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Plant Conservation in New Zealand – the role of Auckland Botanic Gardens, conserving lowland *Olearia* species, conservation of native species in heavily grazed grassland, Hairy Hazelwood, the Red Hot List and more

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Front cover: Dwarf Broom (*Carmichaelia corrugata*) and Creeping Pōhuehue (*Muehlenbeckia axillaris*). Photo: Tim Logan

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The deadline for the March – May 2018 issue is 28 February 2018. The special theme for the issue is *Translocation of threatened plants*. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Paul Adam: editor@anpc.asn.au

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This issue

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From the Editor

PAUL ADAM

The title of this bulletin is *Australasian Plant Conservation,* which indicates that our interests encompass both sides of the Tasman Sea. It is therefore a particular pleasure that this issue has New Zealand as its theme and includes three articles discussing aspects of plant conservation in that country.

Australia and New Zealand were once part of Gondwana, before they separated about 65 million years ago, so the flora and vegetation of both countries has elements reflecting common ancestry. However, despite this history, at first sight the two countries appear very different in flora, vegetation and landscape. New Zealand is tectonically much more active than Australia and has much newer landscapes and younger and more fertile soils. The ancient landforms and deeply weathered nutrient poor soils which characterise much of Australia and support eucalypt and *Acacia* dominated communities stand in contrast to the more mesic landscapes of New Zealand which support diverse broadleaf forests. New Zealand is also unusual in the absence before human settlement of herbivorous mammals.

Both countries are similar in having floras rich in endemics, and having experienced great ecological change as a result of human activity. Amongst their European populations both have a history of concern about the need to protect native biota and to conserve the environment extending back to the late 19th century, while the first peoples had sophisticated knowledge of the biota long before that.

Conservation of rare and threatened plants has long been a focus of both research and practical management in New Zealand. This issue contains three aspects of plant conservation in both the North and South Islands.

The relatively new site for the Auckland Botanic Gardens south of the city is still being developed, and has a particular focus on conservation. Emma Bodley discusses the Gardens' role as part of a broader conservation network and its education activities. The Threatened Native Plant Garden within the gardens has plantings arranged by habitat. The interpretative signs are excellent and when I visited the Auckland Botanic Gardens I found the threatened plant displays gave a good illustration of the range of vegetation types as well as providing opportunities to see some of the rarer plants which would be hard to locate in their natural habitat.

One of the growth forms exhibited by a taxonomically diverse range of New Zealand plants is the divaricating habit of shrubs. John Barkla discusses the conservation of a group of divaricating *Olearia* species in lowland South Island. This is a region of intensive agricultural development where patches of native vegetation are small and fragmented and where surviving populations of *Olearia* species are small. Surveying to locate populations on private land presents particular difficulties which are discussed by John. The need to have good relations with private landholders is a much wider issue, and is of equal relevance in Australia. Regeneration of *Olearia* species is discussed, and possible methods to promote it described. Public advocacy measures to promote *Olearia* species are outlined. Public advocacy and its integration into conservation programs is something that from my observations New Zealand does particularly well.

Survival and regeneration of native species in improved pastures subject to heavy grazing pressure presents particular challenges, which are discussed by Tim Logan. It is a particular pleasure to include this study, as it was conducted while Tim was still at high school. Tim is also the subject of the member profile in this issue, in which Tim displays his enthusiasm for research and plant conservation.

Returning to Australia, Susan Scott discusses her experience with the translocation of Hairy Hazelwood, a Queensland rainforest species, when a need for propagation and translocation occurred as a result of discovery of the species in a site to be affected by a highway upgrade. This was an exercise in learning as the project proceeded, as the species is not well known. Susan discusses the lessons learnt and what would need to be considered in any future transplantation.

There are many endangered species listed on schedules at the state and federal level in Australia, and with limited resources not all can be given the same degree of attention. Jennifer Silcock describes the process of developing the Red Hot List of priority species. I am sure this will stimulate thought and discussion: the list of threatened species continues to get longer as both threats continue to impact on species and communities, and our knowledge of population numbers and biology improves. Since we live in a less than ideal world, funding will always be inadequate and some form of prioritisation, whether explicit or implicit, will be applied.

Our last issue included articles on provenance. In this issue Nola Hancock and her colleagues respond to the article by Ridgeway *et al*., expressing concern about misinterpretation of the Climate Ready approach. Debate on the topic is welcome, provenance has always been an important issue and is likely to be even more so in the future. It is unlikely that there is a single approach that will be appropriate to every situation - the circumstances of each case will be unique; requirements of consent authorities may vary from site to site and the biology of each species may result in the significance of particular environmental factors differing between cases.

The regular contributions include an update on the activities of Australian Seed Bank Partnership, a great diversity of News items and the always informative Research Round Up.

Auckland Botanic Gardens: a hub for plant conservation

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Globally, botanic gardens have three key roles; research, education and conservation. These roles are all interconnected and do not stand alone. While this article focuses specifically on conservation, the other key roles play an important function in supporting and communicating our conservation efforts. Botanic gardens can contribute to *ex situ* conservation while supporting many *in situ* projects. We can significantly contribute to conservation efforts regionally and nationally. This article is based on my talk given at the New Zealand Plant Conservation Network conference in 2015 and focuses on seed banking, seed orchards, revegetation projects and training new botanists and horticulturalists.

The lack of representation of high genetic diversity is thought to be the biggest issue botanic gardens face with plant collections managed for conservation. This might be true for large populations with many individuals, usually for trees and shrubs. However, for threatened plants that have only a few remaining individuals in the wild, botanic gardens are the perfect place to hold an *ex situ* population. At the Auckland Botanic Gardens (ABG) we hold several seed orchards, a collection of plants from which seed is regularly harvested, for plants that have very few wild individuals including kakabeak *(Clianthus puniceus*) and *Euphorbia glauca*. Both of these species have one plant remaining in the wild, and material was collected and brought to ABG for propagation. In 2015, we collected over 17,300 kakabeak seeds for the New Zealand Indigenous Flora Seed Bank (NZIFSB) (Photo 1). Our seed orchard for *E. glauca* is a bed in our carpark. This shows that a seed orchard does not take up a lot of space, nor does it need to be in a prominent location. We collected *E. glauca* seeds during December 2015 and 2016 and sent them to the NZIFSB. ABG has a seed bank in the nursery to hold duplicate seed collections of Auckland and Northland flora from the NZIFSB. All botanic gardens in New Zealand will have a seed bank to hold duplicate collections as a back up to NZIFSB.

Photo 1. Collecting seed of kakabeak from the seed orchard at Auckland Botanic Gardens. Photo: Chester Nicholls

Using our native plant collections for phenology observations is incredibly useful when planning field work. We are a great place to contact for fellow seed collectors wanting information about flowering and fruiting times. It is easy for people to visit the Gardens and check the plants before seed collection or research trips are made. It can be expensive to access offshore islands; therefore what a plant is doing in a garden setting is a useful indicator that the timing is correct for seed collection or phenological studies.

Our database (BG-base) holds extremely important information about the plants in our collections. The database holds information such as location in the gardens and how many individuals we have, but also where we got them from (if they were collected from the wild we record provenance information including GPS points, site descriptions and associated flora). We can help researchers with taxonomic studies and other scientific research with this provenance information. This can be particularly helpful for researchers studying genera or species that are difficult to find in the wild.

At ABG we have a Threatened Native Plant Garden (TNPG) which displays the threatened flora of Auckland and Northland (Photo 2). This Garden aims to hold wild collected threatened plants which are used to advocate the plight of threatened plants through guided walks in the TNPG and interpretive signage. Most of our visitors will never see these plants in the wild so it is our chance to teach them about our rare and threatened flora. The plants in this garden will also be valuable for future recovery projects and plant research.

We use research to inform our propagation techniques on threatened plants that are challenging to grow. We have skilled staff who are experts at growing tricky native plants. For example we have worked with other parts of Auckland Council to collect *Anogramma leptophylla*, an annual fern. It produces spores, disperses them and then dies down. It has been a success to keep this little plant growing in our nursery for a number of years and have the number of plants gradually increase (Photo 3). We carefully document the soil conditions, any treatments applied and keep a record of its phenology and lifecycle. This type of project is one we hope to work with partners to return the species to the wild.

Photo 2. Threatened native plant garden is made up of 15 habitats, including a coastal boulder beach with *Euphorbia glauca* in the foreground. Photo: Jack Hobbs.

Photo 3. Spores developing on the annual fern *Anogramma leptophylla*. Photo: Jack Hobbs

Although *ex situ* plant conservation is a primary way botanic gardens can contribute to plant conservation, ABG also contributes to the region through our Regional Parks revegetation programme. Every year over 60,000 native plants are grown and dispatched. Seeds are ecosourced. The park that the seed was collected from is the park where those plants will return to. Ecosourcing is important because species are thought to be locally adapted to local conditions and to maintain local population genetics. We are creating habitats and improving soil through this process so that other flora and fauna will establish, therefore having wider ecosystem benefits.

We have skilled staff working at ABG who have a range of expertise from growing plants to looking after plants. It is important that we ensure there are more people coming into the horticultural industry who have these skills. Every three years we have three apprentices who work towards their Level 4 Horticulture diploma. Our apprentices learn about revegetation by planning and undertaking their own revegetation project at ABG and by working in all of our native plant gardens, as well as the rest of the Garden. We extend our education to our visitors through workshops for the public (which we call Drop n' Learns), and other Auckland Council teams on various topics such as seed collection and *Harakeke* cleaning. Community groups have come to the Gardens to learn how to 'plant' mistletoe (*Ileostylus micranthus)* using our plants before doing it in the wild. This ensures that they are not damaging natural, wild populations by practising their technique at the Gardens.

As a garden which aims to provide solutions to gardening questions, our *Oioi* (*Apodasmia similis)* trial is one that is trying to help improve stormwater management.

Swales and the use of *Oioi* in urban areas is increasingly popular, however plants can flop over paths and become trip hazards. We are trialling *Oioi* collected from different populations around Auckland to find an upright variety that doesn't affect path accessibility. We hope to be able to determine the number of years that *Oioi* stays upright before they need replacing. Native plants can be very useful for solving these types of stormwater problems and are great plants at filtering and slowing down water flow.

We promote our Gardens as a place for researchers to conduct their work, as well as promoting what they are working on. Researchers in Auckland were invited to the Gardens for a meeting to discuss how ABG could be useful to them. Based on their feedback we learnt that researchers like a place that is 'permanent', interpretation is of high quality, they can be involved in our visitor centre displays and their research can have a life beyond funding.

With nearly one million visitors a year, ABG is a valuable place for educating visitors about native plant conservation through our displays, interpretation and display gardens, such as the TNPG. We hope to inspire our visitors to use native plants in their home gardens, but also understand the importance of our native flora, despite many NZ plants' unattractive and weedy appearance. The NZ chapter of Botanic Gardens Australia and New Zealand (BGANZ) recently signed a Memorandum of Understanding (MOU) with the Department of Conservation to work together on plant conservation (May 2017). This agreement will ensure we are working effectively together on priority species at a national and regional level. ABG will have new opportunities as a result of this MOU which will result in new species being researched and propagated.

Living on the edge – challenges of finding and conserving lowland *Olearia* species

JOHN BARKLA

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Background

The genus *Olearia* (Asteraceae) has approximately 39 native species in New Zealand. In the southern South Island, this includes a group of small-leaved *Olearia* with a divaricating habit (stems spread apart at wide angles, appearing densely interlaced) that favour fertile, lowland sites. Many have suffered reduction in population size over the last century due to agricultural development. These include *Olearia adenocarpa, O. bullata, O. fimbriata, O. fragrantissima, O. hectorii, O. laxiflora, O. lineata*, and *O. odorata*.

Olearia Recovery Group

The New Zealand Department of Conservation (DOC) formed an *Olearia* Recovery Group that prepared a draft recovery plan to guide recovery actions. In the southern South Island, recovery work focussed on the 'Nationally Threatened' and 'At Risk' (hereafter referred to as threatened) *Olearia fimbriata, O. fragrantissima, O. hectorii*, and *Olearia lineata* and was carried out in Southland, Otago, and Canterbury.

Field assessment of known populations

A programme to revisit populations of threatened small-leaved *Olearia* species and assess their conservation status was established by the recovery group in 2000. A standardised field assessment form was designed to consistently capture site characteristics and attributes. The field survey and assessment was conducted by DOC staff and botanical contractors.

Targeted survey

New targeted surveys were carried out to address gaps in distributional knowledge. These were a mix of ground surveys and aerial survey. Ground surveys utilised skilled observers traversing ostensibly suitable habitat on foot. Aerial surveys were normally conducted from a small helicopter e.g. Robinson R22, and, if possible, landings were made at observed populations for species confirmation and assessment.

Surveys were not without controversy. Some landowners were concerned that the discovery of rare plants on their property might lead to restrictions on the way they could use that land. One prominent landowner publicly refused access and expressed his views in a provincial newspaper. Such access sensitivity has, from time to time, surfaced elsewhere in Otago and in other regions of New Zealand.

High country tenure review botanical surveys

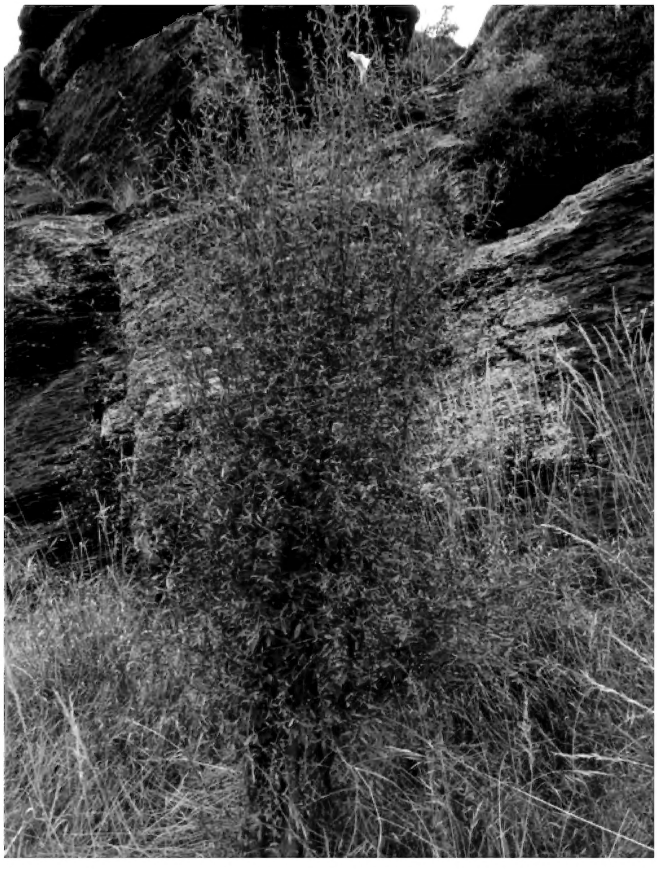
Tenure review is a voluntary process that gives pastoral lessees an opportunity to freehold some of their leasehold land. The rest of the land returns to the Crown ownership, usually for conservation purposes. One of the first stages of a tenure review involves a survey of the lease to determine its significant inherent values leading to the preparation of a conservation resources report. Botanical surveys to support this process describe the vegetation communities present and identify the presence of threatened plants. Many new locations of small-leaved *Olearia* have been discovered through such surveys.

Threatened small-leaved *Olearia* distribution

The combination of targeted surveys, discoveries as part of tenure review surveys, and serendipity, has greatly improved our knowledge of the distribution of threatened small-leaved *Olearia* species.

Threat classification

Data from the survey and assessment programmes for the small-leaved *Olearia* species have been used to inform their conservation status assessment using the New Zealand Threat Classification System (Townsend et al. 2008). Note that the system, established in 2002 was revised in 2008, resulting in some changes to threat categories and definitions (Table 1).



Juvenile *Olearia hectorii* in restoration planting at Flat Top Hill Conservation Area, Central Otago. Photo: John Barkla

Protected areas arising from tenure reviews

One of the outcomes of completed tenure reviews of pastoral leases is the return of land with conservation values to the Crown. Completed tenure reviews on several pastoral leases in the Otago region e.g. Mt Aspiring Pastoral Lease and West Wanaka Pastoral Lease, led to the creation of protected areas and covenants that were driven at least in part by the presence of populations of threatened small-leaved *Olearia* species.

Regeneration trials

Some threatened small-leaved *Olearia* species e.g. *Olearia hectorii*, have populations dominated by large, old trees, with little or no evidence of regeneration. Their presence in often highly modified pastoral environments, where trees are surrounded by dense swards of exotic pasture grasses suggested that these grass swards may be inhibiting *Olearia* regeneration.

To test this, the *Olearia* Recovery Group ran investigations for several years to determine if seedling establishment of *Olearia hectorii* could be improved through spraying herbicide over the grass swards at the bases of relict trees. Spraying in plots underneath *Olearia* trees was timed to ensure that the grass was dead and bare earth available, prior to seed fall. Roundup™ and Touchdown™ were used as knock-down sprays, however subsequent spraying to manage for *Olearia* seedlings used the grass-specific Gallant™. A key problem following initial spraying was a switch from grass dominant swards to herbfields dominated by broadleaved weeds.

Table 1. Threat classifications of target small-leaved *Olearia* 2004-2012

	2004	2009	2012
Olearia hectorii	Nationally Vulnerable	Nationally Endangered	Nationally Endangered
Olearia fimbriata	Serious Decline	Nationally Vulnerable	Nationally Vulnerable
Olearia lineata	Sparse	At Risk - Declining	At Risk - Declining
Olearia fragrantissima	Sparse	At Risk - Declining	At Risk - Declining

It was found that seed beds without competing grasses could be easily created. Getting germination and subsequent seedling establishment however was dependant on rainfall at critical times and this happened only rarely. When it did though, abundant seedlings were produced (up to 4675 seedlings/square metre) and subsequent monitoring showed that at least some of these grew into saplings. No seedlings were produced in monitored plots outside of sprayed areas.

This technique was eventually abandoned as a useful conservation measure due to its unreliability and requirement for significant resources.

Revegetation using threatened *Olearia*

On some public conservation land in the southern South Island e.g. Flat Top Hill Conservation Area, small-leaved *Olearia*, including threatened species, have been widely used to begin the succession from induced grassland back towards native woody communities. Here they have performed well as hardy pioneer species and their inclusion has contributed to the conservation strategies for those species.

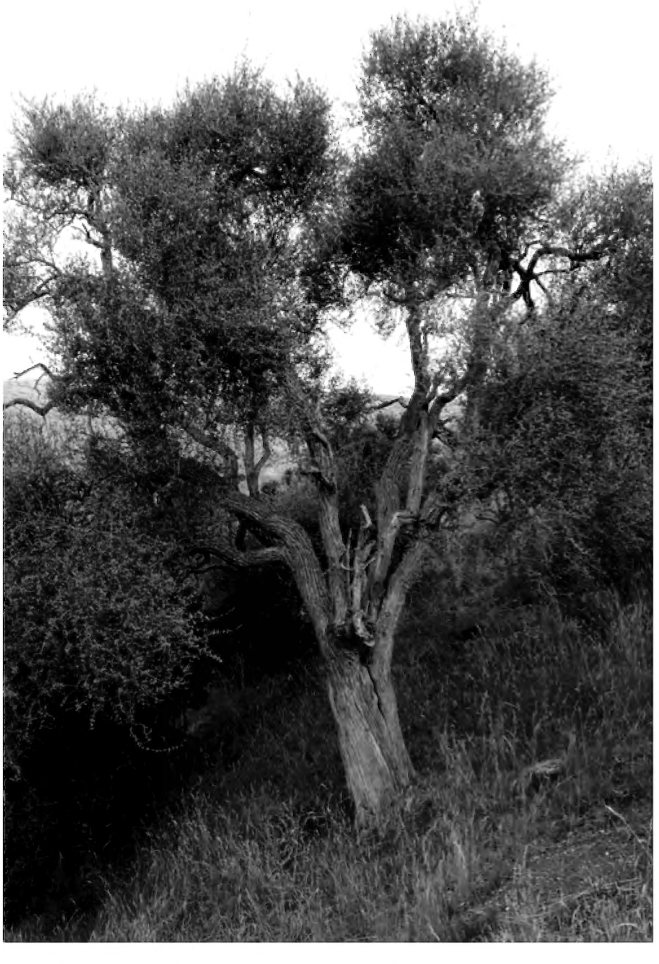
Advocacy

DOC published a series of factsheets on the threatened small-leaved *Olearia* species. The aim of the factsheets is to encourage public awareness of these distinctive New Zealand species, to help people recognise the plants and take an interest in their welfare. The factsheets include photographs, descriptions, habitat requirements and distribution maps.

Specialist native plant nurseries have been encouraged to grow threatened *Olearia* species and to promote their availability for purchase. Interest and demand for these species has been generated through their inclusion in publications (e.g. Otago Regional Council 2005) that list species suitable for riparian restoration.

At a few protected areas where the threatened small-leaved *Olearia* species are being actively managed, on-site interpretation panels have been used to tell the story of their plight and the conservation steps being taken.

Olearia hectorii **tree in pasture on river terrace, Von River, West Otago. Photo: John Barkla**



Olearia fimbriata **in shrub-pasture, North Otago. Photo: John Barkla**

Acknowledgements

Thanks to the many DOC staff, researchers, contractors and landowners who have contributed to finding, understanding and saving threatened small-leaved *Olearia* in southern South Island.

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To graze or not to graze?

TIM LOGAN

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Introduction

Humans have converted 35-36% of the Earth's land to agriculture, causing widespread destruction of native habitat (Foley *et al*. 2007). This trend will continue, as further population growth drives agricultural expansion and increased use of fertilisers and irrigation (Tilman *et al*. 2001). For this reason, land use changes are expected to remain the largest cause of biodiversity loss worldwide (Vitousek 1994) driving declines in ecosystem services. In 1997 global ecosystem services were estimated to be worth double the global gross national product (US$33 trillion – Costanza *et al*. 1997). There is clearly a global need to increase our focus on conserving native biodiversity that remains in anthropogenic landscapes, and to reduce the ecological impact of agriculture. I investigated this imperative on New Zealand's Canterbury Plains. Here, 150 years of burning, stop-banking, and introducing adventive plants has greatly modified indigenous plant communities or displaced them altogether. Traditional dryland grazing practices, consisting of extensive pastoralism with a low to moderate stocking rate, were compatible with the survival of many non-palatable native plants. However, shifts towards more intensive agriculture involving ploughing, irrigating, fertilising and high stocking rates are essentially 'squeezing...herbaceous species between intensification on one side of the fence and dense, uncropped exotic grasses on the other'(Meurk & Greenep 2003).

Today, remaining semi-natural grasslands are dominated by exotic Sweet Vernal (*Anthoxanthum odoratum*) and Brown Top (*Agrostis capillaris*) grasses. Although native woody vegetation (e.g., Kōwhai (*Sophora microphylla*) and Matagouri (*Discaria toumatou*)) remains only in low density, beneath the grasses native herbaceous plants and nonvascular plants are often present. The commonest of these plants include Dwarf Broom (*Carmichaelia corrugata*), and Fan-leaved Mat Daisy (*Raoulia monroi*). Small plants like these make up much of New Zealand's biodiversity (Meurk & Greenep 2003) and are some of the last native vegetation on the Canterbury Plains. However, the dependence of these species upon low-stature communities makes them susceptible to weed invasions and agricultural intensification. This dependency on low-stature vegetation suggests that grazing to maintain a low community height

Dwarf Broom (*Carmichaelia corrugata)* and Creeping Pōhuehue (*Muehlenbeckia axillaris*). Photo credit: Tim Logan

may be crucial to preserving these species. Native plant diversity declines following the intensification of grazing, which indicates that the practices that maximise native biodiversity may differ from those that maximise economic returns. This requirement for intermediate grazing can make these herbaceous plants difficult to manage, especially considering trends of intensifying land use. As such, their future on the Canterbury Plains is uncertain unless an appropriate trade-off or win-win scenario between farming and conservation is reached. I investigated whether win-win scenarios between economic and ecological demands of land use are possible. Specifically, I studied whether grassland management could improve through optimal stock grazing to better conserve native plants. I additionally investigated how environmental conditions affect species composition and the impact of grazing.

Method

To investigate these aims, I performed a field survey in two predominantly exotic grassland sites in McLean's Island, Canterbury Plains, New Zealand. One site was lightly grazed by sheep and cattle (43.479° S, 172.335° E), and the other site was ungrazed (43.468° S, 172.332° E). Rabbits were present throughout. I used stratified sampling to account for variation in micro-topography. I surveyed five randomly placed 1 x 1 metre quadrats per stratum: terrace top, channel floor, north facing scarp, and south facing scarp. In each quadrat, I recorded plant composition by averaging species percent cover in two 25 x 25 cm frames. I also recorded environmental conditions: pH, soil depth, incline, and aspect. I analysed data in R using the vegan package. I used ordination plots to investigate the impact of grazing on vegetation, boxplots to compare species abundance between sites, and accumulation curves to compare diversity.

Results

Grazed quadrats and ungrazed quadrats were highly segregated, indicating that sites had different species compositions (Figure 1a). Native species (Figure 1b) were associated with the grazed site; while exotic species (Figure 1c) were associated with the ungrazed site. There was a large difference in the summed percent cover of native vascular species (Figure 2), which were virtually absent in the ungrazed site. Native nonvascular species abundance appeared unchanged. Native vascular species had lower diversity in the ungrazed site (Figure 3a). This contributed to a decreased percentage of native vascular species out of total species (Figure 3b). Soil depth was the main environmental variable affecting the distribution of quadrats and species within sites (observed in Figure 1). Native percent cover declined with increasing soil depth irrespective of grazing treatment. However, ungrazed quadrats decreased in native cover at shallower soil depths than grazed counterparts.

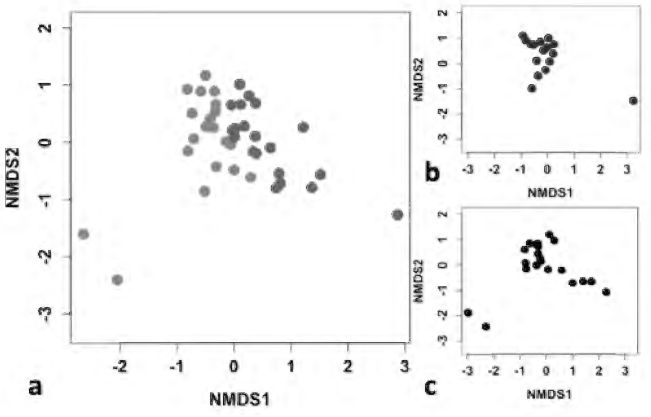

Figure 1 (a) Ordination plot of quadrats separated into grazed (red) and ungrazed (blue). Also shown are ordinations of native species (b) and exotic species (c).

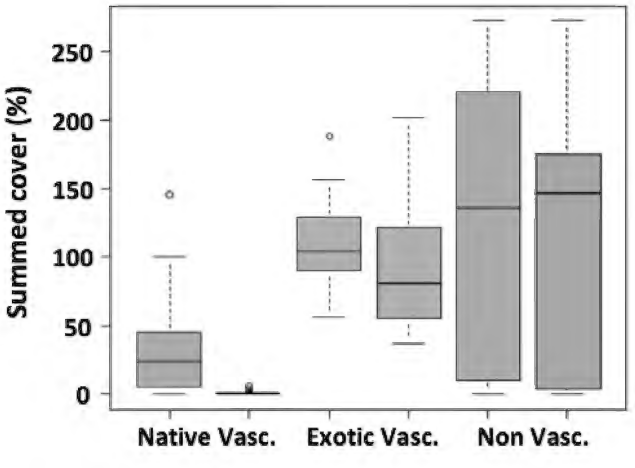

Figure 2. Boxplot comparing native vascular, exotic vascular, and native non-vascular species abundance in grazed (red) and ungrazed (blue) quadrats.

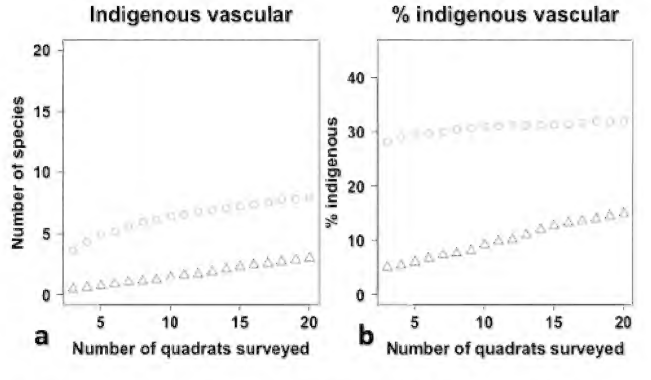

Figure 3. Accumulation curve comparing (a) native vascular species diversity between the grazed (red) and ungrazed (blue) site (b) between sites, the percent of native vascular species out of total species.

My grazed study site, with a small-leaved kōwhai (*Sophora microphylla*) in the centre. Photo credit: Tim Logan

Discussion

Stock grazing improved survival of native species by thinning exotic grasses that otherwise outcompete most native species. This effect was greatest on deep soils (20+ cm). Grazing is a form of disturbance which, like environmental stress, generates low-stature communities; often high in native abundance and diversity. Because stress and disturbance may have interactive effects on vegetation, sites that are highly stressed (soil depths less than 20 cm) could require fewer disturbances than deeper soils to maintain low-stature vegetation. This is likely why shallow soils retained more similar species compositions irrespective of grazing treatment, whereas reduced environmental stress on deeper soils enabled grasses to proliferate in the absence of grazing. Results indicate stock grazing can occur in conjunction with conservation of herbaceous native species. This investigation suggests low to moderate intensity stock grazing could be considered in similar circumstances to achieve ecological goals and make a sustainable income from the land. This indicates a trade-off exists between farming and grassland conservation, although I could not identify a potential win-win situation that maximises both profit and conservation. Further research and creative thinking will yield more compromises and perhaps win-win situations that balance economic and ecological demands of land use. This is essential for the survival of biodiversity in New Zealand and abroad.

Acknowledgements

During high school, I entered this research in the 2014 Canterbury/Westland Science Fair, the New Zealand National Science Fair, and the 2015 European Union Contest for Young Scientists. I'd like to thank Dr Colin Meurk who taught me species identification, Dr Susan Walker who coached me through R , and Prof Jason Tylianakis of Canterbury University and Remco Baars for advice.

Mixed native species, including Fan-Leaved Mat Daisy (*Raoulia monroi*). Photo credit: Tim Logan

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Conservation of Hairy Hazelwood: a propagation and transplantation experience

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Hairy Hazelwood (*Symplocos haroldii*) is a near threatened rainforest species listed under the Queensland Nature Conservation Act 1992 (NCA). It occurs from Beenleigh to Maryborough and west to Yarraman, in Southeast Queensland and described as a shrub or small tree to eight metres in height. It is found in the lower to mid stratum of tall to very tall subtropical and dry rainforest habitats where it requires full to semi-shade and prefers fertile soils on moderate slopes, alluvial flood plains and swales within sandy coastal dunes.

In 2012, 25 Hairy Hazelwood specimens were identified within the footprint of the Bruce Highway upgrade between Cooroy and Federal, located in the Noosa Shire local government area (see Figure 1). Of the 25 individuals identified, 24 were sub-adults and juveniles and one mature individual. All specimens were located in mapped remnant vegetation (Regional Ecosystems 12.11.2/12.11.3) (Sattler and Williams, 1999), however the area when ground-truthed was considered disturbed, with thickets of Lantana (*Lantana camara*) present.

A clearing permit under the NCA was issued to remove the 25 Hairy Hazelwoods. The permit conditioned a program of propagation and transplantation, along with the identification and protection of a receiving site, and the development of an Offset Management Plan.

Receiving site

A detailed desktop assessment identified possible transplantation sites. The site analysis considered the ecological requirements of the species and land suitability, specifically tenure; construction footprint; zoning; slope; aspect; proximity to drainage lines; accessibility; vegetation community; and distance from impacted and remaining Hairy Hazelwoods. A number of sites met the criteria and progressed to ground-truthing. The site that best met the criteria and ultimately selected as the receiving site, is a vegetated parcel of land in Federal, Queensland, less than 5 km from the Yurol Forest Nature Reserve site (as discussed below). The receiving site was not however identical in conditions (exposure) or landscape position (topography and orientation) to the area of impact nor the location of the nearby population in Yurol State Nature Reserve. It did however support two previously unrecorded Hairy Hazelwoods.

Receiving site preparation

Weed management work within the receiving site was undertaken prior to the transplantation activities. This targeted a number of common environmental weeds including camphor laurel (*Cinnamomum camphora*), corky passion vine (*Passiflora suberosa*) and broad-leaved paspalum (*Paspalum mandiocanum*). The removal of all understorey weeds occurred prior to planting activities, with specific emphasis on understorey camphor laurels. Retention of over-storey camphor laurels aimed to replicate an enclosed environment.

Propagation

Round one

Propagation material was collected in autumn 2012 from a population of greater than 20 Hairy Hazelwoods from within the Yurol Forest Nature Reserve. These individuals were located approximately three kilometres from the receiving site and impacted individuals, and occurred in an area of disturbed, wet sclerophyll forest. Branch tips (100 mm long) were taken from healthy Hairy Hazelwoods with sterilised secateurs. These were transported to the nursery after being wet down in the field and transported in a sealed container to reduce evaporation.

Approximately two-thirds of the cuttings' lower leaves were removed. Cutting were then planted in a community tray with composted pine bark fines and placed on a heat mat (28 ˚C) under a misting system. After root development, approximately 60 cuttings were potted into tubes with slow release fertiliser. Potted plants were grown in 50% shade until autumn 2013, after a decline in plant health became evident (loss of vigour, eventual leaf drop and slow mortality) in late 2012.

Round two

As the planting program had a set timeframe and due to the low survival rate, a second nursery was engaged to undertake additional propagation activities.

Material for the second round was sourced in October 2012 from 14 of the impacted 25 Hairy Hazelwoods. The propagation material was collected in line with the first propagation activity. Six hundred cuttings were prepared, treated with Seasol and transferred into a hot house/propagation tunnel, with regular misting.

Despite a 95% cutting survival rate, only a 30% strike rate was observed by December 2012. A further two hundred cuttings were taken but again resulted in a low strike rate. Following this, an additional 320 larger cuttings (200 mm in length) were taken during 2013-14. The larger cuttings were observed to have a better strike rate than the 100 mm cuttings, with these cuttings moved to a 30% shade house in spring 2013. One hundred and fifty Hairy Hazelwoods were re-potted into mega-tubes in summer 2013. Once potted they received weekly tree and liquid plant tonic.

During all nursery phases, the Hairy Hazelwoods' growth was slow and erratic. By early 2014 declining health was observed as a result of an unknown pathogen.

Round three

In late 2014, a third round of propagation commenced. Material was collected from the established individuals in the receiving site. This was undertaken in a similar manner to the other propagation activities, with the exception of humus from the receiving site being added to the potting medium and the cuttings planted directly into tubes. This potting medium inoculation aimed to add mycorrhizal fungi for increased cutting health and resilience. This stock was grown in the nursery for a shorter period, designed to reduce their susceptibility to the unknown pathogen(s).

Plant out and maintenance

In autumn 2014, 75 propagated Hairy Hazelwoods from the Round 2 propagation activities were planted, mulched and guarded at the receiving site. These plants were bucket watered at planting and holes were at least 50% larger than the container (90 mm x 150 mm) at 3-5 metre centres. Each plant received slow release fertiliser/soil conditioner at planting.

Supplementary planting of an additional 195 propagated Hairy Hazelwoods from Round 3 propagation activities occurred throughout summer and autumn 2015 and summer 2016, as plant losses from previous planting activities had occurred. These new plantings were undertaken in a consistent manner to those in autumn 2014, with the exception these plants were smaller but with sufficient root development (guided by their capacity to hold the potting medium when removed from a tube).

Maintenance of the site occurred after planting to reduce competition. Generally this involved removal of common environmental weeds present prior to planting. Due to limited accessibility, no watering activities occurred after plant out. Fire management was also considered during the maintenance phase, but no action was required.

Despite ongoing maintenance and monitoring of the Hairy Hazelwoods, the survival rate was extremely low, with only seven individuals remaining on the receiving site. Tree guards remain in place as plant size does not justify their removal.

Figure 1. General location of Hairy Hazelwood activites.

Conclusion

Qualified nursery and bush regeneration specialists undertook all activities, however the survival of Hairy Hazelwoods in all phases has been extremely poor. This program of works has faced challenges including significant plant losses due to unknown fungal pathogen(s) within the nursery setting, leading to smaller sized individuals planted at the receiving site. From observation, the fungal pathogen(s) affects the plant foliage most significantly. Watering regimes (field and nursery) also appear to influence the survival of Hairy Hazelwoods. The effect of water stress after plant out, with factors such as accessibility and topography, in combination with unseasonal dry weather seemed to have impacted the plants' survival. The build-up of leaf litter around the plants at the receiving site between maintenance rounds may also have impacted the plants. However, none of these hypotheses have been tested and could be examined in future studies.

Mycorrhizal association appears to be extremely important for Hairy Hazelwoods. Planting stock establishment was improved when planted near existing Hairy Hazelwoods and improved resilience of cuttings observed when potting medium had humus from areas known to support Hairy Hazelwoods incorporated.

For future Hairy Hazelwood activities the following may improve results:

- Consistent watering within both the nursery and plant out locations, including protection from heavy, unseasonal rain events.
- Implementation of a nursery-based systematic fungicide treatment.
- Inoculation of potting medium with soil from locations with naturally occurring Hairy Hazelwoods.
- Potential use of Hairy Hazelwood seeds or physical translocation of impacted plants.

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The Red Hot List of threatened plants – But which species do you choose?

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Threatened plants tend to receive less attention than threatened animals, yet the loss of native plant species is as devastating and irreversible. This is why the Threatened Species Recovery Hub has dedicated a project to building a Red Hot List for Australia's most imperilled plants. This article explains that while the task shares many similarities with the development of the animal list, focussing on plants comes with its own unique set of challenges.

Australia has many threatened plants; around 1150 species are listed as Endangered or Critically Endangered under State or Federal laws. That's around 5% of our known plant species, and many of these are extremely vulnerable. For example, a fifth survive in only a single population, while 60% are known from five or fewer populations.

Think about that; the rarity and tiny distribution of many of these species make them highly vulnerable to human impacts and chance events. If the wrong patch of scrub is cleared for a development or a wildfire scorches an area, we could lose a species forever.

Fifty Australian plant species are presumed to have become extinct since 1788. The idea of the Red Hot List is to identify those plants that are on the edge and could go over if we don't do something.

The aim is to highlight the plight of Australia's most imperilled plant species (those at risk of extinction within the foreseeable future), identify and prioritise conservation actions, and alert community groups, scientists and landholders and managers.

Developing a Red Hot List

So, the first action here is to develop a concise statement of the state of play for the 1150 species of threatened plants currently listed in Australia. This will be done by gathering data from over 100 plant experts. This data includes information on current threats and population trends.

To be eligible for the Red Hot list, a species must be rare *and* declining from threats that we can feasibly overcome. This rules out most 'narrow-range endemics' – naturally rare or restricted species such as trees or shrubs that grow only on a few mountain tops or rocky outcrops. These species often occur in remote and inaccessible habitats and while their distribution is small they typically have few threats, aside from the looming spectre of climate change.

The majority of species I assessed, around 60%, have suffered massive declines from habitat destruction, usually for agriculture and sometimes urban development. Remaining populations of these threatened plant species are restricted to small remnants, often on roadsides or in rail reserves. These remnants are susceptible to destruction, disturbance, weeds, disease, and chance events such as fire.

The good news is that where monitoring has been undertaken, the populations of many species appear to be stable or even increasing. Conserving these species is often a matter of safeguarding their habitat and keeping an eye on them.

That leaves 251 plants on the shortlist for the Red Hot List. Of these, 61 species (6% of assessed species) show evidence of continuing decline and 190 species (18%) have suspected or predicted declines but lack monitoring data.

In addition to ongoing habitat loss (from urban expansion and agriculture), the major threats causing recent declines in these threatened plant species are: inappropriate disturbances on roadsides and in rail reserves; weed invasion (especially vigorous perennial grasses which take over entire habitats and can increase fire frequency and intensity); and disease (such as phytophthora dieback and myrtle rust).

***Ballantinia antipoda*. Photo: Paul Foreman**

A wreath of rarely-seen plants growing by a remote salt lake accessed by camel trek. Photo: Ilse Pickerd

Threats such as inappropriate fire regimes and grazing don't seem as pressing, and their severity has not been established for many species. Climate change is considered a threat at high altitudes and for species vulnerable to extended dry periods, but there is uncertainty about the impacts on most species.

Of lists and flagships

In an attempt to winnow our shortlist down even further, we have clumped our threatened plant species geographically and taxonomically – most occur where centres of endemism intersect with broad-scale threats, and some plant groups have a disproportionate number of threatened species.

To engage as many community groups as possible (and to raise the profile of threatened plants in general), the Red Hot List will include a diverse and dispersed range of species. Preference will be given to plants that can serve as 'flagships' to leverage conservation effort to benefit a suite of species or a habitat type.

Flagships include ground orchids with small, fragmented populations; shrubs and herbaceous plants restricted to remnants in southwest Western Australia and southeast South Australia; plants from rapidly urbanising areas such as southeast Queensland, south of Darwin, western Sydney and the Victorian Volcanic Plain; victims of dieback in Stirling Range montane heath; and plants

A botanical wonderland in the Simpson Desert, far western Queensland, after exceptional rainfall, with numerous poorly-known species including the rare and restricted shrub *Maireana lanosa*. Photo: Jen Silcock

in imperilled habitats such as the eastern lowland rainforests, fertile grasslands in higher-rainfall areas and desert springs.

Another flagship is plants which require disturbance to germinate and complete their life-cycle. The West Australian shrub *Daviesia microcarpa* was presumed extinct until roadside grading triggered germination. The Atherton Tableland shrub *Solanum hamulosum* became so common and troublesome during the rainforest clearing years of the 1930s and 40s that it was dubbed the 'Dirran curse'. The only large populations seen in recent years were in cyclone damaged forests.

The 'disturbance-dependent' flagship challenges our notion of rare plants needing to be 'locked up' for their protection. Because if we did lock them up and remove all 'threats', we may well consign these species to extinction.

Known unknowns and forgotten species

Many rare species beyond population centres are neglected, and we simply don't know how they are faring. We have put these in a 'data-deficient' category, and the aim will be to engage botanists to go out and actively look for them – or go for a look ourselves. Most will require baseline counts and monitoring.

There are also species not on any list that might be good candidates for the Red Hot List. They may have slipped through the sometimes haphazard listing processes, or have been recently discovered or described. Even after 200 years of scientific effort, botanists are still finding 'new' species, particularly in remote areas such as the Kimberley. By interviewing experts we aim to identify these species, so they don't slip away unnoticed – "no surprises, no regrets" is our mantra.

The challenges of developing this list are considerable; the dimensions of the problem of threatened plant species are enormous. Sometimes the size of the problem can be depressing. What I have found uplifting in this work, however, is the dedication and knowledge of people working to save many of these plants. And I feel privileged to be a part of this work. Over the next couple of years, I will get to meet some of these people and the plants they work on.

It will be a botanical journey around our vast and beautiful land that promises as many enigmas as it does answers, encounters both inspirational and saddening, and no end of surprises.

Acknowledgement

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***Darwinia whicherensis*. Photo: Andrew Webb**

***Geranium* sp. Photo: Neville Walsh**

Response to Ridgeway *et al.* (2017)

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We would like to respond to the article *Evidence-based provenance: building informed provenance in the Cumberland Plain* by Ridgeway *et al*. (2017) in Vol 26 (1) edition of the Australasian Plant Conservation Bulletin. We believe that the Climate-ready Revegetation Guide (http://anpc.asn.au/resources/climate_ready_revegetation) has been misinterpreted and misrepresented. We seek to clarify these points as suggested by the Editor, Paul Adam, and we note that the Editor's reading of the Guide also differs from that of Ridgeway *et al*. (2017). We agree with the Editor, that the issues around 'Provenance' are not simple, and that a black and white view is unhelpful. Climate change raises challenges for restoration efforts, making informed dialogue all the more important.

The Guide provides guidance, but does not give prescriptive advice and this is emphasized many times in the text. There is much that we do not know about the effects of climate change on vegetation communities, species and local populations. But we do know that impacts on the distribution, life cycles, behavior and physiology of species are already being observed, and that population extirpations and species extinctions are increasingly likely (e.g. Pecl *et al.* 2017). We also know that species differ in their vulnerability and the pace at which they can adapt. The complexity and variability of species responses are problematic for natural resource management and the Guide provides a tool box to assist in planning revegetation programs. The aim of the Guide is to raise awareness of available methods to help with planning, and to provide step-by-step instructions for users.

Ridgeway *et al.*'s interpretation of the Climate-ready Revegetation Guide makes a number of erroneous assertions. First, the paper states that the Guide *'excludes the planting of any species not present at analogue sites. (Step 2)'*. This is not the case - the Guide does not recommend the exclusion of any species. Rather, as one of many steps, it discusses considerations for the inclusion of plants from outside the local area. This is a strategy of last resort if the persistence of existing key species is doubtful under climate change (Step 2.5).

Second, Ridgeway *et al.*'s choice to use the 'maximum consensus' future impact in the Climate Analogues tool may have contributed to the low number of endemic species found in analogue sites. Maximum consensus reflects only the amount of agreement between climate models, so it will project the narrowest future climate, not the most likely. As stated in the Guide, to incorporate the uncertainty of climate projections, a more informative approach is to consider a best case and a worst case scenario.

Finally, we query the evidence put forward by Ridgeway *et al*. that leads them to conclude there is no competitive advantage for climate–ready revegetation in the Cumberland Plain. The "only local studies" (Hancock *et al*. 2013, Hancock & Hughes, 2014) did in fact find evidence that non-local provenance plants had superior growth compared to the local Cumberland Plain provenance plants. In a warming experiment, Hancock & Hughes (2014) found that the local provenance plants of *Eucalyptus tereticornis* were significantly smaller for two of three growth traits than one of the more northerly non-local provenance plants. In addition, the local provenance plants suffered significantly more herbivory than the most northerly provenance plants under ambient conditions. Hancock *et al*. (2013) investigated the "local is best" theory using common Cumberland Plain species and found that the local provenance plants demonstrated superior survival and growth for only two of the six species investigated.

Ridgeway *et al*. caution against generic application of provenance approaches and that climate is not the only factor limiting a species distribution or planting requirements. We agree, and explicitly make these same points several times in the Guide.

We join with Ridgeway *et al*. in encouraging helpful and respectful discussions on how to better integrate local field data and expertise into provenance discussions, and extend this to include the practice of ecological restoration. We encourage practitioners who are willing to embed research into provenance strategies and climate adaptiveness/readiness into new revegetation projects to contact Linda Broadhurst linda.broadhurst@csiro.au and join the newly formed Environmental Research Infrastructure Network (Broadhurst *et al*. 2017).

We would also like to take this opportunity to advise readers of the Guide that an update sheet has been produced to note some minor changes in some of the websites (https://www.mq.edu.au/research/research-centres-groups-and-facilities/secure-planet/centres/biodiversity-node/our-projects – download the 'updates' document found under Current projects / Climate-ready revegetation).

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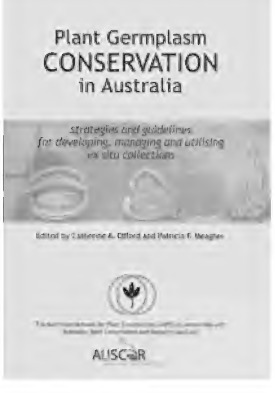

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Member Profile

Tim Logan

Past student at Darfield High School. Present student at the University of Canterbury
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What are you working on at the moment?

I am currently pursuing a Bachelor of Science, majoring in biological sciences, at the University of Canterbury. I will finish this degree at the end of 2018, after which I will likely continue on with post-graduate studies.

How did you become interested in plant conservation?

After living overseas, I returned to New Zealand at the age of 12 with high hopes and expectations about New Zealand's natural environment. However, I was sorely disappointed when I arrived in Christchurch and saw the monoculture that is the Canterbury Plains. After this realisation I became driven to do what I could to bring back the native plants, birds, lizards, and insects that once called this region home. I also realised that to attract the animals, I needed to start with restoring the habitat.

So after a lot of persuasion, my parents agreed to reserve a small portion of our property for planting. Although, after contacting various trusts and organisations I learnt that we could get funding assistance and then afford to make it even larger. So the restoration site grew from just 150m^2 to over 2,100m^2. My goal is to restore a tōtara/mataī forest, dryland woodland, and shrubland. We have planted each year since 2012 to achieve this goal, and the area is almost completely filled now.

In 2013 I attended a field trip held by the local botanical society. We travelled to the dry grasslands along the local Waimakariri River. After searching beneath the grass for hours, I became fascinated with the small native plants of this area. However, I was horrified to learn about the lack of protection these grasslands are given, especially considering that they are some of the last areas of native vegetation on the plains. So I set out to do what I could to protect them. As most of these grasslands are extensively farmed, I wanted to know what effect stock grazing has on these plants. Some time went by from this point until my year 11 biology teacher encouraged me to act. I then started planning my research and refining my methods, until I began collecting data in the summer of 2013/2014. More detail on this research project is available in my paper featured in this APC bulletin.

In recognition of my restoration site and research, I received the 2013 New Zealand Plant Conservationist of the Year Award from the New Zealand Plant Conservation Network. Partway through completing my research project I realised it would be applicable for a science fair.

T.M. Logan

So I entered it in the 2014 Canterbury/Westland science fair under the name "To graze or not to graze". In this science fair I won eight awards including Best in Fair. I was then encouraged to enter the New Zealand national science fair where I received the Supreme Award. It was also around this time that I was presented with the 2014 Prime Minister's Future Scientist Prize. Finally, in 2015 I traveled to Italy to compete in the European Union Contest for Young Scientists, where I was awarded third place after several days of intensive judging.

Why do you think the ANPC and NZPCN networks are important?

In my experience, there is a general lack of outcry over the loss of native plants, particularly those of a more diminutive stature. This could be because rare plants don't usually elicit as strong a conservation response as, for example, most rare animals do. For this reason, I see the ANPC and NZPCN as being crucial in securing the survival of vulnerable native plants. This is especially true in regards to small, quirky, or obscure species that are not currently appreciated by the general public.

What is your favourite plant?

As challenging as it is to identify my single favourite plant - I have eventually decided on *Carmichaelia corrugata*, also known as Common Dwarf Broom. This New Zealand native is 'at risk – declining', although it is thankfully still relatively common in particular grasslands along the Waimakariri River, where I first encountered it. This vibrant green plant can be found on dry soils, and, although small and ordinarily inconspicuous, it is beautiful up close. This is particularly true when displaying its mauve and white flowers. This is my favorite plant owing to its resilience and unusual appeal.

News from the Australian Seed Bank Partnership

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It all becomes a lot easier with partners!

The Australian Seed Bank Partnership (ASBP) is a national partnership of seed banks and conservation organisations operating throughout mainland Australia, and its island territories. We focus our efforts on *ex situ* conservation of native plant species through seed banking and research. Each of the nine partners operate within their respective state or territory with collaboration across jurisdictional borders a common activity. The ASBP is the evolution of many years of collaboration across the Australian seed banking community, supported by the Royal Botanic Gardens, Kew and complemented by funding and in-kind investment from our partner organisations. Kew's Millennium Seed Bank (MSB) signed their first Access and Benefit Sharing Agreement with Western Australia's Threatened Flora Seed Centre and Kings Park and Botanic Garden in 2001, and has invested in seed collecting and capacity building to support Australian plant conservation ever since.

Our seed collectors primarily focus their efforts within state and territory borders, which can present conservation challenges for those species and communities that extend beyond jurisdictional boundaries. The ASBP's ability to coordinate seed collecting effort often results in better outcomes for native species conservation at the local, regional and national levels. Our shared collections have been the catalyst for research that improves our shared knowledge of the biology and ecology of seed storage and germination of many native species.

Over the past three years ASBP partners have been working on a Global Trees Project, funded by the Garfield Weston Foundation and the Millennium Seed Bank Partnership. The Australian National Botanic Gardens (ANBG), Canberra and George Brown Darwin Botanic Gardens (GBDBG) have been working collaboratively on one component of this project to secure seed collections of little studied and previously unbanked tree species from Kakadu National Park (Kakadu NP).

Our collaborative approach to collecting has enabled us to leverage resources from other concurrent projects, including the 1000 Species Project (another MSB Partnership /ASBP administered project) and a Kakadu Threatened Species Seed Banking project, to further bolster our seed collections and deliver greater conservation and knowledge sharing outcomes for Kakadu NP. Through this particular partnership approach, the ANBG, GBDBG and Kakadu NP have worked together to conserve rare and endemic species that are vulnerable to a variety of potential threats including altered fire regimes, climate change and Myrtle Rust.

Andrew Lawson and Anthony Sullivan collecting threatened species in Kakadu, May 2016. Photo: Ben Wirf

Due to the size and diversity of ecosystems within Kakadu NP, as well as the seasonality of seed collecting, preparations required the involvement and cooperation of institutions in Canberra, the Northern Territory, Kakadu NP staff and traditional owners. We invited representative traditional owners from the Wurrkbarbar/Jawoyn, Mirarr/Gundjeihmi, Manilikar, Djok, and Murruwan clans to meet with us and discuss our proposed sites for seed collection. This consultation provided the opportunity to seek permission to collect on traditionally owned lands and also invite traditional owners to help us collect seed on country.

Seed-collectors-in-training joined staff from the ANBG National Seed Bank and GBDBG to collect on country throughout Kakadu NP. These relationships continue to develop and are mutually beneficial, as Indigenous Australians hold local knowledge of plant locations, seed maturation times and economic usage of seed. As skilled seed biologists we provide traditional owners with conservation seed banking tools that can safeguard plants of cultural value. Our collaboration also helps to secure broader research and conservation outcomes.

Rachel Martin, Bessie Coleman and Ben Wirf collecting *Jacksonia divisa* in the field and (inset), a healthy seedling at George Brown Darwin Botanic Gardens. Main Photo: John Westaway. Inset Photo: Ben Wirf, GBDBG

Unfortunately, below average rainfall between 2014 and 2016 limited the flowering and fruiting of some species and we were unable to collect sufficient seed for a number of target species. In these instances the collection of cuttings has been a good strategy for complementing low stocks of seed collection material. This approach ensures *ex situ* conservation of target species can continue, and these cuttings are now in propagation for seed orcharding in the nurseries at ANBG and GBDBG.

Overall we conducted four joint field trips in May, August and December of 2015 and October 2016, during which we sampled at least 94 species and made 110 seed collections. A further two collecting trips were conducted in May and October of 2017 by ANBG, collecting a further 165 accessions of 129 species. The GBDBG made additional trips to Kakadu NP in 2016 and 2017 and continued to collect across the Northern Territory securing species found outside of Kakadu NP and those that are attainable on shorter, one-day collecting trips outside of Darwin. Some of these species are locally

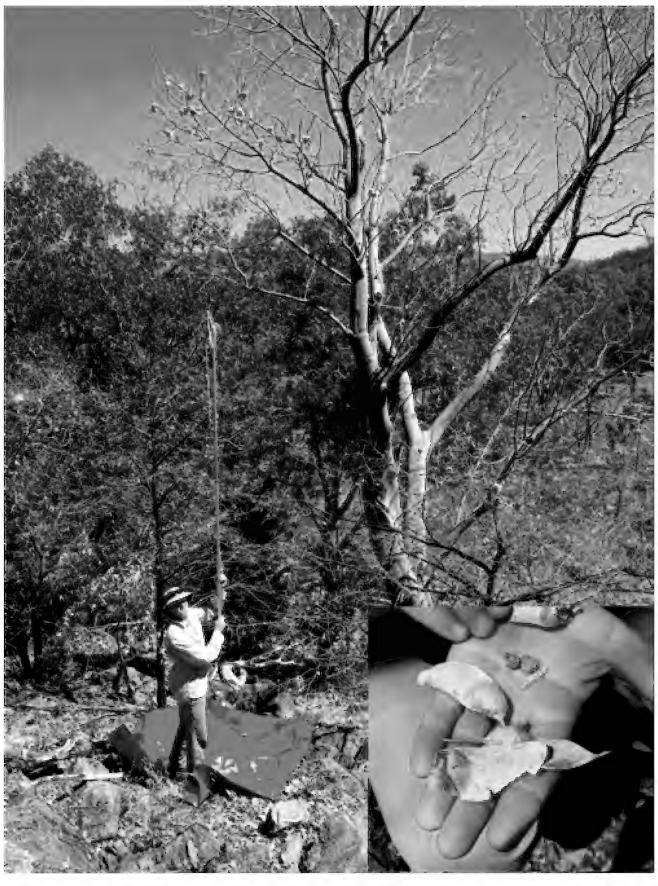
Left to right: Cutting grown plants in GBDBG nursery – *Lithomyrtus linariifolia* (Vulnerable), *Hibbertia pancerea* (Vulnerable), and *Boronia grandisepala* subsp. *acanthophida* (Near Threatened). Photos: Ben Wirf, GBDBG

endemic and at risk of habitat loss from peri-urban development and associated threats such as fire and weeds. Our combined collecting efforts have led to the successful seed banking of more than 60 data deficient and Territory listed threatened species as well as six EPBC listed species, most of which have never been collected or grown in cultivation before.

The seed banking of priority listed threatened, endemic and rare species, as well as those with economic potential provides options for their use into the future. Some of the key genera collected from Kakadu NP include some quite charismatic species. We have managed to secure collections of the native nutmeg (*Myristica insipida*); Quinine tree (*Petalostigma pubescens*); Strychnine (*Strychnos lucida*); Native grape (*Ampelocissus acetose*) as well as the striking *Hildegardia australiensis*, known from only a few scattered populations in Kakadu NP and Arnhem Land. It is also the single Australian member of this pantropical genus.

The standout from the collaborative efforts of ANBG, GBDBG, Kakadu NP Rangers and traditional owners has been the collection of the two EPBC listed threatened species found within Kakadu NP-*Acacia equisetifolia* and *Hibiscus brennanii.* Both species are at risk from an increase in fire frequency within Kakadu NP. The ANBG has been working hard to refine the techniques for collecting maternal genotypes from target species to secure the adequate genetic representation of species in *ex situ* collections, and we have now completed this for both *Acacia equisetifolia* and *Hibiscus brennanii*. By holding seed, cuttings and live plants at ANBG and GBDBG we have material available for translocation of both species if the need should arise.

In the hectic life of seed banking we sometimes forget to reflect on what we achieve as individuals and as a partnership. Like many of those involved in plant conservation, our achievements can be overlooked in the pursuit of the next collection, the delivery of the next research project or when writing up our next funding bid. However it is important that we share our achievements and learn from each other to secure better outcomes for plant conservation. We believe a partnership approach to seed conservation, including collaborations with a range of organisations and communities, helps to secure critical seed collections and research that underpin better conservation outcomes for Australia's native plants. It's also a great way to meet other like-minded plant enthusiasts!



Tom North harvesting fruits and seeds (inset) of the unique, endemic tree *Hildegardia australiensis* in Kakadu National Park, August 2015. Main Photo: Ben Wirf. Inset Photo: Tom North, ANBG

Participation and in-field training in seed collection during the August 2015 trip with Johnny Reid, Enoch Ngona, Dan Wilkins, Doug Wade and Lucas Fiddaman. Photo: Tom North, ANBG

News

'Plants Going Places' – Presentation slides and audio files now available on the ANPC website!

Read and listen to a range of presentations by local and national experts from the successful Threatened Plants Translocation Information Day held in August 2017. Learn more about plant translocation in Australia with presentations on provenance, the science of translocation, monitoring, licensing, policy and numerous case studies including *Asterolasia buxifolia*, *Fontainea oraria*, *Persoonia pauciflora*, and *Wollemia nobilis*. Organised by the ANPC and the Threatened Species Recovery Hub (TSR Hub), with support from the NSW Office of Environment and Heritage and the Royal Botanic Garden Sydney http://anpc.asn.au/workshops/translocation_sydney

ANPC Annual General Meeting held 29 November 2017

The Annual General Meeting of the Australian Network for Plant Conservation Inc. (ANPC) was held on Wednesday 29 November 2017 at the Australian National Botanic Gardens, Canberra. Linda Broadhurst was renominated as President and Bob Makinson as Vice-President. We welcome Chris Ikin as our new Treasurer and Andrew Crawford, Selga Harrington and Kylie Moritz as new Ordinary Members of the ANPC Management Committee and thank them for their nominations. Kate Brown, David Coates, Paul Gibson-Roy, Maria Matthes were renominated as Ordinary Members. Many thanks to Doug Bickerton, Anne Cochrane and Natalie Tapson who stepped down from the committee this year, and to Merryl Bradley who retired from the Treasurer position after 4 years. Read the President's Report on what the ANPC has achieved over the last year here http://anpc.asn.au/committee

Flora of Australia now available online

Flora of Australia is available on a new digital platform that makes Australia's plant taxonomic information more accessible and user-friendly. It has information on the names, characteristics, distribution and habitat of Australian plants—14,000 profiles are already available online, with more on the way. While the main audience is botanists, Flora of Australia will also be useful for conservation and land managers, government/policy makers, researchers and members of the community with an interest in Australian plants. The new digital Flora of Australia was a joint project of the Australian Biological Resources Study, the Council of Heads of Australasian Herbaria and the Atlas of Living Australia. https://profiles.ala.org.au/opus/foa

National Threatened Species Day at the ANBG

This short video was released on National Threatened Species Day 7 September 2017 which shows how the Australian National Botanic Gardens contributes to the protection of threatened plants. See Senior Curator David Taylor's selfie in front of *Banksia vincentia* which has less than 10 plants left in the wild! https://www.facebook.com/AustralianNationalBotanicGardens/videos/10156675837239408/

Protecting threatened plants at the Royal Tasmanian Botanic Gardens

Read about what the Royal Tasmanian Botanic Gardens is doing to save many of the 400 threatened Tasmanian plants, and how ANPC Committee member Natalie Tapson collected critically endangered cushion plant seeds on Macquarie Island last summer! http://www.abc.net.au/news/2017-09-07/protecting-threatened-plants-at-the-tasmanian-botanical-gardens/8881220

World's botanic gardens contain a third of all known plant species, and help protect the most threatened

A study published in the journal *Nature Plants* found that the global network of botanic gardens conserves almost two-thirds of plant genera and over 90% of plant families, including 41% of all those classed as 'threatened'. However, researchers also discovered a significant imbalance between temperate and tropical regions. Some 60% of temperate plant species were represented in botanic gardens but only 25% of tropical species, despite the fact that the majority of plant species are tropical. https://www.sciencedaily.com/releases/2017/09/170925111338.htm

Critically endangered banksia found near Upper Lansdowne

A new population of the critically endangered Glasshouse banksia (*Banksia conferta*) has been discovered in Coorabakh National Park, north-east of Taree, highlighting how much we still don't know about our endangered plants. http://www.manningrivertimes.com.au/story/4789432/critically-endangered-banksia-found-near-upper-lansdowne/?platform=hootsuite

Geosiris australiensis: the recently discovered flower of the Daintree

A new flower, *Geosiris australiensis*, was discovered by amateur botanists, Tim Hawke and Tony de Groot in the Daintree Rainforest. Botanists say that the new discovery demonstrates how little we know about the ancient rainforest, situated in the north east coast of Queensland. *Geosiris australiensis* was native to the Gondwanan rainforests and is said to be closely related to *Geosiris albifloria* and *Geosiris aphylla* that are only found on the islands of Madagascar and Mayotte. http://www.australiangeographic.com.au/news/2017/07/new-species-of-flower-found-in-the-daintree-rainforest

Wee Jasper Grevillea flowers in nature reserve for the first time in 20 years

The threatened *Grevillea iaspicula* has flowered in the Burrinjuck Nature Reserve for the first time in two decades thanks to fencing and feral goat control. The Wee Jasper Grevillea is only found naturally at six sites around the Lake Burrinjuck and Wee Jasper areas in southern NSW. In total there are only about 100 mature plants left in the wild, making it one of Australia's rarest plants. Read more about the threats to the Wee Jasper Grevillea and the measures taken to protect it here http://www.australiangeographic.com.au/news/2017/08/wee-jasper-grevillea-flowers-in-nature-reserve-for-the-first-time-in-20-years

Six Australian plant species saved from the brink

Take a look at some of Australia's endangered plants including the orchid *Caladenia hastata,* which narrowly avoided extinction as a result of successful translocations. http://www.australiangeographic.com.au/topics/science-environment/2017/09/six-australian-plant-species-saved-from-the-brink

Kennedy Exploration botanist William Carron honoured by artist who retraced his steps

Botanical artist Janet Hauser recently retraced the path of an 1848 botanical expedition through Far North Queensland. She hopes that her work will bring wider recognition to botanist William Carron who was one of only three survivors of the expedition. http://www.abc.net.au/news/2017-08-16/artist-retraces-steps-of-william-carron/8794388

New research unlocks the mystery of leaf size

New research analysing leaves from more than 7600 species has found that the limiting factor for leaf size is night temperature and risk of frost damage to leaves. The findings published in Science will be used to improve global vegetation models, which are used to predict how vegetation will change under climate change. https://theconversation.com/new-research-unlocks-the-mystery-of-leaf-size-83294

Wasps seduced by sulfurous spider orchid signals

The chemicals orchids use to attract their amorous insect pollinators have been identified. A set of hitherto unknown sulfur-based natural products that orchids produce to attract their wasp pollinators has been identified by researchers in Australia. Orchids are known for having elaborate and unusual ways of attracting insects. Some species produce chemical signals that mimic the pheromones of a female insect in the hope that they can coat confused males with pollen as they try to mate with the flower. https://www.chemistryworld.com/news/seductive-sulfurs-woo-wasps/3007333.article#commentsJump

Review of historic stock routes may put rare stretches of native plants and animals at risk

Travelling stock reserves across New South Wales represent some of the most intact examples of now-endangered temperate grassy woodland ecosystems. A government review into the Travelling Stock reserve network could see the public ownership move into private hands. A study published in the *Australian Journal of Botany* suggests that privatising stock routes may endanger vital woodlands and put vulnerable species at risk. https://theconversation.com/review-of-historic-stock-routes-may-put-rare-stretches-of-native-plants-and-animals-at-risk-84049

Let's get this straight, habitat loss is the number-one threat to Australia's species

Habitat destruction; overhunting or overexploitation; the presence of introduced species; chains of linked ecological changes; disease outbreaks and climate change are all threatening processes that drive species to extinction. Read the response by Brendan Wintle and Sarah Bekessy to the outgoing Threatened Species Commissioner Gregory Andrews' comment that habitat loss is not the biggest threat to threatened species in Australia. https://theconversation.com/lets-get-this-straight-habitat-loss-is-the-number-one-threat-to-australias-species-85674

'If we could talk to trees'

Science is slowly revealing the language of plants. It's intricate, sophisticated and might change the way we see the world. A new book co-edited by Dr John C. Ryan includes new scientific research that is revealing an extraordinary world of communication and something close to thought among this planet's oldest, original inhabitants: plants. http://www.abc.net.au/radionational/programs/blueprintforliving/if-we-could-talk-to-trees/8820424

Plants in the southern hemisphere

We know that the southern continents were once united as the supercontinent Gondwana. So does this explain the links between the plants of the southern hemisphere? One of Australia's great plant scientists, Dr Barbara Briggs, went to Madagascar to explore further.
http://www.abc.net.au/news/2017-08-16/artist-retraces-steps-of-william-carron/8794388

Conferences and Courses

Victorian Biodiversity Conference 2018 – Melbourne, 6-7 February 2018

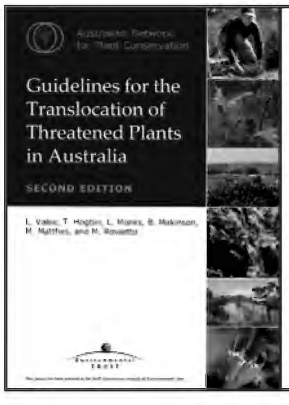
The Victorian Biodiversity Conference aims to provide graduate students and early career researchers with an opportunity to showcase their work locally, and hopes to facilitate discussion with industry, government, senior academics and the public. The call for abstracts for talks, posters and workshops is now open. https://www.vicbiocon.com/

Australian Citizen Science Conference 2018 – Adelaide, 7-9 February 2018

The Australian Citizen Science Conference 2018 will bring together citizen science practitioners, participants, thought leaders and decision makers and showcase best practice in citizen science and share project outcomes from across Australian and the world. Registrations are now open. http://www.citizenscience.org.au/citscioz18-conference-information/

Society for Conservation Biology 5th Oceania Congress – Wellington, New Zealand, 3-5 July 2018

Hosted by the Society for Conservation Biology (SCB) and Victoria University of Wellington, the meeting will bring together the community of conservation professionals to address conservation challenges and present new findings, initiatives, methods, tools and opportunities in conservation science and practice. Scientists, students, managers, decision-makers, writers, and other conservation professionals are invited to participate in this event. Call for symposia, workshops and short courses are now open. http://wellington2018.scboceania.org/



Guidelines for the Translocation of Threatened Plants in Australia

The deliberate transfer of plants or regenerative plant material from one place to another (eg re-introduction, introduction, re-stocking).

Second Edition 2004 | L. Vallee,T. Hogbin, L. Monks, B. Makinson, M. Matthes and M. Rossetto
Australian Network for Plant Conservation, Canberra.

For more information and to order, go to http://www.anpc.asn.au/translocation

Research Roundup

COMPILED BY KIRSTEN COWLEY

Centre for Plant Biodiversity Research, Canberra
Email: Kirsten.cowley@csiro.au

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ANPC Corporate Members

ANPC gratefully acknowledges the support of the following corporate members:

Albury Botanic Gardens, NSW

Australian National Botanic Gardens, ACT

Botanic Gardens of Adelaide, SA

Centre for Australian National Biodiversity Research, ACT

Department of Parks and Wildlife, WA

National Arboretum Canberra, ACT

Naturelinks

Royal Botanic Gardens and Domain Trust, NSW

Royal Botanic Gardens Victoria, VIC

Royal Tasmanian Botanical Gardens, TAS

APCC 12
12th Australasian Plant Conservation Conference 2018

SAVE THE DATE!

12th Australasian Plant Conservation Conference (APCC12) 2018

12 - 16 November 2018, Canberra

www.anpc.asn.au/conferences/2018

ANPC members receive discounts on the conference registration fees!

www.anpc.asn.au/membership

The ANPC is delighted to announce that APCC12 will be hosted by the Centre for Australian National Biodiversity Research (CANBR) at CSIRO, and will be held at CSIRO Discovery at the Black Mountain Science and Innovation Park, Canberra.

ANPC conferences and forums provide:

- **presentations on the latest findings relevant to plant conservation and native vegetation rehabilitation.**
- **practical workshops on ecologically sound techniques.**
- **field trips demonstrating plant conservation in action.**
- **social activities to enhance networking.**

More details on APCC12 will be provided in the near future, so stay tuned!

Australian Network for Plant Conservation Inc

AUSTRALIAN NATIONAL BOTANIC GARDENS

Centre for Australian National Biodiversity Research

Threatened plants from the ACT region all growing at the Australian National Botanic Gardens in Canberra: *Swainsona recta* (Small purple pea) – Lily Berry; *Ammobium craspedioides* (Button Wrinkewort) – Jo Lynch; *Calotis glandulosa* (Mauve Burr-daisy) – Lily Berry.