Murray’s project, so everyone was happy! Indeed, his project achieved all the goals that were set and MPI was also happy – but that is a story for another time.

Ling Hu

Another research collaboration has been the project support (via a scholarship) for PhD student Ling Hu of Massey University. Ling began her PhD in February 2020 and has been studying subsection



A fine form of *R. megacalyx* from the Leonie Day collection has been propagated. It is a Least Concern species, but we considered it to be of horticultural merit.



R. smirnowii is a Vulnerable species, but it is present on many sites so is a relatively low priority for the national collection.



PhD student Ling Hu.

Assessment category	Number of taxa (total 1232)
Extinct (EX)	3 <i>R. longiflorum</i> var. <i>longipetalum</i> <i>R. retrorsipilum</i> <i>R. denudatum</i> var. <i>glabrovarium</i>)
Extinct in the Wild (EW)	1 <i>R. kanehirae</i>
Critically Endangered (CR)	45
Endangered (EN)	43
Vulnerable (VU)	260
Near Threatened (NT)	62
Data Deficient (DD)	316
Least Concern (LC)	502

Maddenia. She has undertaken four main pieces of research:

An examination of the presence and range of wild-sourced accessions present in global cultivation (Hu et al. in press), to determine the adequacy of current *ex-situ* collections and to direct further conservation action.

A study of the ploidy of *Maddenia* species (Hu et al. 2023), with the aim of detecting polyploids. (Polyploids, which are generated by various mechanisms in wild populations, have multiple copies of the standard set of chromosomes.) Polyploids can confound phylogenetic analysis and this research was preparation for Ling's phylogenetic work.

A phylogenetic analysis of *Maddenia* species, to examine species relationships and the conservation

implications thereof. This paper is presently in preparation.

An examination of seed quality and germination, comparing 'selfed' and out-crossed plants, to determine if rare species can be 'selfed' to increase the number of plants in cultivation.

Ling submitted her thesis on 1st September and at the time of writing is waiting for her oral examination. At Massey University PhD's are examined by three examiners: one from Massey, one from another institution in New Zealand, and one international person. Once they have examined the written document, Ling must undertake an oral examination where she makes a short oral presentation and then answers questions from the examiners. The supervisors are present at the oral exam, but we cannot say

anything until the formal exam is over. We hope that the oral exam will be held in early December, and we wish her well for that exercise.

What next?

In this project we have a series of objectives and associated activities. For some activities we have already met our five-year targets, while some other activities are only just underway as part of the second phase. As we continue, we will do 'more of the same'; however, the emphasis will move more onto the national collection and the network, and less on the search aspect (although we are always on the lookout for new sites). Propagation will be ongoing. The Section 26 work will continue as that is a 'very long piece of string' and there is much more to do. An aspect that will 'gear up' will be distribution overseas, of wild accessions that we have that others do not (and where regulations allow us to send material overseas). Andrew has already started this aspect in a small way; however, we expect that this will increase in volume over time.

Further to the project review that we have recently completed, the overall direction of the strategy remains unchanged, although we have made some operational tweaks to aspects that we believe we can do better. (These being recording and focussing propagation, and some aspects of communication.) We hope that the next five years also brings success.



R. searleanum is a Least Concern species; however, it is only present at Pukeiti and is therefore a high priority for propagation and distribution to other sites.



R. subansiriense is only at Pukeiti in the NZ network, and as it is a Critically Endangered species it is one of the most urgent in New Zealand for propagation.



R. pronum (seen in the centre of this picture, at Edinburgh) has been sold twice in the past but presently has no collections records. We hope that it is 'out there somewhere' and we will eventually find it.

Conclusion

The New Zealand *ex-situ* *Rhododendron* Conservation project has been going for five years now and we believe that we have made good progress. Our aim is to make best use of the potential of the collections in New Zealand, as a coordinated whole, to contribute to conservation of this genus. By managing the resource in New Zealand as a metacollection (several sites managed together) we believe we can hold a useful set of accessions in New Zealand, eventually integrating with other international collections to the global benefit of conservation of *Rhododendron*.

Acknowledgements

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R. atlanticum is a Least Concern species but it is presently only recorded on two sites.



R. sanguineum ssp. *sanguineum* var. *haemaleum* is a species that is presently 'lost from view' in New Zealand (seen here in a Scottish collection). It was sold in 1945 and 1982 but there are no current collections listings.



As part of the biosecurity work, *R. fallacinum*, which has been in New Zealand since 1979, was declared 'not new' in 2022 by the Environmental Protection Authority after we made a Section 26 application.