

Science for saving species

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translocations

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extinction crisis

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Threatened
Species
Recovery
Hub

National Environmental Science Programme



Crisis? What crisis?

The Threatened Species Recovery Hub response to the Senate Inquiry into Australia’s faunal extinction crisis

Many researchers in, and stakeholders of, our Hub have long expressed concern about the loss of biodiversity in Australia. Recently, this concern has been recognised by politicians as a national problem, with the Australian Senate currently holding an Inquiry into ‘Australia’s faunal extinction crisis’. Our Hub welcomes this recognition and the opportunity for [high level review of the issues and possible solutions](#).

Along with more than 200 other groups and individuals, our Hub contributed a comprehensive submission to the Inquiry. If you haven’t seen it, please do check it out – [Submission #159](#). Some of it is not pretty.

Here’s a quick overview of just a few of our key messages.

Things are a bit grim, but we occasionally have success. Our submission highlighted the unabated rate of extinctions in Australia, including that of mammals (Figure 1). Recent extinctions, including two mammal species in the last decade, entrench a disturbingly linear trend that seems likely to continue if business as usual is maintained.

This ongoing species loss is accompanied by an equally alarming rate of increase in the number of species listed as threatened, and in population declines of listed species. While almost no species have been down-listed due to recovery, a startling 46 species have been up-listed since the establishment of the *Environmental Protection and Biodiversity Conservation Act 1999* (the EPBC Act) due to ongoing or accelerated declines. *The evidence is clear: recovery – the goal of threatened species management – is not being achieved for the vast majority of listed species.*

So, what is working? For a small minority of species, intensive management (such as enclosure fencing, island eradications of invasive species and translocations to cat-free islands) is producing some recovery.

Buying time. It is surprisingly hard to find out what we spend on conservation of threatened species nationally, with budget papers providing little insight on direct spending.

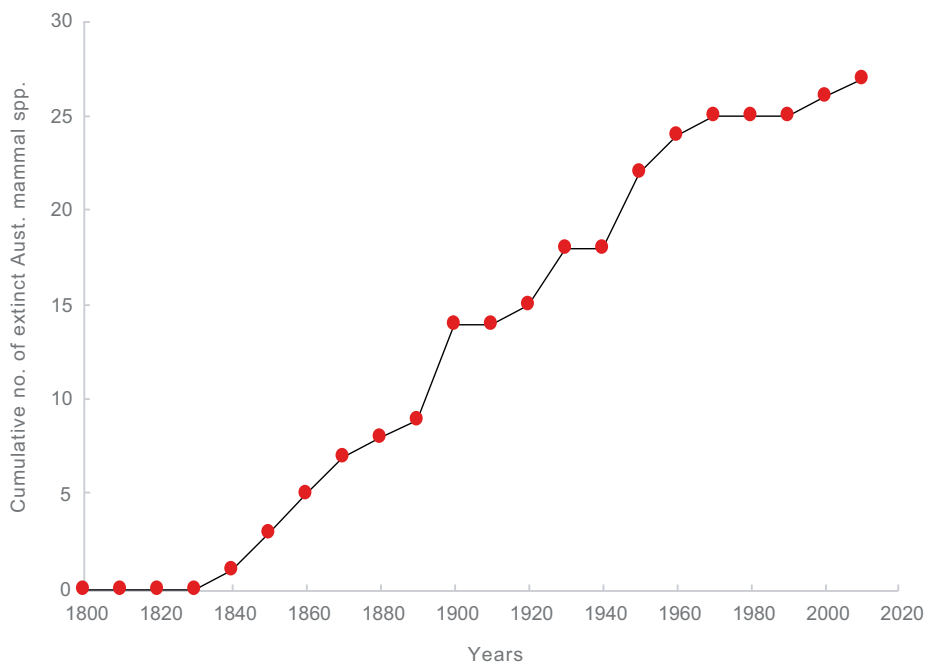


Figure 1. The cumulative number of extinctions of Australian endemic mammal species (excluding those extinct species for which the dating of extinction is too difficult to assess); modified from [Woinarski et al. 2014](#).

However, our assessment indicates *direct* Commonwealth funding for threatened species recovery is about \$41 million per annum.

Indirect but possibly relevant funding through programs such as Landcare amount to between \$41–400 million per annum, though most of these programs do not target threatened species recovery. In contrast, the US Fish and Wildlife Service dispense between \$AUD2.1 and 2.5 billion per year on [targeted threatened species recovery actions](#).

The *US Endangered Species Act* lists 175 fewer species than the EPBC Act, so they’re spending a lot more on a smaller problem. This reinforces findings by Waldron and colleagues in 2013 and 2017 that Australia is an egregious under-spender on threatened species relative to the size of our problem and the size of our economy.

So, what’s the good news here? The best news, reported by Waldron and colleagues, is that threatened species spending works:

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National Environmental Science Programme

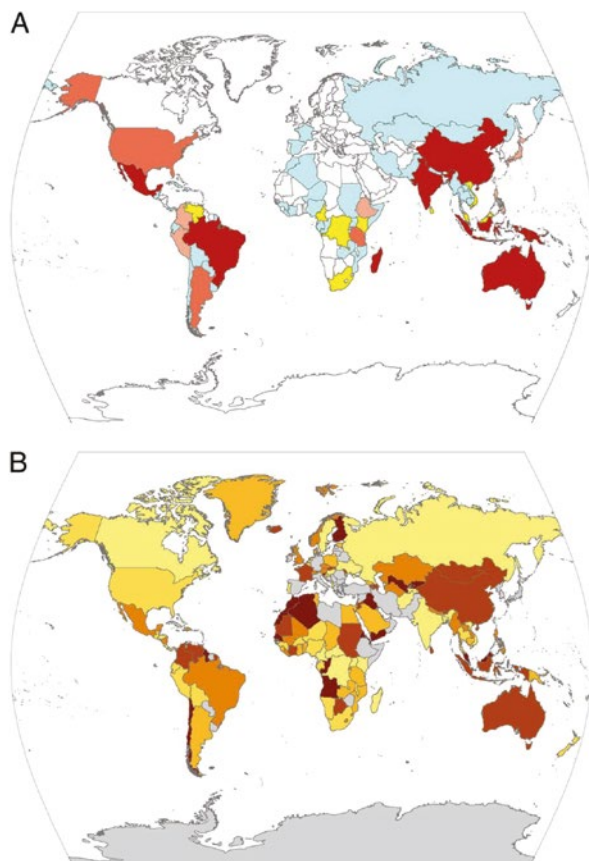


Figure 2. (A) Levels of threatened global biodiversity stewarded by each country. Colour coding: white and blue showing very low and low levels of threatened diversity; yellow, medium diversity; and the four red colours, high levels of threatened diversity, darker reds indicating higher values. (B) Underfunding levels - darker colours indicate worse underfunding. (Waldron *et al.* 2013)

if you spend more, you lose fewer species. Go figure! Even better news is that the species that persist start to recover when the right amount of money is spent on them. The average change in listed bird populations in the US is a more than sevenfold population increase, compared with a decrease in non-listed birds (Suckling *et al.* 2016). Because we spend so little on monitoring Australian threatened species, it is hard for us to derive comparable figures, but early results from the TSR Hub Threatened Bird Index indicate substantially negative trends for Australia's threatened birds as a whole.

So, what's the difference? For a start, the US Endangered Species Act mandates spending on recovery, while our Act doesn't. The fate of our threatened species would much more likely match the US's positive trends if we were to increase funding by approximately tenfold. As context, that would cost the overall budget less than the current exemption from diesel fuel excise for mining companies.

Who's counting? Hardly anybody, as it turns out ... Our submission reviewed the current state of threatened species monitoring in Australia, highlighting the need for significantly more monitoring effort. This reiterated some key messages from our recent book [Monitoring Threatened Species and Ecological Communities](#):

- One in four threatened species are not monitored at all.
- Where monitoring does occur, its quality is generally poor.
- In the extreme case, species could slide to extinction without us knowing.
- We have no national overview of trends in Australia's threatened species.

These come recommended. Our submission wouldn't be a true TSR Hub production if it failed to make specific, tangible and policy-ready recommendations to help slow the rate of species loss. Here are just a couple: (i) the establishment of more regular reviews of the conservation status of listed species, (ii) provision for emergency listing under the EPBC Act, (iii) adequately resourcing threatened species recovery action in line with funding levels shown to result in recovery in the US, (iv) committing to, and adequately funding, effective monitoring, public reporting and interpretation of trends in individual threatened species, (v) bolstering regulation of activities that lead to habitat loss and degradation, and (vi) providing stronger incentives for private land holders to improve habitat retention and restoration on their land. The Hub is committed to helping governments at all levels achieve these outcomes.

Here, I have outlined just three of 11 sections of our submission. Other components include the adequacy of laws for protecting threatened species, the role of Indigenous people, and the ecological impacts of species loss.

The ability of the Hub to pull together authoritative and comprehensive submissions highlights the benefit of having a national threatened species research hub. It affirms that the Hub comprises people who are utterly dedicated to recovery of threatened species, not just threatened species research. The desire to leave a legacy of real-world impact defines our Hub. It requires us to be ready and willing to provide frank and authoritative advice when asked, and sometimes when we're not.

The recovery of Australian threatened species has long presented a formidable challenge for governments. The information provided in our submission, and that of many others, offers a pathway for governments to review, reflect and improve on current policy and practice. From this evidence, we hope that this Senate Inquiry takes this rare chance to significantly improve the fate and future of Australia's biodiversity.

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Plants Red Hot List: No surprises, no regrets

RIGHT: Just 55 mature *Banksia fuscobracteata*, or dark-bract banksia, exist in two roadside populations 125 km north-east of Perth.



IMAGE: ANDREW CRAWFORD

Threatened plants tend to receive less attention than threatened animals, even though they make up 72% of all threatened species listed under national law. To draw attention to our species in trouble, a TSR Hub project has identified the top 100 Australian plant species at greatest risk of extinction. We've also identified the 21 types or groups of plants under greatest threat. **Jen Silcock** from The University of Queensland talks about the findings.

The situation

A total of 1318 plant species are listed as threatened at a national level under the Environmental Protection and Biodiversity Conservation Act, and 370 are Critically Endangered or Endangered at state level. That is around 5% of Australia's known plant species. Of 1135 species and subspecies listed as Critically Endangered or Endangered at national and/or state level, over one-fifth are known from a single population, and 60% are known from five or fewer populations.

With limited resources it is vitally important to identify the species that we could feasibly save that are at greatest risk of extinction. This alerts

conservation managers to their plight and gives them time to act before species are lost. To meet this challenge we have developed a 'Red Hot List' of Australia's most imperilled plants.

The 'Hottest 100'

To identify species we interviewed more than 120 botanists and land managers and reviewed all available published information. To be considered plants had to meet International Union for the Conservation of Nature (IUCN) criteria for listing as Endangered or Critically Endangered.

To maximise the benefits of conservation action we also restricted the list to species which

are rare and declining from threats which can feasibly be overcome. This ruled out 'narrow-range endemics' – naturally rare or restricted species such as plants that grow only on one island or a few mountain tops. While these species only have a tiny distribution, they sometimes occur in remote or inaccessible habitats and have few threats.

From a shortlist of 420 species that met our criteria, we drew up a 'Hottest 100' of Australia's most endangered plants. The chosen 100 species fall into 21 overlapping categories called flagship groups, based on key threats, regions or plant types. These flagship groups represent the most endangered types of plants in Australia.

You can see the final list of red hot list species on the TSR Hub website in the factsheet: [Plants Red Hot List: Australia's 100 most endangered plants](#).

The flagship groups

We designed the 21 flagship groups so that the species in each group can raise awareness and leverage conservation action for the entire group. For example, conservation actions which benefit species in highly urbanised and growing areas, such as increased habitat

LEFT: Southern shepherd's purse (*Ballantinia antipoda*) was presumed extinct until it was rediscovered in Victoria in 1983. It is persisting at a single site on a rocky mountain near Bendigo, with threats from human disturbance, changed hydrology and projected climate change.



IMAGE: PAUL FOREMAN

protection and bushland restoration, are likely to have benefits for a suite of other species that live in these habitats.

Fifteen ground orchids, such as the Critically Endangered blue top sun-orchid (*Thelymitra cyanapicata*) have made the list from six states. While these are the most in peril, they also raise the profile of threatened ground orchids more generally and issues associated with small fragmented populations.

Research or management to address the impact of myrtle rust on the endangered angle stemmed myrtle (*Gossia gonoclada*) is also likely to have applications for many other species facing the same threat.

Hot spots of trouble

The areas with the greatest concentrations of red hot list plants are shown on the map (below). An obvious observation is that concentrations are generally highest in the areas with the highest historical and ongoing development, including around Brisbane, Sydney, Melbourne, Adelaide and Perth. These are followed by the agricultural districts surrounding these regions. In these areas, many threatened plants are now restricted to small, fragmented populations, which are vulnerable to ongoing declines and local extinction. These small remnants surrounded by suburbs or farmland often also miss out on important natural processes like fire, which many species need to germinate.

Saving our species

The good news is that with adequate commitment and investment every species on the list can be saved. We have the knowledge and techniques required, and the threats are manageable. Even plants in the myrtle rust flagship can be saved from extinction: while we may not know how to control myrtle rust at this point, we can set up insurance populations in myrtle rust-free areas. To ensure these plants have the best chance of survival we are raising awareness about them with the federal, state and territory governments, conservation groups and the public to help us spread the word.

For further information

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IMAGE: BOB BATES

The 21 flagship groups

	Flagship group	No. of Hottest 100 plants*
1	Highly urbanised and high growth areas	21
2	Inappropriate fire/disturbance regimes	19
3	South-west Western Australia remnants	16
4	South-eastern Queensland bioregion (including northern New South Wales) includes rainforest, dry scrubs and coastal heath.	16
5	Ground orchids with small, fragmented populations	15
6	Phytophthora (dieback disease)	12
7	South-east Australia remnants (South Australia, Victoria)	11
8	Fertile grasslands and open grassy woodlands	10
9	Herbivore grazing and trampling	9
10	Mountain-top endemics	9
11	Wetlands in modified environments	4
12	Islands (Macquarie, Norfolk, Lord Howe and Tiwi)	5
13	Myrtle rust, east coast	4
14	Enigmatic and cryptic species	4
15	Climate change	4
16	Weedy grasses, northern Australia	4
17	Mining and mining expansion	3
18	Brigalow belt	2
19	Wet tropics/Cape York forests	2
20	Arid shrubs, limited recruitment	1
21	Desert springs, Queensland	1

*Column adds to more than 100 due to overlap between the flagship groups, e.g., a ground orchid (flagship 5) which is also in south-eastern Queensland (flagship 4).

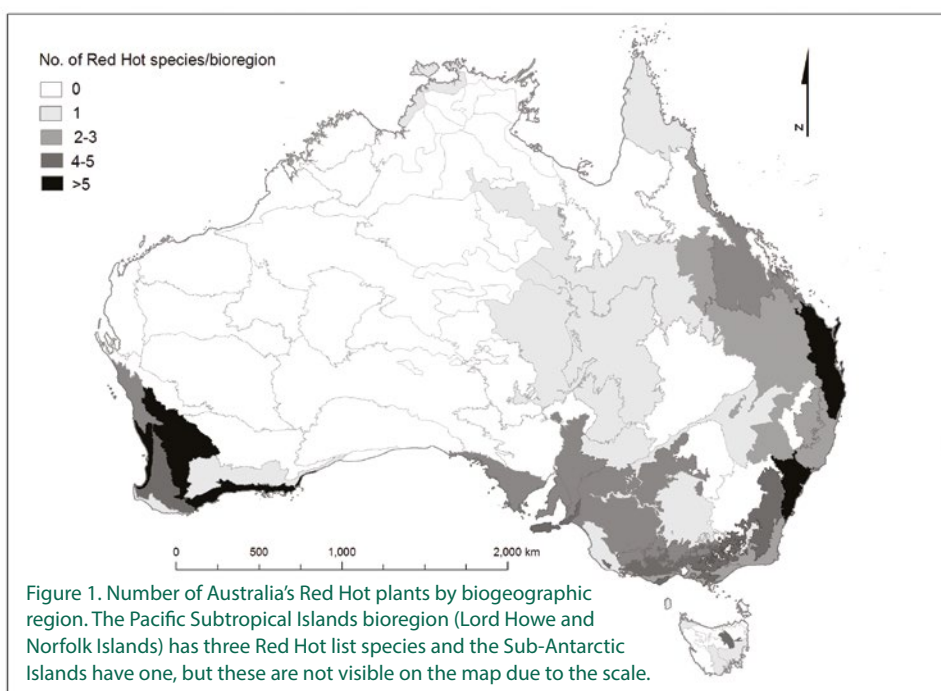


Figure 1. Number of Australia's Red Hot plants by biogeographic region. The Pacific Subtropical Islands bioregion (Lord Howe and Norfolk Islands) has three Red Hot list species and the Sub-Antarctic Islands have one, but these are not visible on the map due to the scale.

LEFT: The blue-top sun-orchid (*Thelymitra cyanapicata*) is known from just one location on the Fleurieu Peninsula in South Australia, where there are <100 individual plants.

Getting strategic with havens

A Wandiyali Restoration Trust fence under construction in New South Wales near Canberra.

IMAGE: WANDIYALI RESTORATION TRUST

In Biblical times, Noah made a plan to secure the Earth's creatures during the almighty flood. He loaded seven pairs of the most valued land animals and birds, and one pair of everything else, onto his Ark. In Australia today, mammal conservationists also need to plan for floods – but not of water, rather of introduced predators. With a bit of systematic planning, havens could serve as modern-day arks for threatened species. **Sarah Legge** has a story to tell.

Feral cats and European red foxes spread rapidly across the continent soon after European settlement, causing many extinctions. Cats and foxes are the main reason that Australia holds the world record for the most mammal extinctions in modern times. Some mammals only avoided extinction because they had populations on islands that remained free of cats and foxes. For example, the once quite widespread greater stick-nest rat (*Leporillus conditor*) was extirpated from mainland Australia, but avoided total extinction because it occurred on the Franklin Islands off South Australia.

Thank havens

These natural arks inspired efforts to fight looming extinctions. From the 1960s, threatened mammals were increasingly translocated to cat- and fox-free islands. At first, managers chose islands that were naturally cat- and fox-free but, from the 1970s, programs to eradicate feral animals from islands grew in ambition and effectiveness. Just this year, feral animals, including cats, were successfully eradicated from Dirk Hartog Island off Western Australia through concerted effort by the Department of Biodiversity, Conservation and Attractions. At 628 km², this is the largest island in the world from which cats have been eradicated.

In the 1980s, the island-ark concept was broadened to include 'mainland islands', where tall fences are built to surround areas from which foxes and cats can be eradicated.

Over the past 30 to 40 years, conservation translocations to predator-free islands and to mainland fenced exclosures (collectively, 'havens'), have increased substantially. These actions have averted extinctions. For example, there are now 13 species that would be extinct if not for their presence on islands or within fenced exclosures; of these, 10 had natural populations on one or two cat- and fox-free islands, but three did not, and all 13 have benefited from translocations to additional havens.

Havens stocktake

If a primary purpose of the network of island and fenced havens is to prevent extinction, we now need to consider which species most need protection in a haven, then make sure that they are represented in enough havens so that an event, like a big fire or fox incursion, will not spell catastrophe. Given the high costs and time needed to establish havens, and the urgency many species face, we also need to achieve this in the most efficient way. A Threatened Species Recovery Hub research project set out to do just that, working with

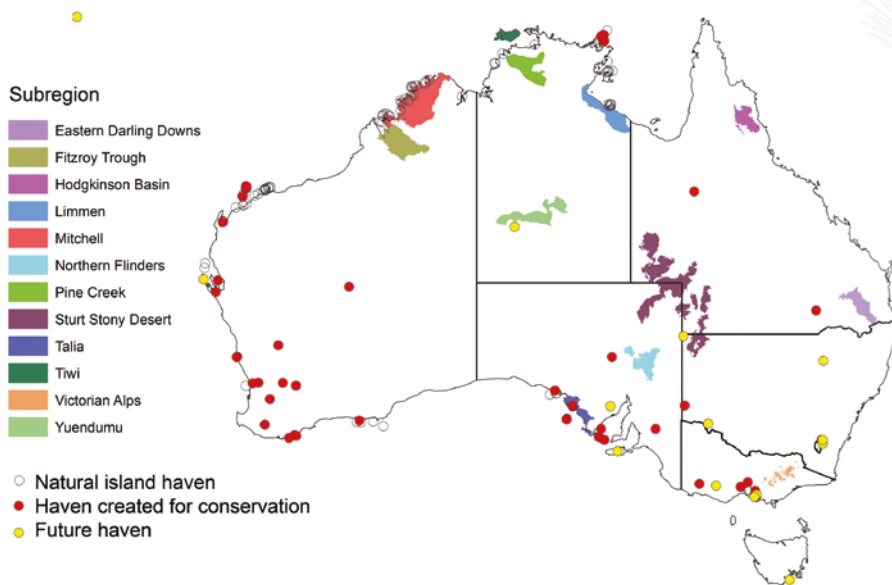


IMAGE: HUGH MCGREGOR, ARID RECOVERY

Boodies (*Bettongia lesueur*) used to occur across two-thirds of Australia, but now only exist within havens. Boodies are protected within seven havens, with more havens planned in the near future. Havens have been crucial for avoiding extinction and consolidating protection for boodies, but arguably, new havens should now prioritise species with less existing protection.

research, government and non-government conservation groups across the country.

First, we categorised every Australian non-flying terrestrial mammal species for their susceptibility to predation by cats and foxes. We found that of 246 species (including extinct species), 89 species are so susceptible that they are either already extinct, or need representation within the haven network to persist.



If new havens were created in each of the 12 regions shown in the map, we could achieve representation, in at least one haven, for all 67 mammal species or subspecies that are highly susceptible to predation by cats and foxes.

Excluding already extinct species, that left us with 52 predator-susceptible species, and 15 additional sub-species.

Second, we took stock of the current network of island and fenced havens in Australia to determine which mammal species (and sub-species) are adequately represented and which are not. We documented the location and size of every haven in Australia, and every population of threatened mammal that exists within a haven.

As of 2017, there were 17 fenced and 101 island havens protecting 188 populations of 32 predator-susceptible threatened mammal species and an additional 6 subspecies. This is an impressive contribution to the conservation of Australia's mammal fauna. Furthermore, 14 new havens are currently being established.

Island havens are much larger on average than fences (the largest island is 628 km², versus 123 km² for the largest fenced area) and islands cover a larger cumulative area than fenced havens (a total of 2152 km² for islands, versus 346 km² for fenced areas). About 80% of the island havens naturally contained populations of threatened mammals; however, 22 of the islands had threatened mammals translocated on to them from elsewhere.

Protection is patchy

A key finding from this stocktake was that representation of predator-susceptible threatened mammals within the haven network is very uneven, with some well-represented, but many others not represented at all. For example, the north-western subspecies of the pale field rat (*Rattus tunneyi tunneyi*) and the northern quoll (*Dasyurus hallucatus*) each occur in well over 15 havens (all islands). At the other extreme, 15 predator-susceptible mammals only occur in one to two havens, and 29 (43%) are not yet protected within any havens.

The central rock rat (*Zyzomys pedunculatus*), one of Australia's most threatened mammal species, is not represented in any havens.

In addition, the 11 most recently-created havens have not added any new species or subspecies to the network, although they have consolidated protection for other species. When investment in new havens is directed towards protecting mammals that are already represented in existing havens, then other vulnerable species miss out.

The uneven expansion of havens has happened for a variety of reasons. Havens have been created and are managed by many independent organisations, ranging from local council and private individuals, to large non-government organisations and state government agencies. This diversity brings resilience to the haven network; however, these groups have a range of priorities and different regional focuses, so it's unsurprising that when viewed as a collective, the growth of the haven network lacks a coordinated national perspective.

The future for havens

To redress this unevenness, future investment in havens should favour species (and subspecies) with no (or low) existing haven representation. Using systematic planning we found that by creating just 12 new havens in the right places (see map), we could protect at least one population of all 67 predator-susceptible species and subspecies. If we created 39 new strategically-located havens we could protect at least three populations for all the 67 predator-susceptible species and subspecies.

In addition, although collaborations between organisations already exist, enhanced national collaboration and coordination would be beneficial. This could include brokering co-funded national investments across organisations to target areas and species that have been neglected to date. In addition, there could be a greater role for well-funded, multi-species recovery teams to guide network growth and the ongoing management of haven populations.

Extending Noah's allegory: after the flood subsided, the animals disembarked and repopulated the earth. Like the ark, havens are essential for avoiding extinctions of Australian mammals in the short term. However, havens cover a minute proportion of species' former ranges, and we need to keep sight of the longer-term objective, which is to return these species, and all their ecological functions, into much greater areas of the Australian landscape, something that will require broad-scale cat and fox control.

This project has many collaborators and partners including universities, Bush Heritage Australia, Arid Recovery, Australian Wildlife Conservancy, Wild Deserts, independent experts and the Australian, Western Australian, South Australian, Northern Territory, Victorian and New South Wales governments.

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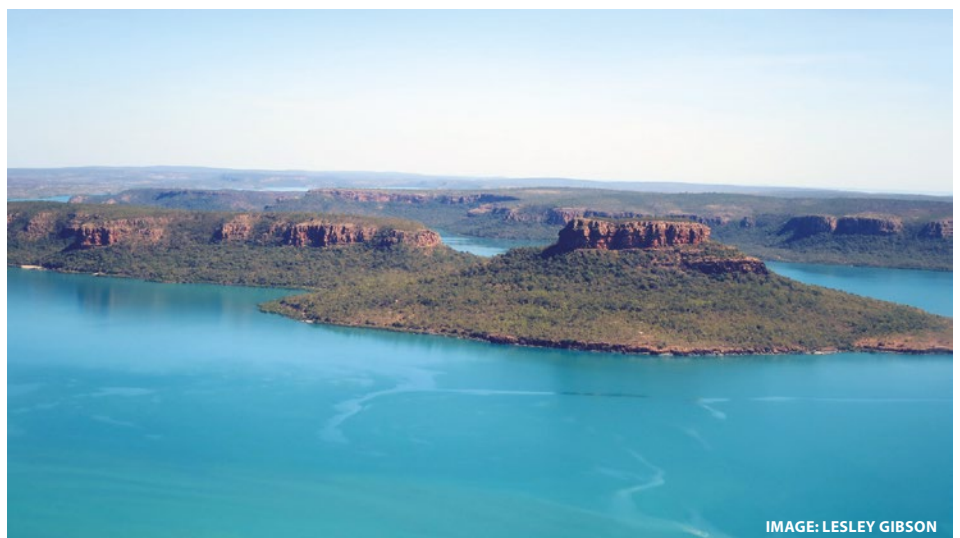


IMAGE: LESLEY GIBSON

Cat- and fox-free islands in the Kimberley are safe havens for many threatened mammals.

Insights from long-term monitoring programs

Restoring box gum grassy woodlands

It was once possible to walk from Melbourne to Sydney through almost continuous grassy woodland. Today most of these temperate woodlands have gone. A team at **The Australian National University** have been studying woodland restoration and management for the past 20 years and have recently embarked on a series of new experiments to investigate bird breeding success, noisy miner control, hollow supplementation and wildflower translocation. **Dr Damian Michael** provides an update on their latest research findings and activities.

IMAGE: DAVE BLAIR

ABOVE:
Box gum grassy woodlands
in the Huon Hills of the
Albury-Wodonga region

Box gum grassy woodlands are an iconic part of the eastern Australian landscape. Widely spaced trees with large spreading canopies, open grasslands and sprays of colourful wildflowers characterise this nationally endangered ecological vegetation community. Dominant tree species include white box (*Eucalyptus albens*), yellow box (*E. melliodora*) and Blakely's red gum (*E. blakelyi*).

These woodlands grow on some of the most productive soils in Australia, which are highly desirable for agriculture. Consequently, land clearing has resulted in the loss of approximately 85% of box gum grassy woodlands, and what remains is highly degraded and impacted by overgrazing by livestock and feral animals, fertiliser application and cultivation. Accompanying the widespread loss of habitat are dramatic declines in hundreds of native plant and animal species, including the Yass daisy, superb parrot, pink-tailed worm lizard and squirrel glider.

Actively restoring landscapes that have been extensively cleared is one part of the solution to reversing biodiversity loss. And so over the past three decades, organisations such as

Landcare, Local Land Services and Greening Australia along with private landholders have been engaged in tree-planting programs to combat soil erosion and salinity, restore woodland vegetation and improve biodiversity. This concerted effort has resulted in substantial increases in native vegetation cover in some parts of south-eastern Australia.

However, little guidance exists on how to best restore remnant woodland vegetation, what makes an effective tree planting for woodland communities, and whether the communities of animals that use revegetation change over time as tree plantings and surrounding remnants mature.

BELOW: Olive legless lizard in remnant grassland.



IMAGE: DAMIAN MICHAEL

What is meant by using plantings?

In 2001, a large-scale biodiversity monitoring program was established across the South West Slopes bioregion of New South Wales. Tree plantings of various sizes and shapes were established, and native vegetation in different growth stages were selected; and key faunal groups such as birds, arboreal marsupials and reptiles were monitored regularly. Preliminary findings from this work showed that tree plantings provide important, and often critical, habitat for a wide range of declining and threatened bird species. Some species, such as the rufous whistler, red-capped robin, scarlet robin and speckled warbler were more likely to be found in plantings than any other sorts of vegetation on farms.

Some reptiles also use tree plantings, and some species such as the olive legless lizard may be relatively abundant in plantings that support native ground cover, logs and leaf litter. Another important outcome of this work is that the biodiversity benefits of vegetation restoration can be severely undermined by livestock grazing, and so measures to control grazing pressure in plantings will improve their conservation value.

When designing new plantings, their size, shape and location should be considered, as these factors are important for increasing bird and arboreal marsupial diversity. Large block-shaped plantings and plantings along riparian areas generally support higher bird and mammal diversity than small strip plantings and those located on slopes and ridges. Linear strip plantings are, however, still valuable, especially for threatened species such as the grey-crowned babbler and, where planting corridors intersect, these areas support similar bird numbers as block plantings.

Changes over time

Do certain bird species disappear once tree plantings reach a certain age, or do undesirable species such as the hyper-aggressive noisy miner colonise tree plantings as they begin to mature? What are the implications of such changes for the recovery of threatened birds in agricultural regions? These are some of the questions our new research will help answer.

Early findings suggest that over a period of 13 years, bird species richness in plantings remains constant but the composition of bird species changes as plantings mature and some elements of the vegetation begin to senesce or regenerate. Some of the increasers include the weebill, yellow Thornbill and white-winged triller, whereas some of the decliners include the common starling, crested pigeon and noisy miner. Some species seemed also to be increasing initially but after a decade of monitoring now appear to be on a declining trajectory. Another interesting outcome of this work is that migratory species appear to be increasing as plantings mature.

Trees in a paddock of cropland



IMAGE: DAMIAN MICHAEL



IMAGE: DAMIAN MICHAEL

ABOVE: This year thousands of yellow-plumed honeyeaters have been using tree plantings in box gum woodland. These birds usually occur more inland but these records of them highlight the value of plantings for inland birds during dry times.

These preliminary results indicate that replanted areas of different ages support different species of birds. Some species associated with young plantings may drop out of restored ecosystems if new plantings are not continuously added over time. Plantings of a range of ages are therefore needed to provide a range of suitable habitats for different native bird species.

New experiments

Many questions remain about what are the most effective ways of restoring and managing box gum grassy woodlands and associated biota in agricultural landscapes. Over the next three years, researchers from the Australian National University

in partnership with Greening Australia and Local Land Services will investigate:

- effective methods for translocating threatened forbs such as the Yass daisy
- optimal tree planting designs to maximise bird breeding success
- effective methods for managing the hyper-aggressive noisy miner
- the influence of nest-box design and placement on their use by threatened birds and arboreal marsupials
- use of experimentally restored rock habitat to improve woodland reptile diversity.

Nest boxes have been installed and some wildflower species have already been translocated into experimental plots. Findings from these new studies will be published in the coming years.

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Plant Translocation



IMAGE: NICOLAS RAKOTOPARE

New guidelines a game changer

Translocation is a very important tool in the fight against plant extinctions. Knowing when to do translocations, how to do them and how to measure their success can be a complicated business, especially considering the huge range of threatened plants in Australia. So where do you find the answers? Luckily, they are now all in one place, in new guidelines that will be a game changer for plant translocation. **Dr Lucy Commander** lets us know what is on offer.

ABOVE: Seedlings being propagated for translocation.

Thirty-seven species of plants in Australia are now extinct, with over 1,300 species Critically Endangered, Endangered or Vulnerable. Translocation, or the movement of plants from one place to another, is one of the ways of preventing species extinctions.

Translocations are undertaken for many reasons. For example, some threatened orchids could be relocated if they were in the path of a new pipeline development. Or if a threatened species is now only found at one site, using translocation to establish other populations can reduce the risk of a single catastrophic event, like a fire, eliminating the entire species. Or when a species is being badly affected by a disease like myrtle rust across its main range, new populations can be set up in areas where the plants will still grow but conditions are less suitable to the plant pathogen.

Hundreds of groups across the country participate in plant translocation projects, from local, state and territory governments, to conservation non-government organisations and many grassroots community groups.

There is a huge number of things to consider. Should we even do a translocation? Where should we get the source material?

How do we propagate the plants, or should we do transplantation? What after-planting care may be required? How do we set up a monitoring program? If you then also considered the incredibly broad range of plant species that could be translocated – from delicate orchids with complex relationships with pollinators and mycorrhizal fungi, to long-lived eucalypts from fire-prone landscapes – you would probably wish someone else had pulled all the available information together for you in one place.

Well, lucky for you they have.

The *Guidelines for the Translocation of Threatened Plants in Australia* is the definitive publication that will inform plant translocation projects in Australia. The Australian Network for Plant Conservation (ANPC) first published the guidelines in 1997, and the second edition was published in 2004. Since the second edition, there has been a large increase in the number of translocations across Australia.

BELOW: The Critically Endangered Mt Lesueur grevillea (*Grevillea batrachioides*).



IMAGE: ANDREW CRAWFORD

Some translocations have now been monitored for over 20 years. As a consequence, we have more information now on how to improve translocations. Production of this third edition was undertaken by the ANPC, with support from the Threatened Species Recovery Hub, and it has had input from leading plant translocation experts from across the country.

The Guidelines will help fight plant extinction by providing information to improve the success of translocation of threatened plants. The ultimate aim of translocations is to establish a viable, self-sustaining population. Hence, if plant translocations are successful, they can prevent threatened plants from going extinct.

Preparing the third edition of the Guidelines has been an 18-month process. We held a workshop in Sydney last year with 30 experts from around the country to kickstart the review. Since then, we've edited and rewritten the Guidelines. The authors are from state and federal government departments, consultancies, universities, CSIRO and botanic gardens.

The Guidelines cover the why and how of translocation. They step through the preparation, implementation and evaluation phases of a translocation project. They start with an overview of plant translocations in Australia, then follow with a chapter that discusses how to decide whether or not translocation should be done. Two chapters outline the information that needs to be gathered about the species to prepare for a translocation, and for selecting a site. Then, there is a chapter on policies and approvals processes as well as an appendix with a draft translocation proposal. Following that are chapters on preparing for, implementing, monitoring and evaluating the translocation. A chapter on community engagement completes the Guidelines.

There are several new features in these revised Guidelines. A decision-making framework is included, which can be used to help decide whether to translocate. We have a new chapter on selecting source and recipient sites, which covers some up-to-date information on provenance and assisted migration. A new section covers conservation genetics, and why it is important to consider genetic diversity. The Guidelines also have information on direct transplantation – a technique used to move plants that are to be impacted by development.



IMAGE: DAVID COATES

ABOVE: Leonie Monks, Rebecca Dillon and Sarah Barrett collecting seeds from a *Lambertia orbifolia* translocation.

We put out a call for new case studies to replace or update the ones in the second edition. This has resulted in 23 new case studies. We've included excerpts from each case study in the Guidelines and the full versions will be published in the ANPC's bulletin, *Australasian Plant Conservation*. The case studies cover topics such as translocation of orchids and the Wollemi pine, the benefits of long-term monitoring, and using population genetics to inform site selection.

A range of new photos illustrates many of the techniques outlined in the Guidelines. A comprehensive translocation proposal template is included that can be used in states or territories where templates are not provided. It will also be of use to policy-makers revising their state/territory templates. And finally, the Guidelines present a list of characteristics that typify successful translocations, and some reasons why some translocations may have been unsuccessful.

So who are they for? Absolutely anyone involved in any part of the translocation process will benefit from the new Guidelines. Policy-makers; those assessing translocation proposals; scientists researching the species; those collecting seed cuttings or whole plants; those involved in propagation, planting and monitoring; and those wishing to engage with community members are just some of the key readerships. Much of the information in the Guidelines is also relevant for people restoring plant communities.

For further information

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IMAGE: DAVID COATES

ABOVE: *Banksia brownii*. There are just 17 populations of this species left in the wild.

The Guidelines are available from the ANPC website anpc.asn.au, where you can also order a print copy.

Germinating seed in a petri dish.

IMAGE: DAVID COATES

Coastal leek-orchid
(*Prasophyllum litorale*).

Race against time for Endangered leek orchids

The Royal Botanic Gardens Victoria is a world leader in endangered native orchid conservation, growing and reintroductions, and is giving new hope to species that seemed doomed to extinction. However, the outlook for our many threatened leek orchids (*Prasophyllum*) has not improved in recent years. Leek orchids are notoriously difficult to grow in cultivation, a problem that has stalled conservation efforts. And with dozens of leek orchid species dwindling rapidly toward extinction, time is running out for PhD candidate **Marc Freestone** from the Australian National University and Royal Botanic Gardens Victoria to work out how to grow them. He takes up the story.

Australia is rich in orchids, with over 1300 native species – a lot when you consider there are only 200 species in all of North America. Around 140 of the Australian orchids are leek orchids, and most live in bushland remnants across the south of the country. However, with a preference for fertile soils and relatively high rainfall, these little plants suffered severely from agricultural expansion in the south-east of the country during the first half of the last century. Rabbits, weeds, inappropriate fire regimes and declining rainfall patterns continue to plague the survivors, which often hang on in tiny pockets of land that were never ploughed – narrow roadsides, rail sidings or rural cemeteries.

Leek orchids are small, ground-dwelling native Australian orchids, so-called for their single spring onion-like leaf. In the spring, if there's been enough rain, they produce a spike of small brown, green or white flowers. Around a third of the 140 species of leek orchids are under serious threat of extinction, and 39 species are currently listed under the *Environment Protection and Biodiversity Conservation Act 1999*. Several species, including the beautiful lilac leek-orchid (*Prasophyllum colemaniae*) from Melbourne's outer eastern suburbs, are already extinct.

Orchid conservation

Leek orchids are certainly not alone in having many threatened species. Many other native orchids are in a similar predicament. The plight of so many threatened Australian orchids has catalysed a boom in orchid conservation in this country over the past decade or two. We have seen this both in research effort and in the development of

specialist orchid conservation programs around the country. For example, the Royal Botanic Gardens Victoria now hosts the world's largest orchid conservation program. Dozens of critically endangered native orchids from the south-east mainland are being brought back from the brink through propagation and reintroduction projects. But not leek orchids.

BELOW: Marc Freestone at work on leek orchid germination in the lab.

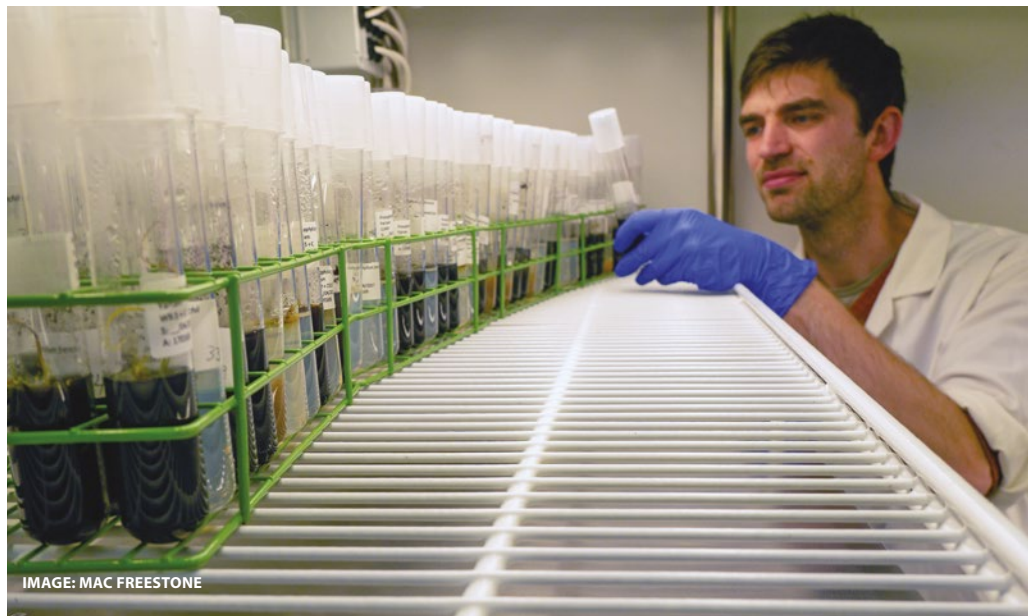


IMAGE: MAC FREESTONE

That's because we still don't know how to successfully grow leek orchids. To start with, growing any type of orchid is hard work. Orchid seed is microscopic, and doesn't contain any food for the germinating orchid seedling. Instead, all orchids rely on symbiotic fungi that live in their roots and the surrounding soil and inoculate their seed. The fungus literally pumps food into the seeds to germinate them. Exactly why remains a mystery, but we can replicate it in the lab by carefully extracting fungi from the roots of a wild orchid plant, growing the fungi in a petri dish, and sprinkling in the orchid seed. But for some reason, leek orchid seed rarely germinates, and when it does, the young seedlings usually brown off and die.

How to grow leek orchids is the subject of my PhD project with the Australian National University, based at the Royal Botanic Gardens Victoria. We have several theories about what might be going on and we are using three of the more common leek orchid species to test them.

Seed viability

An obvious explanation for poor seed germination would be the viability of leek orchid seed. Leek orchids have relatively high rates of self-pollination, and we were curious about how this affected viability. I undertook a large cross-pollination study last season, artificially pollinating over 1000 flowers across our study species, then carefully collecting and painstakingly weighing and chemically staining them to test for viable embryos. Preliminary results indicate that, although seed viability was generally low, it was not low enough to explain the multitude of unsuccessful germination trials in this genus and doesn't appear to be the problem.

Fungi

The main line of enquiry in my PhD is the relationship between leek orchids and their symbiotic fungi. Some recent data suggests that at least some species of leek orchid associate with a wide variety of fungi species, which begs the question: Which fungi are involved in germination?

To answer this, we have been burying modified 'tea bags' full of seed around wild plants to identify the fungi responsible for germination. Supplementary watering over the drier than average winter was rewarded with successful germination events at all three study populations. Hundreds of samples of fungi from these naturally germinated seedlings are now being prepared for germination trials and DNA sequencing.

Nutrition

The final area of study is laboratory germination, particularly the role of nutrients in germination trials. Several experiments are underway with the aim of refining nutrients for future trials. Early indications are promising, and we will have a better understanding of how nutrient levels contribute to the success of germination within the next few months.

I feel like we are on the cusp of a research breakthrough into the cultivation of leek orchids that could enable us to stop critically endangered species from going extinct. If we can work out how to grow them, we can then implement the ex-situ cultivation and reintroduction projects that have proven successful with other endangered orchids. Stay tuned ...

This project is receiving support from the Royal Botanic Gardens Victoria, the Hermon Slade Foundation, the Victorian Government, the Rural City of Wangaratta, Project Platypus and the Australasian Native Orchid Society.

For further information

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ABOVE: Green leek-orchid (*Prasophyllum lindleyanum*), one of the project's study species.

The fragrant Leek-orchid from western Victoria is one of our study species.

IMAGE: MARC FREESTONE



IMAGE: MALCOLM FRENCH

LEFT: White mallee (*Eucalyptus erythronema*) is endemic to the Wheatbelt of Western Australian. This area has experienced extensive clearance of native vegetation, including trees like the white mallee. This project will document the decline of eucalypts from this region (and others) and propose many of these species for Red Listing.

Red listing our national icon, the gum trees

People are often quite surprised to hear that relatively common plant species can be threatened and in trouble. But many species were once so widespread and abundant, that although they are still relatively easy to find, their numbers are only a tiny fraction of what they once were. So it is with many eucalypts. Although many of these icons of the bush have hugely declined, very few are listed as threatened and this prevents them getting the protection and conservation attention they need. **Rod Fensham** from the University of Queensland and the Queensland Herbarium is leading a new project to tackle this challenge.

Evolution of the IUCN Red List

The International Union for the Conservation of Nature (IUCN) was established in 1948 with a charter to protect global biodiversity. One of the first actions of the Union was to compile a list of the species that were prone to extinction and that historic list became the Red List of Threatened Species.

In the early days the assigning of a threat status to species was rather haphazard and relied strongly on the subjective opinion of experts with only nebulous criteria. Gradually the criteria were discussed, evaluated and refined until the current Red Listing criteria were established that assigns species to a range of categories reflecting their extinction risk from Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered to Extinct. The categories incorporate an evaluation of the rarity of species but also the extent to which they have declined and are under future threat of further decline.

While the IUCN Red List has international recognition and has been useful for raising awareness about threatened species the

legal powers to protect species under the international charter are scarce. However, various nations have adopted the Red List process and use them to underpin legislation to protect threatened species. These laws do have legal carriage and have been effective in influencing the way that developments proceed. Australia has adopted and adapted the Red List criteria and every state and territory and the federal government have their own lists. Over the years these lists have got out-of-step, and the IUCN Red List of Threatened Species is hopelessly out of date for Australian plant species. There are only two species of *Eucalyptus* on the register.

Trees on the global agenda

Enter the Global Trees Campaign spearheaded by Botanic Gardens Conservation International and Fauna & Flora International and generously funded by Foundation Franklina. A major objective of the initiative is to carry out a listing assessment for all the world's tree species, a huge undertaking because the current count indicates there are 60,065 of them.



IMAGE: MALCOLM FRENCH

ABOVE and OPPOSITE PAGE: The square fruited mallee (*Eucalyptus brandiana*). Due to land clearing it is now one of the rarest trees in Western Australia.



IMAGE: MALCOLM FRENCH

ABOVE: The square fruited mallet (*Eucalyptus brandiana*) is a small tree, growing up to 5 metres tall but with very large leaves, up to 20 cm long and 5 cm wide. Fewer than 50 plants remain.

The Global Trees Campaign has been focusing on developing countries; identifying and listing threatened trees and then working with local communities to recover the species at risk. Until now, Australian trees have received little attention, but that is about to change, starting with our most iconic tree group the gum trees, otherwise known as eucalypts. The Threatened Species Recovery Hub is working with Botanic Gardens Conservation International and the Australian Government's Department of Environment and Energy to undertake Red List assessments for 863 species in the genera *Eucalyptus*, *Corymbia* and *Angophora*.

The project has two key objectives. First, it will identify and carry out listing assessments for every threatened eucalypt to a standard that is satisfactory for the IUCN and for Australian Commonwealth, State and Territory laws. Second, it will provide a new standard for Red Listing Australian plants that incorporates spatial data and estimates of population size using techniques developed through the hub's Red Hot Flora project.

To be listed as threatened, a species must satisfy one of a selection of criteria. One of these, called Category A, is based on decline in abundance. While this seems a logical way to determine that a species is at threat, unless you have a time machine, this criterion is hard to apply unless there is adequate historical data. However, there are other ways to consider what we have already lost. For example, the gum trees that line road corridors in agricultural areas are a clear indication of what we have lost from the adjoining crop land and improved pastures.

Assessing the threat status of eucalypts relies heavily on conversations with experts from around the country. Australia's eucalypt gurus are as interesting as the trees themselves and they have been essential to the project.

Take Malcolm French, for example.

Malcolm is a real estate agent who made a living selling farms. To know rural property you need to know soil and Malcolm soon realised that eucalypts can be accurate indicators of soil conditions. As Malcolm kept his eye on the trees over many years he built a high level of expertise in the difficult subject of eucalypt taxonomy. His commitment to the subject produced *The Eucalypts of the Western Australian Wheatbelt*, a seminal book, complete with accurate distribution maps, that has become an indispensable text for the project. Malcolm is just one of many people who have devoted themselves to gum trees and generously shared their knowledge for this project

One of the innovations of this project is using spatial data representing habitat decline to satisfy the criteria under Category A. Using this approach can result in the listing of some species that are still relatively common in the landscape on roadsides and in reserves, but that have suffered substantial decline. Many of these species have not been considered for listing previously. Other species that are naturally rare, but that do not exhibit past decline, nor are threatened by future decline will be delisted.

This important project will result in the Red Listing of many eucalypt species, and lead the way for their recognition as threatened under Australian Law. This is an important step in their long-term protection and conservation. It will also develop a new method to improve conservation status assessments for other Australian plants through the lens of the majestic and omnipresent gum tree.

For further information

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IMAGE: REBECCA DILLON

David Coates

A dedication to Australia's plantlife

Since my early childhood I have had a keen interest in wildlife. A fascination from my school years with aquatic life and maintaining aquariums is a passion held to the current day. As a child, I read numerous books on nature and wildlife and was fascinated by wildlife biologists and their conservation work.

south-west Western Australia with its remarkable plant species richness and many issues associated with habitat loss and vegetation change.

In 1979, I moved to the Australian National University and took up a position as senior tutor teaching genetics in the then Department of Botany. The following year I was appointed a postdoc at ANU with another very inspirational person, David Shaw. My research with David, on chromosome evolution and speciation in a grasshopper species complex, involved fieldwork from Victoria to Cape York Peninsula. My interest continued in the association between evolutionary biology and conservation.

I moved back to Western Australia in 1985 for a research position in conservation genetics and plant biology in the newly established Department of CALM. This was not only another great challenge but also a hugely rewarding part of my career. I feel privileged for the opportunity to work on the conservation of one of the world's most diverse and unique floras. I coordinated the establishment of Australia's first threatened flora ex-situ seed storage facility, developed area-based management plans and commenced a translocation program for threatened plants. I expanded my interests in population biology and ecology to better understand small population processes and their interaction with threats such as habitat fragmentation and disease.

I have increasingly appreciated working as a scientist in a management agency where I have not only been able to pursue a research career but also work closely with managers on the ground. It has been a pleasure to be associated with such dedicated people who are always willing to consider the application of science to threatened species management. I work closely with operational departmental staff, and very much value the contribution of community groups and NGO groups in threatened species recovery.

My close association with the Australian Network for Plant Conservation has repeatedly reinforced my view that public support through citizen science projects and community groups is essential to achieving lasting outcomes.

My current project with in the Threatened Species Recovery Hub allows me to combine my interest in conservation genetics with plant translocations, a key goal being to develop success criteria for establishing viable translocated populations.

Dave Coates works with NGOs and plant scientists on translocation projects to protect threatened flora species.

I graduated from the University of Western Australia in 1973 in Zoology and Botany determined to pursue a career in biology but unsure where to start. My botany genetics lecturer, Sid James, changed all that. Sid was an inspiration to me and indeed many other close colleagues. I moved into the fields of genetics, evolutionary biology and botany, working through Honours and then a PhD on chromosome variation and patterns of speciation in triggerplants, a fascinating group that has undergone explosive speciation in the south-west. This work started my interest into plant conservation, taking field trips through



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COVER IMAGE: LEONIE MONKS PLANTING *BANKSIA BROWNII* TRANSLOCATION
(SEE PAGE 10 FOR THE FULL STORY). IMAGE: MEREDITH SPENCER



National Environmental Science Programme