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ThinkingBush

Science for managing native vegetation in Australian landscapes

A Taste of Research Results from the *Native Vegetation R&D Program 10 years on*

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Foreword

By John Childs

Welcome to edition four of ***Thinking Bush***—Land & Water Australia's occasional magazine for the Native Vegetation Research and Development (R&D) Program. This edition wraps up a second term of research on managing Australia's native vegetation. The articles reflect our increasing knowledge about understanding native vegetation systems across the landscape, and about how to better manage these systems at the landscape, regional and local scale. This means understanding the dynamics between agriculture and conservation for outcomes that achieve both production and conservation goals.

Land & Water Australia and its partners began the native vegetation program in 1995, with the program establishing itself as the leading broker of research in Australia in this field. In this first phase of research, projects assessed the status of native vegetation and its viability, and investigated options for integrating vegetation management to agricultural production systems.

In 2000, a second round of research was initiated, with projects assessing the condition and long-term viability of native vegetation; exploring options to integrate native vegetation into agricultural production systems; and testing different landscape design methods and principles for biodiversity conservation. A total of 16 projects were funded including two PhD scholarships, which are near completion. This edition of ***Thinking Bush*** provides some insights into the knowledge gained from these projects.

Land & Water Australia is considering a variety of options to synthesise research outcomes that better meet your knowledge needs. Where possible, this will draw on established partnerships with other organisations, such as CSIRO and Greening Australia. This edition of ***Thinking Bush*** comes with an insert provided by Greening Australia, showcasing research that has benefited agricultural production systems.

We have learnt a lot from the past 10 years of research in vegetation management; however, much is yet to be learned about how native vegetation sustains our farming systems and the services we obtain from healthy ecosystems. In the following article, Andrew Campbell places the collective research effort into context, describing the current limitations in managing native vegetation and what is needed to create the landscape-scale changes that are required. To fill this gap in knowledge, Land & Water Australia, in partnership with CSIRO, has started a third round of research, which includes a focus on ecosystem services provided by native vegetation. For more details on the new Native Vegetation & Biodiversity Research and Development program, see the article by Jim Donaldson on page 38.

Land & Water Australia is keen to hear from you about how research outcomes can meet your knowledge needs. Feel free to contact Land & Water Australia staff in the Native Vegetation and Biodiversity R&D program. Contact details are provided on the back cover.

I hope you enjoy this new-look issue and keep an eye out for a suite of information on the native vegetation website, accessible through **www.lwa.gov.au/nativevegetation/**

John Childs
Chair—Native Vegetation & Biodiversity R&D Program

The Native Vegetation R&D Program is a partnership between Land & Water Australia, CSIRO and the Murray–Darling Basin Commission.

Creating a native vegetation management industry

By Andrew Campbell

Australia has come a long way in the management of native vegetation over the past 25 years.

At management, policy and technical levels, we have made significant advances and developed better approaches based on a deeper understanding of how Australia's unique native vegetation communities function. Across the country, there are hundreds of individual farms and interesting projects that provide pointers to a new era of native vegetation management.

However, if you look out of the window of a plane from 10,000 metres high on a clear day and survey the landscape, it is clear that we have yet to translate good ideas and promising examples into widespread landscape change.

In my view, there are two broad reasons for this.

Firstly, many of the measures that we have advocated to farmers over the past 20 or more years are not sufficiently practical or profitable to be adopted by the majority. Secondly, the mix of incentives and disincentives, and the way they have been administered, has not been sufficiently influential, given the technical options on offer, to cause widespread behavioural change.

These two points are obviously related. If the options are sufficiently attractive in their own right, then governments don't need to worry about making the carrots juicier or the sticks harsher to convince people to take them up. But if the best technical option (in terms of the long-term ecological sustainability of the biota and the resource base) is marginal, as perceived by the majority of land managers, then the mix of incentives and support needs to be right if uptake is to extend beyond the enthusiastic few.

The rapid growth of *Eucalyptus globulus* plantations in southwestern Western Australia and the Green Triangle region (in southeastern South Australia and southwestern Victoria) illustrates how quickly we can change rural landscapes through financial incentives—in this case, a taxation measure. It also illustrates what an inherently blunt instrument tax measures are.

The trick is in getting the balance right, because we cannot afford large-scale subsidies to increase uptake of measures that don't make sense in their own right. Where there is a big gap between what people will adopt on their own and what is desirable for the public good, then research and technology development to offer better options is likely to be a better investment than spending more on incentives. [1]

This is explained in the following boxes.

Making on-farm changes succeed

On-farm change is more likely when innovations:

- offer a relative advantage over existing systems or approaches
- are not too complex
- can be trialled, tested and evaluated (initially on a modest scale)
- 'fit' with the farmer's outlook, capacity and farming systems
- offer good returns within a reasonable time frame.

Changing farming systems in Albany, Western Australia—is it adoptable?

If sheep farmers around Albany were to convert their annual pastures to kikuyu perennial pastures in broad alleys between belts of blue gums, they could improve their profits from $80/hectare to $230/hectare, without counting any forestry income.

At first glance, such a system looks irresistible. It would mean lower nutrient loss and fewer broadleaf weeds on the farm. It would also reduce the risk of salinity, sediment and nutrient runoff into waterways, contamination of groundwater, and erosion of river and creek banks. The kikuyu–blue gum system appears to be profitable, with many environmental spinoffs.

However, viewed from the farmer's perspective, the decision is less clear cut. The new system is more complex, requires a high initial investment, involves a delay in production while trees are establishing, and requires higher stocking rates and more insect and worm control. Compared with the existing system, it requires a much higher level of management skills to balance the risks and achieve the higher returns.

It is not hard to see why adoption of this system has been patchy, despite its higher profitability.

[1] *For a more detailed discussion of the benefits of investing in research and technology to encourage good land management practices, see* **cyllene.uwa.edu.au/~dpannell/dp0601.htm**

We have three big challenges in native vegetation management:

- managing our agricultural and forestry enterprises in ways that use native vegetation within a whole-of-landscape approach for both production and conservation benefits
- protecting the most important remaining native vegetation patches or remnants and managing them appropriately
- revegetating on a large scale in appropriate places to help restore degraded landscapes, improve habitat values and protect water resources, especially in the southern agricultural zones and the 400–600 mm rainfall zone.

Land & Water Australia is in the knowledge business and we have been investing in native vegetation research and development for more than a decade, in partnership with the agriculture and environment departments of the Australian Government, CSIRO and Greening Australia. We also work with our fellow research and development corporations and the Murray–Darling Basin Commission through the Joint Venture Agroforestry Program managed by Rural Industries Research and Development Corporation.

That decade of research investment has seen some outstanding research, from world-class landscape ecology experiments to extremely innovative work on incentives for conservation on private land and new industries based on agroforestry. We have excellent research products directed to all three of the above priorities. [2]

Today we have a more sophisticated understanding of native vegetation in the landscape, but our knowledge still lags behind the production-based knowledge gained in agriculture and forestry over more than one hundred years of research and extension activity. Importantly, this means that the number of skilled and experienced advisers who can help landholders apply the latest native vegetation research within the context of their farming enterprise is a fraction of that available in, for example, the cropping, dairy or horticulture industries.

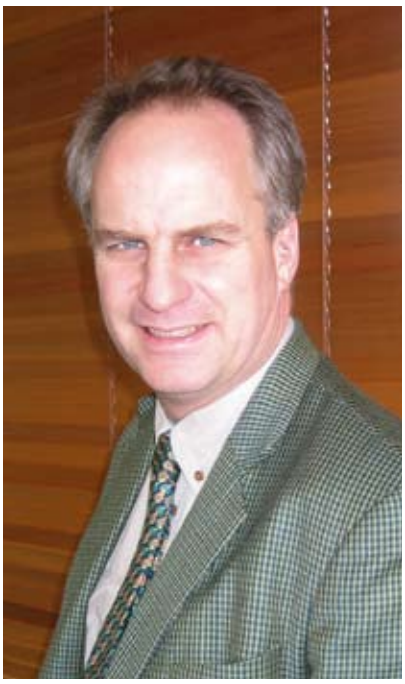
In traditional agriculture, there is a complex array of advice and support available for people wanting to try new things—from product manufacturers and suppliers to contractors, consultants and research and extension staff. For native vegetation management, notwithstanding the excellent work done by Greening Australia, thousands of voluntary groups and a handful of small private firms, we have very little of this service infrastructure.

About 70 per cent of our land is managed by farmers and another 20 per cent by Indigenous communities. Many of the current options for native vegetation management won't be adopted widely without intense intervention through extension, training, management expertise and resources. We need to target these options to regions where they will be of greatest value, and we need to ensure that adequate technical and operational support is available so that any changes made are long lasting.

Over the next 20 years, I hope to see the emergence of a vibrant native management industry in Australia. This industry would be ecologically informed about things like plant genetics and seed management. It would carry out landscape planning, design and action. It would be engaged in managing and restoring habitat on behalf of both on-site and absentee landholders. And it would invest in large-scale revegetation for both economic and environmental outcomes.

We also need new options that are more attractive for farmers and other natural resource managers. Such options are best developed through well-targeted and well-resourced research and development, working with the landholders and informing management and policy at all scales. We need to sort out the hierarchies between the various levels of government and regional management; set some minimum standards; define the environmental outcomes we all want; and strike a balance between providing insufficient incentives and paying too much for too little.

Added complexity, longer timeframes and uncertain returns bedevil many systems based on incorporating a greater proportion of native vegetation into Australian farming systems. These factors underline the importance of research and development to deliver more attractive options, and the development of a viable native vegetation management industry to provide more durable and effective long-term support for landholders keen to do the right thing.



Andrew Campbell, Land & Water Australia (source: Land & Water Australia)

[2] See **www.lwa.gov.au/nativevegetation/**

From principles to practice—managing native vegetation

By Jenni Metcalfe

Paddock trees (small clumps of trees in grazed or cultivated paddocks) are estimated to cover 20 million hectares of temperate woodland areas in Australia and they are at risk from clearing. Scientists have predicted that continued paddock clearing in southeastern South Australia will remove all privately owned paddock trees within 200 years. If the rate of dieback is included, this time would be reduced to 150 years.

Mike Hodder and Sandy Carruthers of the South Australian Department of Water, Land and Biodiversity Conservation have looked at the number of remnant trees in parts of southeastern South Australia. They found that 35 per cent of the remaining red gum, 72 per cent of the remaining pink gum and 53 per cent of the remaining blue gum tree cover are now found as paddock trees. In fact, they found that paddock tree cover represents about one-third of the total remnant tree cover in the region.

Almost two-thirds of Australia's intensive agriculture and urban areas have been cleared or substantially changed. Nearly all bioregions (94 per cent) in Australia have one or more threatened ecosystems. This is especially true of the heavily cleared regions of southern and eastern Australia (see box). Therefore, we need to improve the conservation status of fauna and flora on private land in Australia by using sound management practices.

Findings on biodiversity from the National Land & Water Resources Audit

- Across Australia, 2891 threatened ecosystems and other ecological communities were identified.
- Almost all (94 per cent) bioregions in Australia have one or more threatened ecosystem, with the greatest numbers in the heavily cleared regions of southern and eastern Australia.
- Nearly half of the threatened ecosystems are eucalypt forest and woodlands with extensively cleared shrubby or grassy understorey.
- The highest number of threatened species occurs in southern and eastern Australia, within the subregions of the southern highlands in Victoria and New South Wales and along the coast from Sydney to north of Brisbane.
- Vegetation clearing is the most significant threat to species and ecosystems in eastern Australia.
- Fragmentation of remnants, increased salinity and firewood collection are also threats to biodiversity in the highly modified regions of southern and eastern Australia.

Source: Australian Terrestrial Biodiversity Assessment 2002, **audit.ea.gov.au/ANRA/vegetation/docs/biodiversity/bio_assess_contents.cfm**

Making informed decisions about managing the land

Given that most of Australia is managed privately by farmers, it is crucial that we are guided by sound ecological principles to protect our native vegetation. These principles should support informed and independent decisions by farmers and natural resource managers, each of whom may have different management objectives.

To do this, we need to start by looking at the objectives of management. What does a farmer or land manager want to achieve? Environmental managers may want to recover an endangered species, reintroduce a species, reduce the rate of decline of a common species, or maximise total species richness. Farmers may want to develop different farming systems that will reduce their risk, increase their profits and have environmental spinoffs.

'Conservation biologists also need to address a social objective: what to say to farmers and their neighbours on how best to contribute to the conservation of biodiversity in agricultural landscapes', says David Freudenberger of CSIRO Sustainable Ecosystems. 'This social objective is just as valid as species conservation. In my experience, our approach to species conservation can also provide sound and timely advice to better inform decisions and expectations of farmers.'

Freudenberger also argues that an approach to landscape restoration that only focuses on a species approach will fail. 'An ecosystem function approach must also be adopted, but not on its own. A functional approach to landscape restoration can come up with solutions such as commercial forestry, and engineering fixes such as salt interception schemes or better crop rotations. But it will fail to account for the habitat requirements of many thousands of species. A dual approach is essential: species based and function based.'

Black wallabies need large tracts of native woodland (source: Max Herford, Foundation for National Parks and Wildlife)

Some of the objectives of native vegetation management are focused on the following outcomes:

- protecting biodiversity
- restoring biodiversity
- maintaining healthy, functioning ecosystems (meaning healthy soil and water resources)
- integrating more productive agricultural systems with environmental outcomes.

Guiding principles for managing native vegetation

As many threatened species' habitats are on farms, it is important that landholders look at strategies that protect these habitats. Environmental outcomes need to be balanced with production outcomes to be sustainable. Benefits could include shelter for livestock, wind or fire breaks, erosion control, water quality, carbon credits and increased property values.

The following 10 general principles have emerged from a number of Land & Water Australia research projects on managing native vegetation:

- Develop a long-term shared vision and use it to identify quantifiable objectives and constraints.
- Manage the whole landscape, not just individual pieces—that is, the remnants, patches of native vegetation, paddock trees and agricultural pastures or crops.
- Manage and assess the patches of native vegetation within the context of the whole landscape.
- Manage within an experimental framework—that is, use adaptive management, monitoring and modifying activities to make sure there is progress towards achieving objectives.
- Target activities to the local social, environmental and economic needs (what works on one part of the property may not work on another part).
- Recognise that clearing native vegetation in one area cannot be fully offset by planting vegetation elsewhere on the farm or local scale.
- Protect different types of vegetation, such as old growth forest, regrowth woodlands, replanted areas—these all have different habitat values for different species of animals.
- Conserve the structural attributes of vegetation, including the number of dead trees, the density of tree cover and the level of understorey cover—these all affect the presence and abundance of animal species.
- Assess the condition of remnant vegetation in the contexts of the farm and landscape.
- Use both a species approach (e.g. look at the habitat that species of birds and animals need) and an ecosystem management approach (e.g. look at what native vegetation is needed for healthy soil and water).

These principles can help inform policies and programs for managing native vegetation. The social and economic contexts they are developed and implemented in should also be considered.

How much vegetation should there be?

Small vegetation clumps and single paddock trees are also important for the bigger picture of native vegetation conservation. 'Of course, we'd prefer larger blocks of native vegetation', says Carruthers. 'But even a single paddock tree can create biodiversity and

production benefits. As well as this, they have great potential for assisting with landscape restoration.'

'If just some of the areas containing paddock trees were targeted for restoration to woodlands, the area of native vegetation cover in the landscape could potentially be doubled.'

Keep livestock out of native vegetation remnants

Native vegetation covers just seven per cent of the Wallatin Creek catchment in the Western Australian wheat belt, mostly in very small patches of less than 10 hectares. Livestock are generally not excluded from these remnant patches, resulting in loss of ground and shrub cover, increased erosion and weed invasion. This threatens what little vegetation is left.

Research by Sue McIntyre and David Tongway of CSIRO Sustainable Ecosystems, and Rob Lambeck of Greening Australia, concludes that livestock need to be kept out of native vegetation remnants. 'Given the limited amount of native vegetation on the landscape, an objective of protecting existing remnants from livestock is realistic', they say. They also suggest that degraded areas could be restored by putting existing fallen timber parallel to land contours. This would disrupt surface water runoff and encourage water, soil and litter accumulation on degraded slopes.

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Paddock trees are important for biodiversity (source: Jim Donaldson, Land & Water Australia)

Farmers need good technical support and backup, such as on-site training provided by Greening Australia Limited (pictured) (source: Greening Australia Limited)

Together, people make the difference

By Duncan Handley

It's often the little things that count. This is especially so when we are faced with the seemingly insurmountable, such as making a measurable and positive impact on largely hidden ecosystems.

The good news is that more and more research is showing that small contributions really make a difference to improving ecosystem health.

This article looks at how the little things are adding up to big outcomes for two vastly different environments: farms and the Brisbane metropolis.

How do I know if conservation is working on my farm?

Nearly a decade ago, a farmer's challenge to an environmental scientist initiated a new and visible way of assessing ecosystem health, which is now working for researchers and farmers. The challenge was this: 'Okay, you've convinced me of the importance of conservation on my farm, but how do I know how much I need to do to make a positive impact?' The challenge led to the development of the focal species approach (FSA).

In a lay person's terms, the FSA says if you can look after three or four of the most sensitive species in a given ecosystem, the rest of the ecosystem will be able to look after itself. These sensitive species act as a barometer for the environment.

Like a lot of research, the FSA is theoretical—there are not enough data to use it with 100 per cent accuracy. Identifying the species that are most sensitive to habitat loss is difficult, because they are likely to be quite rare in a threatened environment. However, the FSA provides solid information for making good, practical recommendations for conservation.

'The FSA is a means of getting started—a useful rule of thumb', says David Freudenberger of CSIRO Sustainable Ecosystems, who has used the approach to develop revegetation guidelines for Greening Australia and landcare groups.

'For example, after analysing our bird data, we are able to say to farmers, "The eastern yellow robin is a particularly sensitive bird. If you can plant or conserve 10-hectare patches of

Planting native trees and shrubs can provide valuable habitat, particularly if areas are at least 10 hectares in size, but such patches do not provide the same habitat as old-growth remnants with lots of tree hollows and fallen timber (source: David Freudenberger, CSIRO)

woodland that are well connected to other patches with an understorey of tussock grasses, fallen timber and native shrubs, then you have a great chance of conserving not only this gorgeous bird, but other, less sensitive, wildlife affected by the loss of woodland and habitat.'' '

'Farmers can rely on these rules of thumb because they occur wherever we work: repeatedly we see that patch size, a diverse understorey and effective corridors really matter. This is a simple message that explains a lot of complexity', Freudenberger says.

Freudenberger says birds make the perfect focal species because they are visible and their presence and health status are measurable. Farmers are able to view the environment 'through the birds' eyes' and see whether their conservation efforts of fencing patches of bush and replanting native shrubs are working. But it is not only seeing and counting the birds that are useful measures of environmental health.

'We often use the idea of the ''silent spring'' to help landholders become more aware of the environment around them', Freudenberger says. 'We are no longer losing birds due to highly toxic pesticides, but due to overapplication of farming practices like clearing and grazing. If you can't hear that wonderful dawn chorus of bird song, then maybe the environment is not as healthy as it could be. We find that encouraging landholders to listen for birds really helps them tune in to what's going on in the environment.'

Freudenberger says that birds are also great indicators of success. 'They are mobile, so if there is a suitable patch of replanted or protected woodland, they will find it. Birds allow researchers and landholders to see and hear the impact of the farmer's good work. We all need a pat on the back now and then to keep us going. The return of native birdsong is that kind of tangible reward.'

Every drop counts—balancing rural plant and water functioning with urban water needs

In a vastly different arena, upstream producers have the opportunity to use their farm management systems to make a real difference to water quality and flow for Brisbane's 1.8 million residents.

Brisbane's dam levels are currently below 30 per cent and severe water restrictions have been introduced. Sediment and nutrient runoff are

'When using the focal species approach, identifying the right ''barometer'' species is important. It needs to be visible, easily identified and counted, and reflect the health of the environment. For these reasons, birds are proving useful.'

The scarlet robin needs shrubs and native tussock grasses for feeding and nesting habitat (source: Bird Observers Club of Australia)

also affecting water quality and management costs.

Traditionally, authorities might have turned to strategies in the dam's immediate surrounds. This time, however, the focus is squarely on farms in the upper Brisbane, Logan and Mary River catchments to improve the quality and availability of the regional water supply.

Justin Ryan is a PhD student, finishing his thesis on land-use impacts on the plant and water functioning of the upper Brisbane River. He says an important message for farmers is that their actions do affect the quality and quantity of water in the catchment. 'It is equally important for city dwellers to accept that in order to guarantee their water supplies, there have been, and continue to be, far-reaching impacts on natural ecosystem functions in the upper catchments of the river (caused by sediment and nutrient loads).' So we all bear some responsibility to put strategies in place to avoid an unhealthy and degraded landscape.

'We are suggesting to farmers that they retain or restore native vegetation in small and specifically targeted areas to slow the surface runoff. This can reduce erosion and sediment buildup in dams and improve water availability and quality. Nutrient loads are also reduced because the native vegetation acts as a filter, storing the nutrients as biomass rather than letting them enter downstream waterways', Ryan says.

Using the example of a farm dam, Ryan explains that fencing off a small area around a dam's inlet and outlet, and the dam itself, will encourage the growth of native vegetation. As already mentioned, this will slow down and filter the water going into the dam. But as time goes by and trees mature, their shading and wind-breaking effect will also reduce evaporation, lower water temperatures and provide a regulated flow if flooding occurs.

'It's a win for the farmer and a win for the catchment', says Ryan. 'The skill now will be getting the message out there in a form that allows farmers to engage in this type of management themselves.'

Ryan feels that one of the most effective ways for this to happen is for farmers to become involved in an expert group—ideally one linked to a university or similar specialist research organisation. Such a group could take many forms. It could be a formally organised catchment or landcare group, or a less formal gathering of farmers who use expert advice to design a plan for an area.

'It is important that farmers are involved in the design of the work as well as its implementation', says Ryan. 'Through understanding the design, farmers become more immersed in the process and are more likely to take more action, particularly if the work enhances production. Understanding the design also shows farmers how they stand to benefit by making the investment. The role of the researcher then becomes one of providing advice on which species are best to use for the job, how to arrange them in the landscape, and how they may further be used to restore organic matter on nearby hill slopes to trap nutrients, rather than allowing them to "leak" into waterways.'

'The beauty of being associated with a specialist research group is that it gives access to resources that can provide additional analytical capacity and the ability to link in with other projects

Riparian erosion (source: Greening Australia Limited)

taking place in the same region or across the country', Ryan remarks 'It also empowers farmers, by recognising the significance of local expert knowledge, often accumulated over successive generations on the land. For example, farmers participated in an expert survey that we were then able to use to generate probability statistics that show potential transitions in land use for this region, in the face of ongoing water shortages and climate change.'

Patches of native vegetation that are at least 10 hectares in size have the greatest chance of being valuable habitat for many different species.

Revegetation work near water (source: Conservation Volunteers Australia)

Tips on making a difference to ecosystem health

- Work with others.
- Work with researchers to identify an on-farm strategy that can work.
- Form an expert group to help with design and monitoring.
- Adopt a farm design and monitor changes you make to your land.
- Aim to learn about how the changes you make can help the environment and make your land more productive.
- Involve others to increase the impact.

What works best?

- The least productive parts of the farm can be managed for their conservation value.
- Streamside vegetation is particularly valuable for wildlife and for improved water quality.
- Shelter-belt plantings of native trees and shrubs can be used to connect patches of bush that might otherwise be too small and isolated, even for birds.
- Conserving wildlife on farm is a big experiment—monitor the results of your actions and aim to continually improve results.

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Rufous songlark reflects biodiversity at Boorowa

Managing sunlight, time and birds is a new preoccupation that works for David Marsh's 813 hectare property in Boorowa, New South Wales.

Traditionally, it would be said that David agists cattle and runs merino wethers for wool and meat. However, now he describes his main operation as managing sunlight and time for sustainable plant production.

In 2001, David, along with more than 70 other farmers, became involved in the Saltshaker Project: a partnership between Greening Australia ACT and southeastern New South Wales, the Boorowa Regional Catchment Committee, and Boorowa Council to protect native remnants and revegetate the Boorowa catchment.

The project measured biodiversity outcomes, using the focal species approach, among other methods. David Freudenberger and his team from CSIRO Sustainable Ecosystems were involved in the initial survey of birds, but now Freudenberger informally monitors bird numbers on this property as a matter of course.

'The rufous songlark is a ground-dwelling bird species in decline. Before we changed practices on our farm, it was rare to see them. Now that we have more vegetation and groundcover on our pasture, we have heaps of them. The same goes for the little red-capped robin and the rufous whistler, both of which have become prevalent in response to changes on the farm.

'Over time, we've recorded 118 species of birds on our farm. We're pleased to see the birds. Not only because they make our farm a nicer place to be, but they're proof our management practices and philosophies are having a real impact,' says Marsh.

Rufous songlark numbers have been increasing as a result of improved habitat conditions on David's property (source: Bird Observers Club of Australia)

Thinking big with vegetation management

By Don Alcock

What do we really mean by a healthy landscape?

Like most answers to complex questions, it depends on who you ask and to which area you refer.

Pastoralists use measures of farm productivity and sustainability. Park managers have developed measures of biological conservation. Scientists often use biological, chemical and physical indicators. Indigenous communities have long-standing measures of the cultural values of the landscape.

Used on their own, these measuring systems may not be satisfactory in gauging the health of a whole region or catchment. A healthy landscape needs to have basic ecological functions intact, such as the ability to store nutrients and capture water so that it can support pastures and native vegetation.

Diversity of plants and animals is also necessary—perhaps not at the scale of a paddock, but certainly at the scale of a catchment. In addition to the biophysical characteristics, a healthy landscape may need to support a range of livelihoods, such as cattle grazing or wheat farming.

From paddocks to landscapes, scale makes all the difference. When it comes to managing vegetation, we need to consider multiple scales (from site to block to landscape to catchment) in any natural resource management decision. As many land managers know, what works in one place doesn't always work in another. That's why farmers and resource managers are now thinking 'big'.

A landscape approach to planning

'A landscape approach to vegetation management offers many potential environmental, economic and productivity benefits over property scale management, because individual farm plans can be aggregated into a single landscape unit', says Neil MacLeod of CSIRO Sustainable Ecosystems. 'Large-scale planning helps conserve vegetation corridors and habitat areas, ensures connectivity and biodiversity is maximised, and achieves greater economic and productivity gains.'

Farms and private land with native vegetation are typically managed at the paddock and property scale, while many resource problems, such as tree decline, threatened species loss, water quality and nutrient management, are likely to occur over a larger scale, such as catchments or regions. So it makes sense to integrate landscape restoration and vegetation management at an individual property, or with a cluster of properties, into a regional plan.

Emu Creek in southern Queensland is dominated by grassy woodlands. The catchment, located in the upper reaches of the Brisbane River, is a priority area under the National Action Plan for Salinity and Water Quality (source: Neil MacLeod, CSIRO)

It's the cumulative effects of many actions that result in large-scale improvement.

Scaling up local guidelines to regional plans

Recent research by MacLeod at CSIRO is being used to develop 'best-practice' landscape management principles (see box) and ecological thresholds that integrate farm production and resource conservation on grazing properties in grassy woodlands. The research, largely conducted in southern Queensland where grassy woodlands dominate, has implications for many agricultural and semiurban, or subdivided, landscapes.

'While the principles were set in a grazed landscape context, they can be applied to agricultural landscapes across much of Australia, including Queensland and the Northern Territory', says MacLeod. 'The principles address all major natural resource management issues in landscape production, including management of soil and vegetation, protection of riparian zones and watercourses, and maintenance of viable wildlife habitat.'

MacLeod's research project extended the management principles to the local catchment and regional scales. He studied land management practices in a group of small farm properties in the Emu Creek catchment of southeastern Queensland. The catchment, located in the upper reaches of the Brisbane River, is a priority area under the National Action Plan for Salinity and Water Quality.

Initially, MacLeod identified barriers that prevent individual landholders from adopting conservation practices, particularly those relating to economic and equity issues. However, he also identified opportunities for overcoming these barriers through adaptive management, collective action and appropriate incentives.

'The guidelines, which promote positive land-use changes, can be widely adopted across major Queensland regions if the principles are adapted to cover the diverse range of nongrazing land uses, such as cropping, horticulture and hobby farms', says MacLeod. 'Their ecological value was never disputed and we are now starting to see them used for vegetation planning in other parts of Australia, such as southern and central New South Wales.

'But to apply the guidelines successfully over a large scale, there also needs to be a range of incentives, access to scientific knowledge, on-ground advice, and clear regional policies for landholders. In particular, the principles need to be validated, and possibly modified, to suit the large number of small-area land uses that now dominate agricultural landscapes around major town centres', says MacLeod.

Using 'best-practice' principles

The following box shows best-practice principles and guidelines for managing eucalypt woodlands. These principles and guidelines promote positive land-use changes, and can be adapted to many regions of Australia.

Property planning and management should include a long-term vision that considers the whole of the property and its place in the catchment

- Manage the limitations and potential of the land, based on an understanding of ecological processes.
- Apply the precautionary principle of conservative or delayed development.
- Balance land uses of high intensity with significant areas of low-intensity use across landscapes.
- Be aware of the arrangement of land use across landscapes, because land uses can have influences that spread beyond their boundaries.
- Retain and manage vegetation representative of all land types occurring on a property.

Soils should be managed to prevent erosion and to maintain productive capacity and water quality

- Keep the amount of bare ground exposed to no more than 30–40 per cent of the ground surface in pastures.
- Place infrastructure in stable locations on the landscape to avoid erosion.
- Pay particular attention to the management of soil types that have a higher risk of erosion and salt problems.

Pastures should be managed for production and to maintain the variety of plants and animals

- Graze conservatively to maintain dominance of large and medium tussock grasses over 60–70 per cent of the native pastures.
- Limit the extent of intensive land use (grain and forage cropping, sown pastures) to a maximum of 30 per cent of the property area.
- Vary the management of pastures to provide for a variety of species and a diverse range of fodder sources.

Local native trees should be maintained for the long-term ecological health of the property and catchment

- Retain a minimum of 30 per cent woodland or forest cover on properties.
- Always favour natural regeneration of existing trees to planting and re-creating habitat.
- Retain woodland patches of a minimum of 5–10 hectares to ensure their long-term viability.
- Retain trees of different ages within stands to retain the long-term viability of tree populations.
- Maintain or regenerate trees in appropriate places to minimise degradation, enhance livestock production and enhance diversity.

All properties require core conservation areas for species that are sensitive to agricultural land uses

- Where possible, choose the areas with existing flora and fauna values for ongoing management and include areas on good-quality soils.
- Retain critical habitat elements, such as mature trees, understorey vegetation and standing dead and fallen timber for fauna.
- Protect core conservation areas from heavy or continuous grazing.
- Carry out ongoing weed control and burning off in core conservation areas, where necessary.
- Connect core conservation areas to others on the property.
- Manage at least 10 per cent of the property as core conservation area.

Watercourses are particularly important to the ecosystem and grazing enterprise, and require special management[a]

- Retain vegetation along the edges of watercourses.
- As a general principle, exclude livestock from watercourses to reduce soil erosion and maintain water quality (see Land & Water Australia's recently released publication, ***Stock & Waterways: a Managers Guide***, available online at **www.lwa.gov.au**).
- Control exotic species in riparian zones.

[a] See S McIntyre, JG McIvor and KM Heard (2002). ***Managing and Conserving Grassy Woodlands***, CSIRO Publishing, Melbourne.

The changing nature of landscape condition. While eucalypt woodland in the background looks normal, an old wooden fence post in the foreground indicates soil erosion: the post protrudes a mere 40–50 centimetres out of the ground, indicating the ground level is now 70–80 centimetres higher than when the fence was built (source: Neil MacLeod, CSIRO)

Jim Moll (left) and Josh Dorrough being interviewed by journalists in the Ararat Hills (source: Jim Moll)

Farm business good for biodiversity

Perhaps the best example of many individual landholders contributing to biodiversity goals at a large scale comes from research undertaken in Victoria's Goulburn region. Jim Crosthwaite of Victoria's Department of Sustainability and Environment, and Jim Moll of the Goulburn Broken Catchment Management Authority, led a project which clearly showed that economic, financial and environmental strategies exist for landholders to meet their catchment management targets.

The project found that through a farm-business approach, there are opportunities to make significant changes to grazing properties that are a good investment and make important contributions to biodiversity in the catchment. The project predicted that broad-scale improvements in the extent and condition of native vegetation would occur if landholders adopted simple strategies at the farm level.

The results indicated that substantial areas could be revegetated through natural regeneration, and that better grazing management has the potential to improve native vegetation cover on as much as 2 million hectares in Victoria alone. Productivity gains of approximately $2 million could be expected across southeastern Australia in five years.[1]

Steering the way

Linking different scales of vegetation planning—and different individuals, programs and authorities—can be a challenge. For example, in Queensland, there are four vegetation plans to be considered at a national level, seven at a state level, six at a regional or catchment level, and three at a property level.

Different scales of vegetation management require different types of research, surveys, assessments and plans. They also require different ways to package and communicate information. Landholders and managers face a daunting task in today's information-rich environment. They must make intelligent judgments based on a jumble of facts, opinions, forecasts, gossip and intuition.

[1] *This project was a partnership between Land Water and Wool and the Native Vegetation R&D Program. For more information on Land Water and Wool, see their website at* ***www.landwaterwool.gov.au*** *or visit the new-look Land & Water Australia website on* ***www.lwa.gov.au***

Crosthwaite and Moll's research shows how to successfully communicate findings about biodiversity management by framing them in a farm context. Effective communication of information, which inspires actions that cause positive changes to public policy, land-use practices or community behaviour, depends on well-established organisational partnerships, extensive personal networks, and active involvement of landholders in the information-seeking process.

Scaling up agricultural education and extension programs has considerable cost benefits. Moll says there are clear pathways for integrating biodiversity messages in these programs. 'There are opportunities for alignment or "joining up" of policies and integrating extension programs to ensure clear and consistent delivery at the land manager level', he says.

Economies of scale are also important for clusters of landholders working together on restoration projects—particularly in practical activities such as removing weeds, fencing remnant vegetation areas for conservation, and monitoring water quality in a catchment. MacLeod says significant savings can be made by sharing resources, equipment and expertise.

MacLeod ponders the question of scale: 'You have to manage parts of a landscape for different purposes. We now need to manage sites, properties and landscapes for multiple objectives. Some parts must be managed for sustainable agriculture. Other parts must be preserved for wildlife conservation. Some, like waterways, need special protection, because they become damaged more easily.'

The table below lists the types of vegetation management plans that apply to different landscape scales, and the tools used to manage these landscapes. With the right mix of knowledge of basic ecological functions, whole-of-farm business plans, suitable policy and management guidelines, and good research and communication, Australia's native vegetation and biodiversity can be conserved and restored at the levels of site, property and catchment.

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Vegetation management plans and tools for different landscape scales

Scale	Main tools and disciplines	Types of vegetation-related plans
Sites	Biology, botany, surveys	Operational plans, rehabilitation plans
Farms	Agronomy, planning, economics, management	Farm plans, property level plans, portfolio management, voluntary agreements
Landscapes	Ecology, hydrogeology	Local strategic plans, biodiversity action plans, fire plans, precinct plans
Catchments	Natural resource management, geographic information systems	Integrated catchment plans, investment plans, incentives
States	Legislation, vegetation and biodiversity policy	Conservation priorities, program delivery
National	Legislation, national action plan, international conventions	Resource condition targets, native vegetation policy frameworks, bioregional plans

Landscape model connects ideas with reality

By Don Alcock

After sifting through a myriad of native vegetation maps, climate classifications, natural resource management plans and land-use databases, two ecologists have come up with a new way to classify Australia's diverse landscapes.

The classification system provides a tool for land managers and researchers to analyse our landscape—from changes in native vegetation and habitat loss to climate variability and forest management. Significantly, the classification system blends the biophysical characteristics of land, water and vegetation types with variables such as climate and human impact.

Classifying complex systems

The conceptual framework, like most models, offers a useful way of looking at complex systems. It classifies landscapes on the basis of simple indicators. The framework can be used for both research planning and communication, and encompasses the entire range of landscapes that occurs throughout Australia.

From the wet tropics and dry savannas of Australia's north to the cold temperate forests and alpine mountains of our southern regions, the framework provides a practical way to interpret landscape variation, explains Sue McIntyre of CSIRO Sustainable Ecosystems.

'A key question in ecology and ecological management is the extent to which management guidelines developed in one location can be "generalised" to suit other areas. Each landscape differs in its biophysical characteristics and by the amount of human alteration', says McIntyre.

'Our aim was to develop a conceptual framework of Australian landscapes, on the basis of a few simple indicators, that improves the communication of information for planning and managing landscapes, particularly for biodiversity conservation.

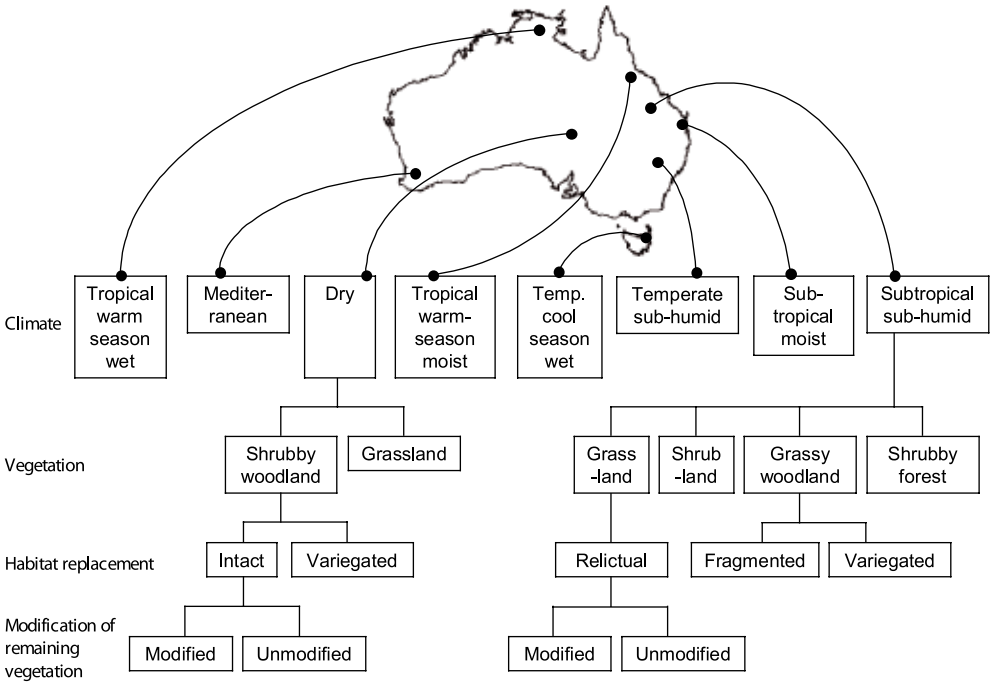
'We wanted to offer peak groups, such as Land & Water Australia, Greening Australia and government agencies, a model they could use to inform their own landscape planning needs', says McIntyre.

'Previous descriptions are limited. Natural resource managers and environmental scientists need more than just regional vegetation, soil or geological descriptions. Australia's landscapes are complex and involve many processes operating at different scales.'

McIntyre, based at CSIRO Sustainable Ecosystems in Canberra, together with colleague Richard Hobbs of Murdoch University in Perth, included biophysical

'We believe that the agroclimatic dimension of the classification will become important for detailed management guidelines', says McIntyre. 'For example, climate and bioregion will determine the types of weeds growing and appropriate responses, the severity of erosion problems, and the ease with which vegetation can be established for restoration projects.'

Landscape ecologist Sue McIntyre: 'Our aim was to develop a conceptual framework of Australian landscapes' (source: Jon Lewis)



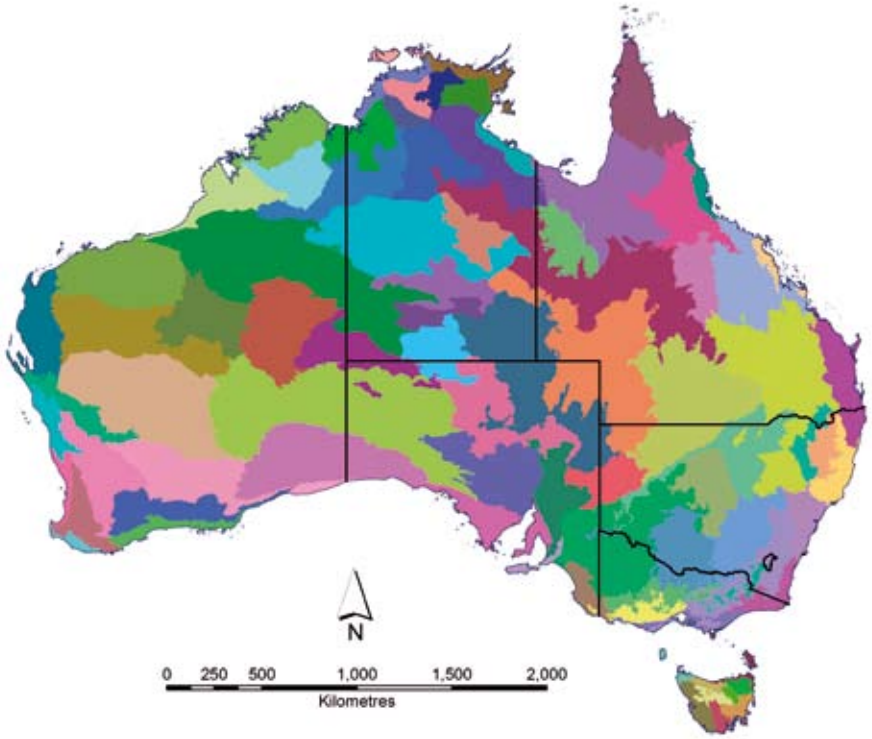
CSIRO's new landscape classification framework

features of landscapes, which reflect differences in the way landscapes succumb to, or recover from, land degradation.

The framework incorporates existing and popular classification systems, such as the Interim Biogeographic Regionalisation for Australia (IBRA), which describes 85 major bioregions and 403 subregions. This system, based on physical, climatic and biological features, was integrated with a climate classification to simplify it. Human changes to landscapes, such as the replacement of native vegetation, plus broad vegetation types, have been added as variables to an information matrix.

The matrix helps organise the framework so landscape researchers, planners and managers can collate information and consider landscape issues more systematically. There are ten climate, five vegetation, four habitat-replacement, and two habitat modification variables, giving options for 400 types of landscapes.

While this may appear to be a lot, not all categories need to be expanded in full. An example of a partial expansion of some of the classification is given in the figure, above.



The Interim Biogeographic Regionalisation for Australia (IBRA) *was developed in the early 1990s by the states and territories, under the coordination of the Department of the Environment and Heritage. Using specialist ecological knowledge, combined with broadscale data on climate, geomorphology, landform, lithology, and flora and fauna, IBRA is used to assess landscape health and prioritise regions that require Australian Government funding to protect biological diversity (source: Australian Government Department of the Environment and Heritage)*

Filling information gaps

The project assessed information gaps, which will be useful for Land & Water Australia's Native Vegetation & Biodiversity Research and Development Program. McIntyre and Hobbs identified several regions where Land & Water Australia's research effort has been comparatively low, such as in 'moist' subtropical coastal landscapes in New South Wales, which are influenced by urbanisation pressures. They also found the framework helped identify regions where Land & Water Australia's research effort has been relatively high, notably in landscapes where agriculture has had the greatest impact, such as in the eastern and southern wheat belts and the temperate cool-season wet pastoral areas of Victoria and southern New South Wales.

'These highly researched areas contain productive lands, critically endangered ecosystems, and some areas have extremely high levels of biodiversity. We suggest that the concentration of research investment here is appropriate, given that integrating native vegetation into agricultural production systems is a major focus of the native vegetation program', says McIntyre.

One research gap revealed by the framework is associated with subtropical and subhumid regions, represented by the brigalow belt. This region spans inland and eastern Queensland, from Townsville to northern New South Wales, covering an area of about 6 million hectares. Because much of the landscape is ideal for agriculture, some areas have been extensively cleared of brigalow—a common species of silvery wattle found in open forest and woodland communities.

Applying the framework

According to Bruce Cummings, assistant director of the Australian Government Department of the Environment and Heritage's National Reserve System Section, the framework's focus on key drivers for ecological processes in different landscapes is a major strength. 'This thinking makes the framework more widely applicable to conservation planners per se and facilitates its incorporation into other spatial analyses using a range of physical and biological data', says Cummings.

'As custodians of the IBRA framework, we're delighted to collaborate on this project to relate the bioregional and subregional boundaries to climate surface data and delineate new climatic regions for Australia.'

The scientists envisage the framework will help identify the extent to which particular land management guidelines can be generalised and used in other regions. In early testing, they applied two sets of existing landscape management principles to the framework. Obvious limitations of generalising are the practical considerations of vegetation structure and land use, because the framework cannot be used to form guidelines for managing vegetation types that are not found in a particular region. Similarly, there is little value in discussing how to manage remnant vegetation in landscapes that have not been cleared. To overcome this limitation, the framework includes vegetation indicators of structure, replacement and modification.

On the other hand, some management principles are so fundamental to biological processes that they can be generalised across all landscape types. Examples are guidelines that maintain or create connectivity, protect watercourses, and preserve structural complexity in habitats.

'We believe that the agroclimatic dimension of the classification will become important for detailed management guidelines', says McIntyre. 'For example, climate and bioregion will determine the types of weeds growing and appropriate responses, the severity of erosion problems, and the ease with which vegetation can be established for restoration projects. These are specific on-ground management considerations In this way, the framework is flexible and can be adapted for particular management guidelines.'

Encouraging discussion and improving land management

The framework's capacity to improve discussions about planning and managing Australian landscapes will depend on the extent to which it is used as an organising framework, and how it complements other approaches to landscape classification.

'Some natural resource planning and management groups have found it useful for Australia-wide assessment and priority setting, and in contextualising activities within particular regions', says McIntyre. 'But it's not designed as a decision support tool for a local area.'

'The framework complements other approaches, including the IBRA scheme and map-based landscape classifications. These different approaches have different aims, with our framework providing an additional conceptual model for more detailed local and map-based approaches', explains McIntyre.

McIntyre and Hobbs hope the framework will help improve how ideas are communicated about landscape ecology, research and management in Australia. The framework is a tool that may help scientists and land managers connect ideas with reality.

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Protecting our bushland in agricultural landscapes

By Jenni Metcalfe

Looking down when flying across parts of Australia reveals a colourful kaleidoscope of patterns of all shapes and colours. This is what makes up our landscape: a mix of cleared land with patches of vegetation varying in size, shape and extent.

It is the patches of 'remnant' native vegetation that are so important for conserving Australia's natural biodiversity, and for providing ecosystem services, such as reducing erosion and protecting our water quality. Managers of our farms and reserves are looking at ways to protect native remnant bushland and to revegetate agricultural land with native plants. To do this, we need to understand how to manage remnant bushland areas and work out the best way to revegetate land.

This article looks at how we can protect our remnant bushland. However, we also have to remember that preserving and enhancing biodiversity will be best achieved through a combination of activities.

In what condition is our remnant bushland?

Many projects funded by Land & Water Australia's Native Vegetation R&D Program have studied the health and viability of remnant vegetation. These projects have given us better knowledge about how remnants function and how best to protect them.

Through the program, Andrew Young and Linda Broadhurst of CSIRO Plant Industry looked at the genetic and ecological viability of plant populations in remnant bushland in two contrasting ecosystems. They compared the temperate grassland–woodland ecosystem of New South Wales with the dry, evergreen shrub and small tree ecosystem of the Dongolocking region in Western Australia (kwongan shrublands).

The kwongan shrublands represent a truly fragmented landscape, with remnant vegetation isolated in confined patches by intensive wheat and grazing areas. In contrast, the grassland–woodlands of New South Wales represent a more continuous landscape, with a mix of remnants and improved native pasture in varying condition.

'The aim of our research was to understand and quantify how genetic and demographic processes interact to influence the viability and long-term conservation value of native plant populations in remnant vegetation', says Young.

Other Land & Water Australia research under the program has looked at bushland remnants in different parts of Australia to understand how these landscapes function. Examples include:

- remnant vegetation in the poplar box woodlands of the Maranoa–Balonne in the Murray–Darling Basin region of southern Queensland (Chris Chilcott of the Queensland Department of Primary Industries)

Australia's landscape is a kaleidoscope of patches, which include native vegetation remnants (source: Andrew Campbell, Land & Water Australia)

- paddock trees and bushland remnants in southeastern South Australia (Mike Hodder and Sandy Carruthers of the South Australian Department of Water, Land & Biodiversity Conservation)
- remnant vegetation in agricultural land in northern Victoria, particularly looking at the impact on bird and mammal populations (Andrew Bennett and Jim Radford of Deakin University)
- the Western Australian wheat belt and the grassy woodlands of southeastern Queensland (David Tongway and Sue McIntyre of CSIRO).

What is healthy remnant bushland?

Healthy remnant bushland contains patches of vegetation with healthy trees, a diverse mix of animals and plants, genetic diversity within populations, and a mix of vegetation structure that includes woody debris. Unhealthy remnants are likely to have dying trees, inbred populations of plants and animals, bare soil, weed invasion and erosion.

Poplar tree dieback in unhealthy remnant bushland in southern Queensland (source: Chris Chilcott, Queensland Department of Primary Industries and Fisheries)

Healthy remnants are a response to a mix of species and a well-functioning landscape. Such a landscape is one where soil is not susceptible to erosion; where rainfall gets into the soil rather than running off it; and where nutrients cycle throughout the soil, plants and decomposing matter.

Clear signs of unhealthy remnants were seen in Queensland. 'We observed moderate to severe dieback of poplar trees at 95 per cent of all our study sites in the Maranoa–Balonne', says Chilcott. 'We also saw invasion by buffel grass, woodland thickening and a decline in landscape functioning, all pointing to the loss of viability of these remnants.'

What makes remnant bushland healthy?

Four major factors influence whether or not remnant bushland is healthy. These comprise tree cover, remnant arrangement, isolation and exposure to disturbances.

Bennett and Radford found that tree cover is the most important factor influencing bird populations at the landscape scale: 'The yellow-tufted honeyeater was not found in landscapes with less than five per cent cover of remnant vegetation, and other species of birds showed similar patterns as well.' Hodder and Carruthers also found paddock tree cover is important: as the overall cover of paddock trees increased, so did the number of bird species present.

The size of a remnant was also important for predicting the abundance of other species, as Chilcott found for ant populations. Smaller remnant patches were found to be more susceptible to weed invasion, erosion and runoff.

The way remnants are arranged and connected in the landscape is important in determining their health. 'It is the spatial distribution of woodland elements in the cleared landscape that is a critical factor in determining the way animals and birds can (or cannot) travel between remnants', says Tongway.

'In landscapes with low tree cover, networks of streamside and roadside vegetation can be particularly important for woodland birds', Bennett adds.

Chilcott's work in southern Queensland found similar trends for poplar box tree density: 'We found that the wider landscape patterns, such as where remnants were in relation to other land-use activities, had a greater influence on the density of older growth trees in remnants than any local effects.'

Another factor influencing remnant health is their degree of isolation from other vegetation patches or remnants. 'Increasing isolation was associated with increased inbreeding of trees and lack of genetic diversity', says Chilcott. 'These remnants also had a greater rate of tree dieback.'

The last major factor influencing remnant health relates to the amount and type of environmental disturbances. For example, Chilcott found that remnants surrounded by grazing activities had a higher level of inbreeding among their popular box tree populations, compared with remnants left undisturbed. He also found

Five guidelines for protecting native vegetation remnants in agricultural landscapes

- Maintain a range of landscape patterns, such as remnants, streams, revegetation, fallen timber and native grasslands at the property scale (1000 hectares) and beyond.
- Manage different populations of plants and animals together within landscapes of 5–20 square kilometres, rather than as a series of populations independent of each other.
- Actively protect individual patches of native vegetation, especially streambank vegetation, rare types of plant communities and large blocks of native vegetation.
- Manage disturbances like fire and grazing in a proactive manner through property planning—for example, fence off 5–10 hectares of streambank vegetation from grazing to form riparian conservation reserves.
- Conserve paddock trees in the landscape, along with larger patches of remnant vegetation, to help maintain all existing habitat across the landscape.

remnants exposed to severe grazing had a reduced layer of grasses and herbs.

Bennett notes: 'Many species use the whole landscape, moving between landscape elements on a daily, seasonal or irregular basis. The land use surrounding remnants influences the ability of animals to move through the landscape and use the remaining patches of bushland.'

The impact of these four factors shows that management and protection of remnants needs to occur at scales larger than a single site. Management of sites and farms needs to be integrated with wider local and regional plans and actions. Guidelines for protecting our remnant patches of native vegetation are outlined in the box below.

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Making conservation pay on the farm

By Duncan Handley

Farmers are, by necessity, commercial. Before making a decision to adopt a new conservation practice, they need to know whether it will give them a return on their investment. Fortunately, new research has shown that in many cases it will.

In northern Victoria, scientists assessed the use of different management strategies on 17 grazing properties to identify strategies that can both increase profit and improve the environment. Four management strategies were tested: deferred grazing, intensive rotational grazing, correcting soil nutrient deficiencies and natural regeneration (see the box).

Strategies for improving biodiversity

- *Deferred grazing*
  The removal of stock from hill areas during summer allows perennial native species to reseed and become more abundant. The production benefit comes from increased feed available on hilltops; these are often denuded by camping stock during the dry months. In most instances, this strategy requires extra fencing, but the increased pasture use and productivity can make this investment profitable.
- *Intensive rotational grazing*
  Often referred to as cell grazing, this strategy uses a series of small paddocks to intensively graze stock. It can lead to better groundcover, a greater diversity of grass species (including native species) and a reduced fertiliser requirement. This strategy also requires additional fencing. The financial benefit comes from increased pasture use and increased stocking rates, and the environmental benefit comes from the increase in land available for revegetation as well as improvement in pasture diversity.
- *Correcting soil nutrient deficiencies*
  In line with the 80:20 rule, where 20 per cent of the land produces 80 per cent of production, some parts of a farm are more productive than others. By investing resources into the more productive areas, and resting less productive areas, overall production can be increased. This allows the less productive areas—often the marginal hill country—to be managed to establish native vegetation.
- *Natural regeneration*
  Actively regenerating land can be expensive, with new rootstock, new fences and labour all adding to the cost. But a more passive form of regeneration can be far more cost effective. For example, fencing off existing paddock trees and allowing the area to regenerate naturally is often a cheaper alternative. Past research confirms the benefits of shelter (provided by vegetation) to stock and pasture.

Each management strategy aims to improve productivity by increasing stocking rates through better pasture use, while allowing the least productive parts of the farm to be managed for native revegetation. In addition, the strategies will increase the amount of shelter provided by vegetation, which, in turn, will improve productivity by slowing wind movement across the pasture, reducing evaporation and pasture damage, and providing shelter for stock from cold wind (therefore decreasing mortality rates in extreme circumstances).

The study found that 15 of the 17 farms could use at least one of these management strategies, and many of the farms could use two or three to help conserve biodiversity as well as increase profits. Jim Moll of the Goulburn Broken Catchment Management Authority said this was a great result, and means that most of the farms in the catchment have the potential to profitably improve the health of the catchment.

'If we extrapolate these figures across Victoria alone, we estimate that up to 2 million hectares of land could be managed successfully to improve the condition of native vegetation through better grazing management', Moll says. 'This is an exciting prospect.'

Whole-of-farm approach

All the farm management strategies tested have the potential to turn a profit over time; however, in some cases, it could take up to 15 years. This delay on investment might deter some farmers at the outset, but researchers are discovering that working with farmers and their families, and taking a whole-of-farm approach, can help clarify the benefits of each management strategy and increase the chance of them being used.

Moll says that one important part of whole-of-farm planning is identifying what drives farmers at a personal level.

'Farmers are business people, but they also have personal goals, such as educating children and family succession, that also need to be met', he says. 'When these personal goals are considered as part of the whole-of-farm approach, it encourages farmers to think differently about their long-term plans for the farm.'

Rate of adoption

Peter Chudleigh of Agtrans Research believes that profitable conservation strategies have a future on Australian farms. Unfortunately, he does not believe the strategies are being adopted quickly enough to meet conservation targets. To do this, financial incentives are needed.

'The use of incentives is justifiable, based on the potential to avert further biodiversity loss and continued deterioration in natural resources, both of which are valued by the public', Chudleigh says.

Moll is also a believer in the need for incentives: 'One-off incentives will be important to kick-start uptake of these investments. Many of these strategies require an upfront investment that many farmers are unlikely to make. We believe that once farmers experience the real benefits of the investments, they will increase adoption across the farm.'

How much land is enough?

Implementing any farm-based conservation strategy will be positive for the environment, but how much is enough?

The work done in the Goulburn Broken catchment shows that if, on average, farmers allocate 15 per cent of their land to native revegetation, the catchment will meet its biodiversity management targets.

For many farmers, the target of 15 per cent might seem out of reach, but adopting the type of strategies used in the study make it possible, and profitable, for most farms.

Good returns on deferred grazing

Robert and Debbie Shea run their fine wool property, 'Yadin', in hill country near Ararat in central Victoria. They have been investing in tree planting and revegetation on their property since the 1980s and are now reaping the rewards. Debbie Shea says that the practice of deferred grazing has been the most effective for their operation.

'We used to have one huge hill paddock where the sheep would only graze and camp on the top, leaving it bare in summer and exposed to wind and summer storm erosion. Since then, we have fenced off the top of the hill and destock it every summer.

'When we get the autumn break, we put wethers back on the hill and join our ewes in flatter country. This means we have more production from the hilltop and use hillsides far more effectively than we did in the past.

'We've learnt a lot from deferred grazing, one thing being that we underestimated the production we can get from native grasses. By encouraging native grasses, we have really increased production from our farm', Shea says.

Of the 967-hectare farm, nearly 50 hectares have been fenced off and revegetated, some with funding assistance from government agencies. By doing this, Robert and Debbie have increased their farm's production, improved its aesthetics, and have made an investment in the region's biodiversity and its future.

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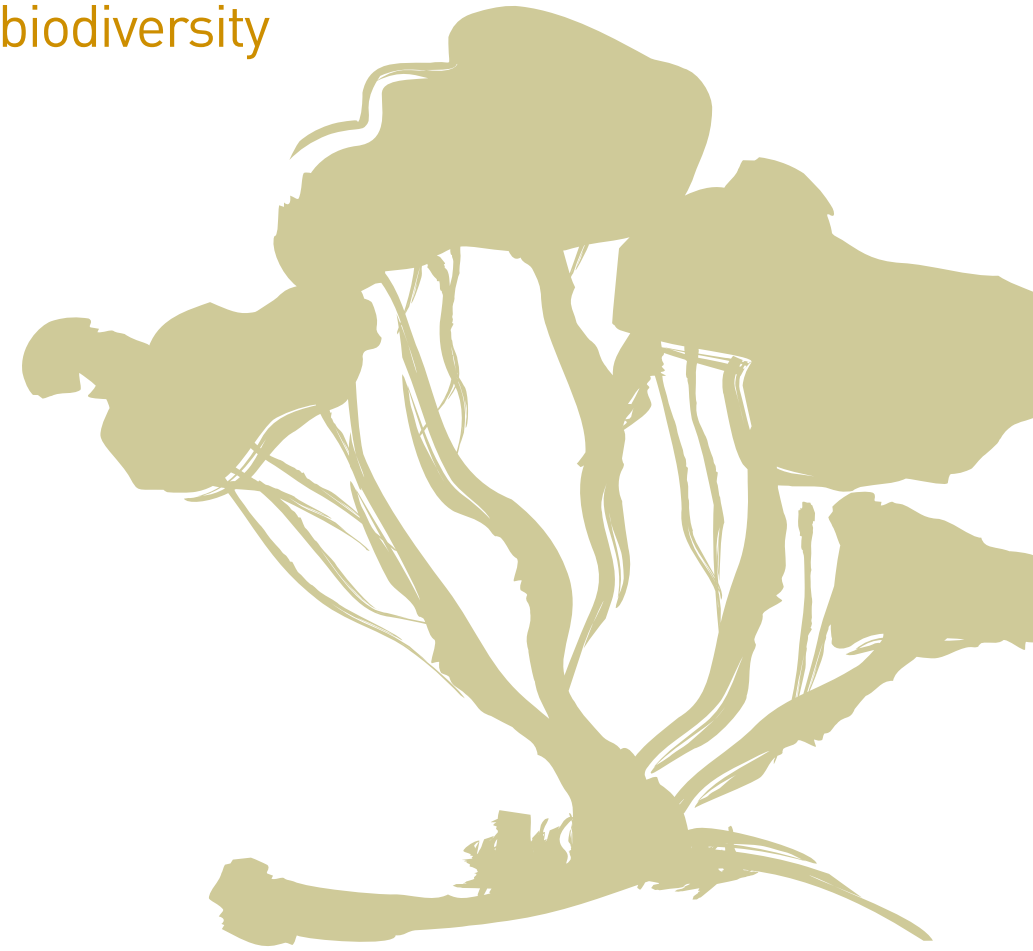
Integrating native vegetation and grazing land improves biodiversity while maintaining productivity (source: Andrew Campbell, Land & Water Australia)

No short cuts to biodiversity

By Mary O'Callaghan



In the face of fire, drought and floods, many of our ecosystems are surprisingly robust. At the same time, they are complex and ever-changing and, while we continue to learn more about how we can maintain and improve their biodiversity, our public funds are scarce and need to be well targeted.

Wouldn't it be great to have some cost-effective rules of thumb that we could rely upon to achieve nature conservation goals with the least impact on farmers and their production goals?

A consistent insight from the recent Land & Water Australia Native Vegetation R&D Program is that principles and guidelines are useful starting points, but there is no substitute for a detailed understanding of biodiversity. We need to learn as much as we can about individual species and their habitats. It appears that no 'one size fits all'—our diverse ecosystems demand diverse management responses.

This article highlights some of the findings from the program that show why generalised approaches can make good starting points, but are not complete solutions.

Letting the land management conservation objectives drive the approach

At the broadest level, different objectives need different approaches.

'If your objective is to recover an endangered species or to reintroduce a species, there is no substitute for detailed research on that single species to determine its threats', says David Freudenberger of CSIRO Sustainable Ecosystems. 'However, if your objective is to reduce the rate of decline of relatively common species, or to maximise species richness, I recommend what I call the "threat–response approach".'

The threat–response approach is a species-based method for quantifying threatening processes. It uses data on the distribution of individual species to estimate their sensitivity to threatening processes, such as decreased habitat patch area, habitat degradation and increased isolation.

Freudenberger claims that the threat–response approach is more targeted than the focal species approach for determining where to replant.

The focal species approach is based on the premise that the habitat and management needs of the most sensitive species will meet the needs of all other species similarly threatened.

'The focal species approach is impractical for defining the habitat requirements of all species', explains Freudenberger.

The sampling effort needed to model the habitat requirements of highly sensitive, and therefore rare, species is large. Relying on rapid surveys of birds is likely to underestimate the habitat requirements of many rare species.

'Quantifying the habitat requirements of easily surveyed birds is a useful starting point for generating local vegetation management guidelines, not a final solution', says Freudenberger.

Species richness—when less is more

Maximising species richness is another conservation objective. It implies that the more species, the better. However, this objective can fail to recognise the value of habitat patches dominated by a few specialist species that are absent in species-rich patches.

'Species richness analyses treat all species as having equal conservation value, but the threat–response

approach places a greater conservation value on declining species', explains Freudenberger.

'Using the threat–response approach, and the bird survey data that we have for 316 remnants in Western Australia's northern wheat belt, we can now say to farmers in the Buntine–Marchagee catchment: "You are likely to have only a 10 per cent chance of attracting a honeyeater to your 40-hectare planting, but a 30 per cent chance if you increase it to 100 hectares"'.

The risk of adopting too narrow an objective

But what about the risk of adopting a single approach to restoring landscape?

'The risk is not whether the approach you select is flawed', says Freudenberger. 'They all clearly have limitations. The risk is in adopting too narrow an objective.'

Freudenberger claims that any approach to landscape restoration that is solely species based will fail. An ecosystem function approach must also be adopted, but not on its own.

On the other hand, a solely functional approach to landscape restoration—for example, commercial forestry, salt interception schemes and drains, better crop rotations and designs—will fail to account for the habitat requirements of thousands of species. A dual approach is essential: species-based and function-based.

Birds as indicator species

In a study of 54,000 remnants in Western Australia's central wheat belt, Freudenberger found that birds differ from other taxa in the area of vegetation that they require.

'The area thresholds derived from bird data do not necessarily meet the needs of mammals and reptiles', he says.

In contrast, his research in the New South Wales Riverine Plains bioregion found that the most sensitive birds can encompass the habitat and landscape needs of many other species from a wide range of taxa. Sensitive birds need larger and better condition remnant areas than other animals occurring in the same conditions. However, as birds are relatively insensitive to isolation, this may not reflect the connectivity needs of other animals.

David Freudenberger planting trees in the fire-affected Cotter catchment, near Canberra (source: Toby Jones, Greening Australia ACT and SE NSW)

Cows grazing near Nukinenda Creek, a tributary of Emu Creek (source: Tara Martin, University of British Columbia)

The influence of scale

Scale can also influence the conservation outcomes.

Past research has determined design principles and thresholds at the paddock and property scale for sustainably managing grazed landscapes, especially grassy woodlands.

The design principles are based on landscape design and management measures, such as woodland cover, amount of intensive development, level of ground cover, presence or absence of vegetation buffers, and uncontrolled grazing access. The research suggests these measures relate to indicators of catchment condition and, therefore, ecological sustainability. Catchment conditions include soil surface condition, soil erosion, pasture health, riparian tree health, riparian weeds and bank stability, wildlife diggings and scats, and representative remnant vegetation.

Using the Emu Creek catchment near Crow's Nest, Queensland, as a case study, Neil MacLeod of CSIRO Sustainable Ecosystems set out to determine whether these principles and thresholds, which have attracted national and international interest, held true at the larger catchment scale.

Selecting 30 small catchments in the area, each of approximately 500 hectares, MacLeod found the relationship between landscape design and management measures, and catchment condition indicators to be weak. Furthermore, he found that vegetation patterns had no localised effect on the condition of the catchment.

'There has been a lot of discourse on the theory, and while it might be relevant at sites larger than 500 hectares, or if salinity is an issue, it was not borne out at the catchment scale', explains MacLeod.

Land condition and biodiversity—a fuzzy relationship

But is catchment condition a good indicator of ecological sustainability? Not according to Alaric Fisher and Alex Kutt of the Tropical Savannas

Ironbark in the Emu Creek catchment, Queensland (source: Tara Martin, University of British Columbia)

Cooperative Research Centre. Based on their research in the Victoria River district in the Northern Territory and the Burdekin rangelands in Queensland, they claim that biodiversity status will be poorly predicted if we assess land condition alone.

'The relationship between land condition and biodiversity is fuzzy', says Fisher.

'Land condition is, by itself, too blunt an instrument to adequately monitor biodiversity status. In most cases, other attributes such as canopy cover are more predictive of a broader range of species than land condition.

'People would like to have generalised indicators that they can use to readily and cheaply assess biodiversity across broad landscape scales. But there are no simple trends that can be generalised.'

Adequate indicators for biodiversity in the rangelands must be tailored to individual regions, ecosystems and land-use histories. This requires investment in improving baseline biodiversity data and ongoing sampling of at least some plants and animals.

Diversity begets diversity

How do we know what to plant, how much to plant and where to plant it? Or indeed, how much vegetation should we clear, and from where? The simplicity of the questions belies the complexity of the answer.

The best outcome demands a thorough understanding of the land management objective and an equally thorough analysis of the influencing factors. The habitat values of different vegetation types, the habitat preferences of different species, and the scale can all have an influence. Biodiversity itself demands from us a diversity of considerations.

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Land management tradeoffs

By Cathy Sage

Knowing how much remnant native vegetation is enough to maintain plant and animal populations can be difficult to determine. But it is important to know because it provides essential information for designing effective strategies for land management.

Inevitably, there are tradeoffs in managing native vegetation. For researchers, the tradeoff may be between using a long-term, all-encompassing approach and a short-term quick fix. For producers, the choice may be between keeping areas for viable production and preserving remnant vegetation. For conservationists, there may be a tradeoff between using (possibly) poorer-quality seed from local sources, or higher-quality seed from further afield, for revegetation programs.

Interestingly, the dilemma of these tradeoffs often provides an opportunity to find management solutions.

This article looks at three broad areas of recent research on vegetation and biodiversity where significant tradeoffs are involved. The first area involves research into whether increasing the amount of remnant vegetation actually supports more native fauna. The second area examines whether some farmers should think about keeping remnant vegetation that may not be viable. The third area involves research into whether native seed for local revegetation should be obtained locally.

Does more habitat equal more species?

Does increasing habitat make a difference in helping wildlife populations survive and thrive? There is little question that a baseline habitat is needed to support native fauna. Surveys show that landscapes with more than 25 per cent cover contain twice as many woodland bird species as landscapes with less than five per cent cover. Research by Andrew Bennett and Jim Radford of Deakin University suggests that for woodland-dependent birds, a baseline tree cover of at least 10 per cent is needed to maintain the number of species.

But this is not necessarily the whole picture. Bennett points out that many species begin to decline in abundance at much higher levels of tree cover. 'It is only when they reach the endpoint of their decline and become locally extinct that species richness falls. So if we let tree cover get down to 10 per cent, it will be too late for many species that are already threatened', he says.

How do different birds cope with decreasing tree cover?

Populations of the little lorikeet, crimson rosella, swift parrot and olive-backed oriole become smaller as the amount of tree cover decreases. This is because these birds feel free to move away from the area, leaving progressively fewer birds to breed.

On the other hand, birds like the grey shrike-thrush, yellow robin, crested shrike-tit, black-chinned honeyeater and rufous whistler prefer to stay in one place, because they have trouble crossing large gaps between patches of vegetation.

If the amount of tree cover drops below 10 per cent, numbers of these birds decline quickly because no new birds come to increase the population.

Crimson rosellas
(source: Bird Observers Club of Australia)

A third group, the 'all or nothings', like the yellow-tufted honeyeater, red-capped robin and Gilbert's whistler, only live in spots where there is a baseline tree cover of at least 10 per cent. This is because they need a large patch of vegetation to inhabit.

Production versus pure conservation

There is an age-old tradeoff between the amount of land used to grow food and fibre, and the amount of native vegetation left to keep the rural landscape healthy. Once again, patterns of use can help us work out what proportions to use for which purpose.

Research has also been done at a more local level to determine what is needed to maintain and build remnant vegetation in fragmented landscapes.

According to Andrew Young of CSIRO Plant Industry, it is important to plan landscapes to have more than 100–200 reproductive native plant populations and to minimise the distance between patches to allow pollen and seed to disperse. It is also important to 'think big', using a 5–20 kilometre sphere to manage the remnant vegetation as a group, rather than focusing on a small area and treating the vegetation as single patches.

Local or remote seed?

Land managers and conservationists have a further tradeoff to consider—when revegetating small remnant areas, is it best to use local, possibly more compatible seed or higher-quality seed from further afield that may be less well adapted? To date, the trend has been to go local. But a new pattern of seed sourcing is emerging from research.

Inbreeding can be a problem in sourcing seed locally for small remnant patches, according to research by three separate studies (two by CSIRO and one by the Western Australia Department of Conservation and Land Management). Young says that genetic limitations of locally sourced seed, such as low genetic diversity, high inbreeding and hybridisation, need to be weighed up against the major benefit of local seed's adaptability for revegetation programs.

'It may be more important to look for genetic quality rather than local adaptation', Young says. 'It could be much better to source from large and possibly distant populations to maintain diversity [and] outbreeding and minimise hybridisation to ensure you have genetically healthy seed.'

The size of a plant population and its level of connection with other remnant vegetation are important for a range of mating systems, according to a preliminary study by David Coates and his team at Western Australia's Department of Conservation and Land Management. Their research has shown that smaller plant populations have more inbreeding, and possibly less genetic variation between plants.

Another CSIRO study, by Linda Broadhurst and her team, has looked at a specific example—sourcing seed for a key revegetation species in southeastern Australia, ***Acacia acinacea*** (the gold dust wattle). Their research challenges current collection guidelines by delineating gold dust wattle seed as three distinct genetic groups, each needing different sourcing methods to prosper. Previously, gold dust wattle seed had been considered as one genetic entity, needing to be collected from only one local source.

Grey shrike-thrush
(source: Bird Observers Club of Australia)

Surveys show that landscapes with more than 25 per cent cover contain twice as many woodland bird species as landscapes with less than five per cent cover.

In reality, we will always have to live with tradeoffs when working out the best native vegetation strategies to use. But understanding these tradeoffs may be the key to future opportunities.

Where sourcing local works

The genetics of ***Allocasuarina verticillata*** (drooping she-oak) could well hold the key to improving seed supply in Victoria's Corangamite region.

This is the aim of Christine Gartlan, area coordinator of Greening Australia's seed bank, who is working with Linda Broadhurst of CSIRO and Michelle Butler of the Victorian Department of Primary Industries on a project that will help to improve current strategies for local seed sourcing.

'This project is an opportunity to see how a particular plant species really works, so we can source the best local seed based on fact rather than intuition', Gartlan says.

'It's about finding the healthiest seed; perhaps we'll find out we should source seed from 60 rather than 20 trees. 'We want to source seed from here to ensure the local species that have naturally been here survive and thrive. We always try to source seed locally—where we've done that, we've seen natural regeneration; we've brought back other local plants, which has increased habitats for fauna.

'The result is the return of bird species, insects and other small animals.'

The team has had success with germination trials, working out species-specific establishment rates and response to seed pretreatments, such as scarification, hot water or smoke water treatment to mimic a fire response.

'It's important in our area to achieve sustainable vegetation communities and improve on current practices. My concern is that if we revegetate with inappropriate species that don't work for the area, in 50 years' time we'll be back to square one. So it's important to work out the best way of getting the most appropriate local seed to achieve successful revegetation.'

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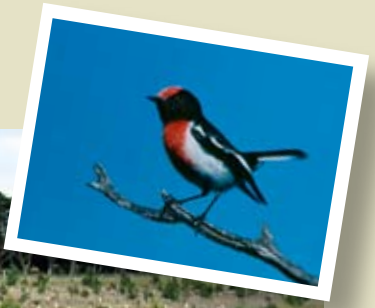

Red-capped robin (source: Bird Observers Club of Australia)

Revegetation using locally collected seed of native plants along Armstrong's Creek, Connewarre, near Geelong, Victoria (source: Rod Cameron)

Keeping vegetation above the threshold

By Don Alcock

There is a lot of discussion about setting conservation targets and thresholds for native vegetation and biodiversity for farms and regional plans. In southern regions of Australia, many areas now have less than 10 per cent of their original native vegetation cover, which has had a major impact on agricultural productivity, and native plants and animals, as well as on water quality in streams and lakes.

Past research supported by the program indicates that more than 10 per cent vegetation is necessary for the survival of many species of fauna—and even at this level, many species can disappear. In other words, many native birds, mammals, reptiles and fish are being pushed beyond their threshold, or limit.

Understanding ecological thresholds

An 'ecological threshold' in a natural system refers to a point at which relatively rapid change occurs from one ecological condition to another. Sometimes there is a point or zone at which a dramatic change occurs—a species crashes or an ecosystem breaks down—in response to changes caused by other factors.

This understanding of thresholds offers insights for land management. It informs us about the ecological limits of different regions and the precautions needed to prevent excessive disturbance and degradation of the natural environment. Understanding thresholds helps us set targets to better preserve and restore our land and waterways.

For example, consider the effect of isolation on the ability of native animals to move between patches of vegetation. They may be prevented from migrating or breeding. The threshold may be the distance beyond which animals are no longer able to cross from one habitat to another—***an isolation threshold***. Consider also the relationship between fire frequency and the occurrence of seed-germinating plants. These plants require a certain amount of time (measured in years) to grow and set seed. If fires are more frequent than the time that plants require to set seed, the species will be lost from the community—a ***fire frequency threshold***.

Protecting biological diversity

In a recent study investigating thresholds for the conservation of biological diversity in rural areas in Victoria, scientists Andrew Bennett and Jim Radford of Deakin University measured the effects of reduced vegetation cover on birds and mammals. They found the number of species dropped as native vegetation cover in the landscape decreased. This was especially true for woodland-dependent birds.

'Landscapes with more than 25 per cent vegetation cover contained twice as many woodland bird species as landscapes with around two per cent cover', says Bennett.

Is the decline in species richness directly proportional to native vegetation cover, or is the relationship more complex? The results for woodland-dependent birds show strong evidence for a 'threshold response' in the relationship at around 10 per cent vegetation cover in the landscape.

'As the amount of tree cover decreased from 60 per cent to around 10 per cent, there was little change in the trend for species richness', explains Bennett. 'Below 10 per cent tree cover, there was a disproportionate loss of species and the bird community crashed. For many species, this was the endpoint, with population decline often starting at much higher levels of native vegetation cover.'

Setting targets for vegetation cover

Bennett and Radford's research indicates that while 10–15 per cent native vegetation cover is a useful

Chris Chilcott searching for those elusive thresholds (source: Queensland Government)

minimum target for restoring many landscapes that currently have little native vegetation, a long-term goal of 30–35 per cent vegetation cover is needed in rural landscapes to maintain resilient populations of most bird and mammal species. Vegetation on public land, such as stream frontages, roadsides, conservation reserves and state forests, can complement habitats on private land to achieve this restoration goal at a larger scale.

Protecting ecosystems in southern Queensland

Chris Chilcott of Queensland's Department of Primary Industries and Fisheries has led a team of researchers from the Environmental Protection Agency and the Department of Natural Resources and Mines in the investigation of ecological thresholds for vegetation management in southern Queensland for the past three years. Their research found relationships between the level of remnant vegetation retained in the landscape and deterioration in the health of trees (dieback); an increase in shrub density; declines in ecosystem function; and changes in fauna communities with high levels of fragmentation.

Poplar box ecosystems, which once made up 63 per cent of the study area's vegetation cover, now account for less than 23 per cent, and total remaining remnant native vegetation cover is approximately 36 per cent. Using plant and animal species as bioindicators of ecosystem health, and measuring vegetation cover in the landscape, the team found that threshold limits may have been exceeded for some components of the ecosystem.

The health of poplar box trees was generally poor, and many now suffer from dieback. While dieback can be related to droughts, poor soil condition coupled with a thickening of the shrub layer will make it worse. The decline in tree health since a survey in the late

Some species are sensitive to fragmentation while others increase in their abundance with clearing. The common dtella (Gehyra dubia) *(left) was twice as abundant in remnants on properties with less than 30 per cent retained vegetation, whereas a whole suite of species was more common on properties with more intact landscapes. One species, the ocellated velvet gecko* (Oedura monilis) *(right) was nearly eight times more abundant in remnants where there was greater that 30 per cent vegetation cover.*
(source: Dan Ferguson, Environmental Protection Agency)

1980s seems to suggest an underlying symptomatic decline.

'The decline in the canopy health of the remnants suggests we may have passed a viability threshold, with obvious implications for the management of the remnants in the future,' says Chilcott.

Thresholds were not as easily identified in other parts of Chilcott's study. The biodiversity component revealed important insights into ground cover plant and reptile communities in the area. While the team found no obvious vegetation-clearing threshold for plant or reptile diversity, they did find that species respond differently to clearing and fragmentation.

Some plant and animal species decreased in population size, some species remained unaffected, and a small number increased. Species with decreased population sizes tended to be absent, or less abundant, in fragmented areas. One such species, the ocellated velvet gecko (***Oedura monilis***) was a habitat specialist that was, on average, nearly eight times rarer in remnants on properties with less than 30 per cent retained vegetation. Conversely, another tree-dwelling gecko, the common dtella (***Gehyra dubia***), was a habitat generalist, and was nearly twice as common in more fragmented areas (with less than 30 per cent vegetation retention). Vegetation condition appears to play an important role in species' occupancy of poplar box patches.

'The results weren't all bad', says Chilcott. 'Many parts of the study area had high levels of vegetation retention, above 30 per cent, and we were able to find large remnant areas on properties that were in excellent condition.'

Applying thresholds to different environments

Chilcott acknowledges the challenges of setting particular area targets for vegetation for every landscape, catchment and farm. 'Thresholds in landscape design principles need careful consideration of scale and the desired outcome to avoid detrimental conservation outcomes beyond the property, while avoiding onerous conservation measures for individual landholders at the paddock and property scale.'

Bennett and Radford agree there is no 'correct' or universal answer, because different species prosper in different environments. The type and arrangement of native vegetation in the landscape, as well as land use, landform, climate and biogeography, all influence species composition. They suggest the question land managers should be asking is: what will happen to the native fauna in this landscape if we manage it in this way?

The search for thresholds is difficult. There is no single threshold that will protect all species and processes. But there are many ways in which private landholders can help. Careful management of regrowth, conserving large areas of native vegetation, linking vegetation corridors (especially along waterways), developing property level management plans, and supporting regional catchment management initiatives are all critical for sustaining native vegetation and biodiversity.

The composition of reptile communities is influenced by the condition of remnants and the level of fragmentation. Good habitat has fallen woody material, lots of tussock grass, large mature trees, and low levels of weeds. The Queensland Environmental Protection Agency has developed 'BioCondition' to measure how well an ecosystem is functioning for the maintenance of biodiversity values (see ***www.epa.qld.gov.au/****).*
(source: Melanie Venz, Environmental Protection Agency)

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Kicking the dirt around vegetation at the Veg Futures conference

By Nadeem Samnakay

After 20 years of debate on managing vegetation in rural landscapes, people could be excused for thinking that the subject was well and truly worn out. However, with more than 500 delegates attending the Veg Futures conference in Albury in March 2006, vegetation management is clearly still an important environmental matter.

The Veg Futures conference, titled The Conference in the Field, was jointly organised by Land & Water Australia and Greening Australia. The conference placed considerable emphasis on on-ground management issues.

Capturing key issues and interests

Held over three and a half days, the conference revolved around the following five questions about vegetation management, which were developed to capture the interest of land mangers, advisers and policy makers:

- What is the role and value of native vegetation in the regional landscape?
- Who pays for native vegetation management?
- How do we balance conservation and production?
- What are we doing about the threats to native vegetation (action and on-ground works)?
- How do we know if we are making a difference (monitoring and evaluation)?

Participants evaluated the success of the conference using these questions as a framework. Conference organisers are now using the evaluation sheets to assess the key messages from the conference and identify the next steps for vegetation management in Australia.

Putting vegetation management into practice

The conference's success was largely due to the practical nature of the sessions, which was reinforced by the fact that a large proportion of delegates (about two-thirds) were from the nongovernment sector. The conference included four field trips in the Albury-Wodonga region, as well as several small-group workshops. The field trips investigated real scenarios highlighting the complexities of vegetation management in intensively managed landscapes, and the innovative solutions that are being applied to resolve conflicts. The workshops provided the context for delegates to see how the issues raised during the conference related to their own experiences and the specific issues for their regions.

Recognising people making a difference

Although the five key questions from the conference cannot be solved in the short term, the conference provided numerous regional examples of people making a difference to how vegetation is managed in Australia and examples of people learning through action. For example, the field trip session to Leneva on the outskirts of Wodonga highlighted the conflicts between rural landholdings adjacent to large cities and the demands for residential land as populations increase—a scenario affecting many cities and regional towns across Australia. With the local population projected to increase rapidly within the next 20 years, Leneva is earmarked to absorb the demand for housing. Participants on the field trip were given a tour of the Leneva valley and presented with the real-life planning decisions faced by the City of Wodonga.

Leneva field trip participants 'reading' the landscape to plan future urban development (source: Nadeem Samnakay, Land & Water Australia)

Andrew Hicks, a farmer from the Holbrook Landcare Group near Albury, and delegates from the Veg Futures conference, discuss the challenges of realising a vision for a sustainable future that balances healthy productive farmland with the protection of biodiversity, water quality and soils (source: Jim Donaldson, Land & Water Australia)

The field trip showed that change brings its own problems. While some answers can be found for current problems, new problems are created with changing land use. These include intensive modifications to landscape design, pressures from the recreational needs of urban communities, and threats to wildlife from human activities (such as increased traffic, straying pets and environmental pollution).

Looking to the future

Some key positive messages emerged in the concluding session of the conference. Conference participants agreed that landholders are increasingly sympathetic to conservation objectives. However, landholders also have financial and operational constraints, and more participation and support from the general public is needed to achieve conservation outcomes.

The conference fostered new partnerships and networks, and provided Land & Water Australia and Greening Australia with ample feedback to consider future activities to help broaden knowledge on the role of vegetation in our landscapes.

Additional information

Join an online discussion forum that arose from this conference (outlined in this article) by logging on to the Greening Australia website and following the links to the exchange site at **www.greeningaustralia.org.au**. Additional information on the Veg Futures conference, including an evaluation report, is also accessible on this website.

To view the approved Leneva development plan, log on to the City of Wodonga website at **www.wodonga.vic.gov.au**. Further information about the plan can be obtained from Darren Rudd, Manager Strategic Planning, phone (02)60229245.

Land & Water Australia leads investment in native vegetation research

By Jim Donaldson

With farmers and graziers managing approximately 70% of Australia's landscapes, the decisions they make have a profound effect on the status of our native vegetation, and consequently on how we support sustainable production systems and conserve our native flora and fauna.

Over the past 10 years, research funded by Land & Water Australia and its partners—CSIRO, the Murray–Darling Basin Commission and the Australian Government Department of the Environment and Heritage—has provided significant insights into the management of native vegetation in agricultural landscapes.

The Native Vegetation Research and Development Program

The Native Vegetation R&D Program, which began in 1995, has substantially increased our understanding of the ecology of native vegetation in the more heavily cleared rural landscapes of southern Australia. The program has also helped to identify the types of policies and institutional arrangements that are needed to retain natural values, such as fresh water and wildlife habitat, in the landscape.

In 2000, in its second phase, the program aimed to develop methods for assessing native vegetation condition and its long-term viability. The program investigated different landscape design principles and methods for protecting biodiversity, including assessment of methods used to identify the most appropriate size and spatial configuration of areas to be revegetated.

The Program has also examined barriers facing landholders in integrating native vegetation management in their agricultural production systems. Towards the conclusion of this second phase, Land & Water Australia's board reviewed research priorities and relevant reports, and consulted with key stakeholders to determine the course of future investment in native vegetation research.

Another five years

Land & Water Australia has now begun another five years of research through the Native Vegetation & Biodiversity R&D Program, which replaces the Native Vegetation R&D Program. This new program recognises the importance of healthy ecosystems in providing us with essential resources and services, such as fresh water, salinity and erosion control, shelter for stock, and carbon sequestration. Research will focus on improving the sustainable use, protection and management of native vegetation in rural landscapes.

With an investment of $5 million, the program will develop collaborative partnerships with a wide range of agencies with similar interests, and extend its geographical focus to the woodland and rangeland ecosystems of Australia, especially northern Australia. A management committee will guide research along the following themes:

- understanding and valuing landscape processes, including the role and function of biodiversity in the delivery of ecosystem services
- understanding risks and threatening processes so that effective responses are developed
- understanding ecosystem processes, condition and dynamics
- informing policy and management to improve Australia's capacity to manage vegetation and biodiversity effectively
- enhancing national research and development capacity in native vegetation, ecosystem services and biodiversity
- ensuring effective communication and adoption.

Within these themes, 15 new projects have started. The projects are diverse and cover topics such as landscape design, the role of fire, waterpoint management, the value of regrowth in conserving biodiversity, and improving the understanding of genetic flows for protecting local species. More information on these projects can be found on the Land & Water Australia website.[1]

The Native Vegetation Management R&D program has funded several research projects by David Lindenmayer from the Centre for Resource and Environmental Studies at the Australian National University.

Wildlife on Farms, published in 2003, continues to be an important guide for land managers. More recently, David and his colleagues have published other references of interest, including *Practical Conservation Biology*, *Woodlands: A Disappearing Landscape* and *Landscape Change and Habitat Fragmentation: An Ecological and Conservation Synthesis*.

For abstracts and further information on these and other publications by David, visit the ANU CRES website at **http://cres.anu.edu.au/dbl/books.php**

[1] See **www.lwa.gov.au/nativevegetation/**

Spreading the news

Land & Water Australia is working hard to ensure that the knowledge gained from research is better communicated and adopted. The results of individual projects can sometimes be relevant to broader audiences and geographical locations, and Land & Water Australia is keen to foster more opportunities for knowledge exchange between regional natural resource management groups and those working in research, policy, industry and the community.

A particular challenge over the next year is to ensure that the results of previous research programs are communicated to stakeholders in a form that is relevant and valued. Key messages from a suite of projects will be synthesised for target audiences.

To achieve this, Land & Water Australia is interested in drawing on the range of research occurring across its investment portfolio, such as in the Joint Venture Agroforestry Program and the Social and Institutional Research Program. We will also focus on better integrating the design and delivery of results for example by working in partnership with regional groups, CSIRO, Greening Australia and state agencies to meet stakeholder needs.

Looking ahead—the quest for a better way

Through its research programs, Land & Water Australia has contributed to the significant changes that we've seen over the past decade in the way native vegetation is managed in agricultural landscapes.

As the Productivity Commission concluded in its landmark 2004 report,[2] management of native vegetation is important for many reasons, including resource sustainability and ecosystem protection. A major challenge is to find more efficient and effective ways to achieve desired production and environmental outcomes so that they are attained using methods that maximise the benefits and minimise costs to farmers, other land managers and the community as a whole.

Land & Water Australia's Native Vegetation & Biodiversity R&D Program can make an important contribution to this quest for a profitable and sustainable future. The next 10 years will build on research to help stakeholders—including landholders, community groups, decision makers and scientists—benefit from the effects of better integrating native vegetation into agricultural landscapes.

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Jim Donaldson
(source: Land & Water Australia)

[2] Productivity Commission (2004). *Impacts of Native Vegetation and Biodiversity Regulations*. Report 29, Melbourne.

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Land & Water Australia is keen to hear about your information needs arising from the content in this publication. If you would like to know more about the research or topics presented in this issue, please contact:

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Also, keep an eye out for the soon to be redeveloped Native Vegetation website at **www.lwa.gov.au/nativevegetation** which will feature news, new research, events and publications.

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Land & Water Australia is a partner of a number of industry organisations and other research and development organisations delivering collaborative R&D programs with links to vegetation management. These include:

Land, Water & Wool
a collaborative national research program providing wool producers with practical tools for managing natural resources sustainably and profitably. Wool producers across the country are actively involved in research and development projects and demonstration sites to address specific natural resource management issues. Visit the Land, Water & Wool website at **www.landwaterwool.gov.au.**

Grain & Graze
an exciting new collaborative research program working with farmer and catchment groups in Australia's wheat–sheep zone to improve on-farm profitability and productivity while also achieving local catchment management targets. Visit the Grain & Graze website at **www.grainandgraze.com.au.**

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