Australian Government
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ThinkingBush

Knowledge for managing native vegetation in Australian landscapes

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Forests in Agricultural Landscapes

NATIVE VEGETATION AND BIODIVERSITY R&D PROGRAM

CONTENTS

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Thinking Bush Foreword

Jim Donaldson, Executive Manager, Sustainable Landscapes

Welcome to another edition of Thinking Bush.

Welcome to another edition of *Thinking Bush*. This edition has much in it to provoke thinking about the nature of our Australian landscapes, how they're used and managed, and what it takes to maintain or restore them to a healthy state to conserve our native biodiversity.

With the national media and policy agenda dominated by climate change and the parlous state of many of our rivers and water resources, we are certainly living in interesting times. However, amidst this media maelstrom, it would seem that management of our native vegetation and biodiversity has virtually disappeared off the policy radar, despite the seemingly obvious connections between these issues. It is therefore reassuring to see that biodiversity remains a core part of the Australian Government's new Caring for our Country initiative (page 21) and that the value of previous investments to help guide decision-making, such as the National Vegetation Information System, are being recognised and built upon.

The precarious nature of funding for research into vegetation and biodiversity issues was brought home to me again at our recent Native Vegetation & Biodiversity Program research coordination workshop. The program provides a unique national focus for research in this area and helps to forge links between science and practical policy and management issues. There is still so much we don't know about how our ecosystems work, let alone how to design effective landscape conservation strategies or implement practical management actions to achieve particular ecological outcomes. Some of the research featured in this edition, for example on local provenance (page 5), waterpoint management in the rangelands (page 16) and the dynamics of tropical eucalypt forests (page 23) are all contributing to building our knowledge base in these areas. 'Systematic reviews' (page 26) are one approach Land & Water Australia is exploring in conjunction with CSIRO to see what scope they offer to provide greater assurance that NRM

decisions are founded upon a robust scientific evidence base.

For some, the drive towards mitigating and adapting to climate change raises concerns that carbon driven investments may emerge as a threat to Australia's biodiversity rather than being harnessed to provide an additional, complementary source of funding to support its further protection, restoration and management.

It is evident that Australians expect a lot from their landscapes. On the one hand, we want them to produce the food and fibre our increasingly globalised world so desperately needs, and which helps sustain our regional economies and the livelihoods of the rural sector. We are also keen on the prospects for 'greener' energy, such as biofuels and bioenergy. As the article on plantations (page 18) reveals, we are very adept at growing and managing such industrial crops and, increasingly, are improving our understanding of their impacts on water, biodiversity, the environment and rural communities. On the other hand, Australians also want to conserve the range and diversity of our unique terrestrial and aquatic biological heritage, tackle dryland salinity, ensure the health of our soils, produce ample supplies of potable water and retain urban amenity (page 14). Increasingly, we need tools to help catchment managers make sense of the available data and navigate the complex decision-making processes involved in deciding where to invest in NRM; the MCAS-S decision-support tool (highlighted on page 30) is one such example.

As the difficulties of adjusting our daily lives, even modestly, to reduce the level of greenhouse gas emissions attest, getting the population at large to understand the nature and magnitude of all these issues, their inter-dependencies and some of the trade-offs involved, let alone to actually take action, presents enormous challenges for all of us as researchers, policy advisors, NRM professionals and land managers. Yet this is precisely the challenge we take on in pursuing landscape restoration.

The article on 'Restoring landscapes with confidence' (page 2) presents insights from a recent national review about how we might organise ourselves to go about meeting this challenge better. The review makes it clear that while we have invested in world class landscape science we have a long way to go to provide good access to that knowledge so that it can be applied by regional NRM groups, NGOs and others to tackle biodiversity conservation issues more effectively. A significant quest lies in working out how the 'matrix' of land uses can best fit together to meet the various demands we make on the landscape: how do we move from developing a great biodiversity conservation plan to practically implementing it?

I was fortunate to attend the recent Grain & Graze national forum which brought together researchers, farmers, catchment groups, extension agents, and program stakeholders. One of the things which struck me in hearing about the results of the BiGG (Biodiversity in Grain & Graze) project was that while it is evident that patches of remnant vegetation provide the richest on-farm biodiversity, at least above the ground, it is the potential pest control benefits of these patches and the services provided by soil biodiversity in the paddock that most excites farmers. It was great news to hear that BiGG was the winner of the recent 2008 Banksia Land and Biodiversity Award (**see http://grainandgraze.com.au/**), recognising that participating farmers have become advocates for biodiversity, selling the message that biodiversity does not start and end in patches of remnant vegetation. More generally, this raises the question of how best to go about influencing the land use choices and management practices of farmers to achieve NRM outcomes. The Master TreeGrower program (page 28) is one course which aims to help land managers explore the potential for managing vegetation for both production and conservation. The program has for many years been supported by the Joint Venture Agroforestry Program (JVAP, see page 12) and is now being co-sponsored by Land & Water Australia to give more emphasis to non-commercial vegetation management issues.

Veg Futures 08, the national conference on vegetation management, being held in Toowoomba over 20-23 October, will be a great place to contemplate and discuss the above issues and more. I look forward to seeing many of you there.

I would like to take this opportunity to thank our outgoing Board Director, John Childs, for his contribution to Land & Water Australia and in particular his guidance as Chair of the Management Committee for the Native Vegetation & Biodiversity R&D Program. Also, this will be the final *Thinking Bush* coordinated by Nadeem Samnakay, as he is leaving to take up a new work challenge. Nadeem has done a magnificent job re-invigorating the magazine and encouraging input from our various contributors; we wish him well.

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Restoring landscapes with confidence – snippets from key findings and recommendations

By Nadeem Sammakay

In Thinking Bush Issue 6, we presented some preliminary information on a project that was assessing how much of the research, tools and information relating to landscape restoration was available to, and being used by, regional NRM groups and others, to achieve on-ground outcomes.

Phase one of the project 'Restoring Landscapes with Confidence' has now finished. The project has identified a number of initiatives and actions for addressing deficiencies in the organisation, form, accessibility and local relevance of the current knowledge base that underpins landscape restoration efforts. Attending to these actions should greatly improve the capacity and confidence of planners and practitioners to implement landscape restoration initiatives, leading in turn, to better outcomes for biodiversity and ecosystem services at the landscape scale.

The full report provides a comprehensive presentation of the project results, but below is just a teaser of findings to whet your appetites.

Gems from the executive summary

Contributions from regional workshops and interviews provided a wealth of information on on-ground actions and impediments to landscape restoration. Some of the highlights include:

- Landscape restoration is an umbrella concept under which a number of different philosophies and approaches are grouped.
- While conservation planning, and prioritisation science and tools, are not usually included in the ambit of landscape restoration science, they have an important role to play and are of keen interest to policy and on-ground practitioners.
- The effectiveness of landscape restoration approaches once implemented are largely untested. Emerging trends are the increasing number of large-scale 'biolink' style projects to combat threats such as climate change and continuing fragmentation.
- Within States and Territories there is no central communication coordinating mechanism, so it is quite common for projects to be underway that only a few people or groups know about.
- Experts are often inaccessible to regional communities.
- There is a lack of 'logic' for people to use to work out which landscape restoration approach is best suited to the work they are doing.
- People working in the area of landscape restoration are time poor with unrealistic demands placed upon them to achieve

on-ground outcomes in short project time-frames.

- Policy and funding program frameworks are not conducive to achieving long-term sustainable landscape restoration outcomes.
- The focus of many landscape restoration projects and policies has been on private land, with a parallel set of initiatives on publicly funded conservation reserves. These two areas will need to form closer partnerships in the future if effective landscape scale restoration is to occur.
- Staff turnover in organisations at all levels results in a loss of corporate memory. Relationships of trust cannot be established with the constant changeover in personnel.
- Non-government organisations and private sector groups are becoming major players in large-scale restoration projects.
- There is a need for research into the socio-economic and cultural issues associated with landscape restoration

Pearls of wisdom from the recommendations

The project results present a number of important recommendations that have implications for policy and funding. These in summary include:

- Invest in the development of an 'information hub' on landscape restoration to improve access to information.
- Work with scientists, science communicators and education experts to develop an on-line series of 'information sessions' using 'Webinars' (online seminars) and 'Lectopia' (lectures with follow up tutorials with the teacher) to cover key topics in landscape restoration.
- Invest in the development of a distance education Landscape Restoration course.
- Invest in the development of a practical, science communication course for graduates and people working in academic institutions so that they can learn how to make their science relevant to people working 'on-the-ground'.
- Establish a national database of landscape restoration projects that will enable people to look at what has been done, see what is underway and make connections to integrate work.
- Develop a framework for integrating the various principles and approaches of landscape restoration, and provide a logic for people to be able to work out which approach is best suited to the work they are doing.
- There is a need for a shift in the philosophy of funding programs so that longer-term landscape restoration projects can be undertaken, and relationships built within local communities.
- Many reports have been written on social engagement and there is a need to assess what has already been done and work out ways to make it relevant and accessible for people working in landscape restoration.
- Include indigenous knowledge in research and communication outputs.

This project was funded by Land & Water Australia, Greening Australia's Exchange program and North Central CMA. A steering committee provided overall guidance to the project comprised of representation from the funding partners and CSIRO.

For more comprehensive information on outcomes from this project, download the project summary fact sheet:

Restoring landscapes with confidence - A summary of key findings and recommendations (Product code PN21576);

Or access the full final report:

Restoring landscapes with confidence – an evaluation of the science, the methods and their on-ground application.

A draft *'State of Knowledge Discussion paper on Landscape Restoration Science in Australia'* is also available.

These publications are downloadable from **http://www.lwa.gov.au/nativevegetation**

Date claimer – 10th Queensland Weed Symposium.

To be held at Rydges Capricorn Resort, Yeppoon, Queensland from 26 – 29 July 2009. For more information, visit: http://www.wsq.org.au/10thWeedSymposium/home.html

A new national Vegetation Portal

A National Vegetation Information website has been developed with a view to provide a nation-wide perspective on what's happening in vegetation information. The site is due to go live in late September and will cover news, projects and resources at state/territory and national levels. Main themes for the site include maps and data; status and trends; standards for data collection and mapping, and; organisations, legislation and major programs. The site, which will be regularly updated, is sponsored by the Executive Steering Committee for Australian Vegetation Information (ESCAVI) and managed by the Australian Government Department of Environment, Water, Heritage and the Arts (DEWHA).

The site can be accessed at: **http://www.environment.gov.au/land/vegetation/nvip/index.html**

Greening Australia

There's more to seed than local provenance

David Carr, Greening Australia

For many years conscientious seed collectors and revegetators have insisted on only using local provenance seed for conservation plantings. The evidence from this approach, along with recent research (Broadhurst et al., 2008), now shows that using local provenance as the first and only priority for sourcing seed does not always achieve the best results.

Local provenance – what is it?

For the uninitiated, local provenance refers to the collection of seed for revegetation projects from close to the site where they are to be planted. The rationale for this is that local seeds will be well-adapted to the site conditions; that this practice will conserve local genetic diversity; and that it will reduce the risk of "genetic pollution", where seeds from non-local sources could potentially interbreed with local plants to produce genetically different "hybrid" progeny. Biodiversity occurs at multiple scales: from ecosystem level to species level down to population level. The use of local provenance aims to conserve this diversity, particularly at the population genetic diversity level. There is an argument that as global warming changes the climate across the continent, using seed adapted to local conditions, may be consigning plants to a "genetic dead-end" (Harris et al., 2006), however in most cases locally adapted plants have been in situ for millennia and have probably gone through numerous episodes of climate change and most more than likely have the genetic resilience to see out plenty more.

One problem with sourcing seed locally, is that everyone interprets "local" differently. Some people think it should be collected within a few hundred metres of the revegetation site, while others will use the closest seed available at the time (up to hundreds of kilometres away). There is also a high risk that by rigidly using seed collected nearby, collectors will ignore the potential of these populations to provide a genetically diverse and vigorous source of seed. Regulators and seed buyers now apply arbitrary distance (5-20km) requirements on seed collection to ensure compliance with local provenance. This could potentially have adverse outcomes if seed is collected from only a few plants that are likely to have produced seed resulting from inbreeding. Another problem could arise if seed is collected from plants at a nearby site that has a completely different environmental match (such as higher altitude or soil type) to the site being restored.

To better understand provenance-related issues, Greening Australia coordinated a national workshop in 2004 (Carr, 2005). Conclusions from the workshop included that:

- the geographic proximity of a targeted seed source may not necessarily provide the best source of genetic diversity,
- maintenance of high levels of genetic diversity should be given greater emphasis rather than strictly adhering to the 'local is best' paradigm, and

Collecting Eucalyptus macrocarpa fruits and seed for revegetation, Western Australia. Photo: Penny Atkinson

- expert advice be made available to seed collectors and revegetators to decide on the most appropriate seed sources.

In progressing the workshop outcomes, Greening Australia has been working to develop and disseminate new guidelines for seed collection through the Florabank and Exchange programs. Based on the best available science, Florabank now recommends that when selecting seed for a revegetation project, collectors should consider: taxonomy, adaptation, physical and genetic quality, and proximity. These four points will help answer the questions, "where should I collect seed for my revegetation project, and how should I collect it?"

Taxonomy

The first step in selecting the right seed for a revegetation project is correct identification of the targeted taxon. In some instances, collectors will need to be aware that different but closely related taxa may occur nearby. There may also be instances where collectors may encounter an undescribed species that has yet to be recognised by taxonomists. Differences between provenances often indicate different sub-species. Adaptation to different environments is how species evolve into new species. Taxonomists are constantly looking at the diversity within plant species and reclassifying variants into new taxa. The Australian Plant Census, (**http://www.anbg.gov.au/chah/apc/ accessed August 2008**), coordinated by the Council of Heads of Australian Herbaria, presents a census of accepted plant names used on an Australia-wide basis. It also gives a comprehensive overview of all taxonomic treatments that have been published or are in preparation. If you are targeting a highly variable species for revegetation, you may need to seek expert advice from your State or Territory herbarium to ensure unpublished taxonomic work has not been conducted. This will help you choose the populations from which to collect seed from, and ascertain if two or more subspecies occur in any one region.

Adaptation

When plants occur on sites with different environmental characteristics, they are subject to different selection pressures that can lead to genetic differentiation among populations and even divergence into new species or subspecies. The choice to use only local provenance recognises the importance of conserving existing levels of genetic diversity across a landscape. Altitude, rainfall, temperature, soil texture and depth, and soil chemistry (pH, salinity) are major drivers of adaptation in plants. These factors can vary over very short distances and may be associated with adaptive variation in plant populations. There are many documented examples of plant adaptive variation across altitudinal gradients (e.g Brown et al., 1976). Plant populations that are many hundreds of kilometres apart, at the same altitude can be more similar than plants a few kilometres apart that are at different altitudes: *E. obliqua* for example (Carr, in press).

Florabank recommends that seed is collected from sites with similar environmental characteristics to the revegetation site. We suggest seed should be collected within the same bioregion (see **http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html**) as the revegetation site to ensure similarities in rainfall average and distribution. Within the bioregion, match your source seed as close as possible to the environmental conditions of your restoration site (e.g. soil types, topographic position, etc.). However, you should also collect from multiple populations within the bioregion to increase the potential of the plants to adapt to climate change (see box below).

Physical and genetic quality

An important factor to consider in seed collection is the physical and genetic quality of the seed. Seed collected from a large population following a heavy widespread flowering event will ensure the capture of genetically diverse and viable seed. High quality seed will optimise the chances of successful revegetation that can potentially develop into self-sustaining plant communities.

Climate change complication

The plants we establish from seed today will have the potential to develop into mature plant communities in 50, 100 and 200 years time. Over these periods, they are likely to have to cope with a climate that is substantially different from the present climate, along with associated changes in pests, diseases, soils and the like. For individual regions it is difficult to predict what the climate will be like in the future, although we can be confident that it will be hotter. The main action we can take at the revegetation patch scale level is to maximise the potential for reintroduced plants to be able to cope with climate change. To do this we need to ensure that they have been sourced from seed that captures high levels of genetic diversity (Rice & Emery, 2003). The more genetic variation plants contain the more likely it will be that populations can adapt to changing climatic conditions. Professor Andrew Young of CSIRO Plant Industry suggests we should "have faith in natural selection". To optimise the potential for high levels of genetic diversity it may be better to source seed from populations growing under a wide range of temperature and rainfall conditions, than just from a single site.

For species that are obligate out-crossers or have a mixed mating system (i.e. mainly outcrossing species with some propensity for inbreeding) it is essential that seed is collected from many plants from a large healthy, fecund population. Seed collected from a limited number of plants during a poor seeding year is likely to result in seeds not being viable, or if they do germinate they will grow poorly due to lack of vigour. Struggling plants are also unlikely to survive environmental stresses such as drought or increased temperatures associated with climate change. Recent Land & Water Australia funded research (Broadhurst, 2007) highlights the importance of genetic health in seed collection.

Seed must also be collected at the right stage of maturity, then stored under optimal conditions to ensure optimal germination rates are obtained. High temperature and humidity will rapidly reduce the viability of stored seed. For most sclerophyllous species storage at 5% humidity and 15°C is best. Fleshy-fruited species usually need to be used fresh. Storage problems can be avoided by sowing the seed as soon as possible after collection.

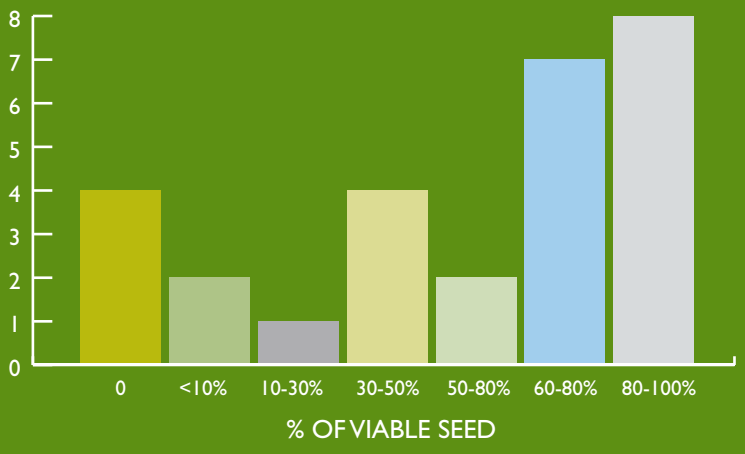
Proximity

Once you are sure you have correctly identified the species targeted for your revegetation site, you should source seed of the species from a site close to your revegetation site and with similar environmental characteristics. As outlined above it is essential that the population targeted for collection is a large, fecund, healthy population, that occurs on a site with similar environmental characteristics to your revegetation site. If collecting from a population in close proximity is not a viable option due to factors discussed above then the collector will need to keep looking further afield until a population that matches the quality seed criteria is located.

A cautionary tale

The Border Rivers Gwydir CMA and Greening Australia are currently conducting trials of large scale direct seeding using agricultural seeders in the Moree district of NSW. Seed for the trials was obtained by tender from 8 different seed suppliers including both professional and amateur collectors. As part of the trial process, all seed batches were tested for viability using a tetrazolium test. The results were alarming. Of the 30 seedlots obtained, 4 had zero viability and a further 8 had less than 50% viability. If these had been sown in the paddock, one third of the effort of seeding would have been wasted with little or no germination resulting. One seedlot of river red gum (*Eucalyptus camaldulensis*) had zero viability and made up most of the seed mix for one site. Sowing this mix would have resulted in a bare site that would need reseeding. The cause of the low viability is likely to be collecting immature seed, collecting poor quality seed from small isolated populations and/or from poor storage practice. Interestingly, both professional and amateur collectors provided seedlots that had serious viability problems.

Moree Seed Viability Trial



Collecting Weeping Pittosporum for seed in Victorian Mallee using a fruit collecting bag. Photo: D. Walters

For all sites however, the seed should be sourced to capture high levels of genetic diversity and have optimal physical health. The Florabank website contains several examples of how different organisations have tackled many of the issues discussed here.

For more information visit the Florabank website at **www.florabank.org.au**

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Florabank tools and resources

Florabank has launched a new suite of online tools designed to help seed collectors, revegetation planners and people working to revegetate sites around Australia. Developed by Greening Australia in partnership with CSIRO, with funding from the Australian Government through the Natural Heritage Trust, the new tools include:

- Species Navigator – an interactive key that assists users to select common revegetation species suitable for their revegetation site.
- Seed Collection Advisor – an interactive key to help seed collectors to maximise the genetic quality of collected seed.
- Site Descriptor Tool – provides basic guidelines, resources and a spreadsheet to effectively describe revegetation sites
- Vegetation Management Tool – a tool that helps users to design, prepare, revegetate and maintain their revegetation sites by providing information and access to resources.

Other resources and references available on the Florabank website include; Floradata Online, which provides information on how to collect, store, propagate and establish a range of Australian native species; and the Florabank Guidelines (how to collect, store and manage seed for revegetation).

Become a Registered User on the Florabank website to get access to discussion forums where you can ask and answer technical questions and discuss issues relating to native seed.

Florabank also provides Professional Development Training for seed collectors and can assist NRM regions to develop seed supply plans. Florabank is working with the native seed industry around Australia to develop and implement a certification and accreditation program and to educate seed buyers about the importance of using appropriately sourced, quality seed.

For more information contact:

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David Carr is the national technical capacity manager for Greening Australia, and has managed the Exchange and Florabank programs for the last 5 years. Through these programs he has been actively encouraging vegetation managers to make more use of research to improve the success of on-ground resource management and biodiversity conservation projects

Early stages of propagation of native seed stock for revegetation purposes. Photo: Penny Atkinson

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Agro-ecology: ecological diversity by design

By Jason Alexandra

Jason Alexandra was a former coordinator of Land & Water Australia's Native Vegetation R&D program and previously a board member. Here he recounts his personal experiences in managing and implementing an ecological approach to land management that has reaped rewards through managing vegetation at a property scale.

After 22 years of developing the farm Jason and his partner Marg have decided to sell the farm to concentrate on national scale work on natural resources policy.

In 1986 Margaret and I purchased a run down dairy farm nestled into the foothills of Victoria's Strzelecki Ranges. A coastal range that has been extensively cleared for dairy farming and is home to the world's tallest flowering trees *Eucalyptus regnans* or Mountain Ash.

I had a revegetation nursery and wished to demonstrate, in practice, what could be done on a farm using trees. We set about transforming the land using trees, basing our planting on the design principles proposed in *Permaculture I* (Mollison and Holmgren 1978), and various ideas about agroforestry and revegetation.

Some of the "principles" or strategies we adopted included replicating successional processes in natural regeneration. **First** – we established a network of rapid windbreaks by planting fast growing pioneer species – such as wattles and tree lucerne (a fodder tree from the canary islands) to create shelter and suitable micro climates for the nursery and other horticultural crops. **Second** – "diversity equals stability" so we planted many species both local and exotic. It was assumed that a diversity of species would provide a diversity of resources and habitats for native species, like birds, that would recolonise the farm. **Third** – we aimed to create "sun traps" – paddocks which were both sheltered from the prevailing cold winds but also maintained their solar access. **Fourth** – we attempted to restore connectivity between the remnant eucalypts along the creek to the new plantings across the farm. **Fifth** – in many shelter belts we wanted to create "analogue forest" in which crowding and competition would force dominant species to grow tall and straight for future timber production. To achieve this, under and middle storey species were used, rather than relying on an intensive pruning regime in the future. **Sixth** – "edges" and structural complexity are valuable and productive and should be deliberately developed, especially in simplified landscapes.

The species chosen for revegetation included endemic natives like black-wood, silver wattle and blue gum, other natives species which had strong farm forestry prospects such as spotted gum, shinning gum, Gippsland grey box and silky oak. We also planted numerous understorey species. Deciduous exotic tress were planted along tracks and on the north side of paddocks, so that the shelter belts did not shade out adjoining areas.

Once the "infrastructure" of shelter had been established, then we were able to "work" the various sheltered paddocks for more intensive horticultural production including potatoes, orchards and the expanded nursery.

From a "green desert" of improved pasture nearly two decades ago, the farm today is a rich mosaic of pasture, woodlots, windbreaks and orchards, producing a wide range of fruit and nuts. It is a haven for wildlife – native bird and frog populations have increased dramatically – with large flocks of ibis and egrets returning to the dam to roost each evening.

Orchards have been developed on three discrete areas, each between two and three hectares, with a total area of about eight hectares surrounded by windbreaks, mostly of Australian native species, but also about two hectares of deciduous trees – mostly oaks. Apples, of approximately 15 varieties are the major crop but smaller amounts of other tree crops are produced, including pears, plums, chestnuts and persimmons.

The windbreaks and agroforestry have introduced new structural elements such as large trees and fallen timber and increased the species diversity by providing habitat and food sources. A wide range of species produce flowers over many different months of the year. Additional habitat diversity within the orchards has been established by planting a range of pasture species and encouraging complexity by the mowing regimes adopted.

No chemical insecticides have ever been used on the orchards. Instead, nature's checks and balances keep pest populations low. While the orchards produce the high value crops, areas devoted to windbreaks, wetlands and wildlife habitat are important to the farming system, enhancing the pest-predator dynamics and re-establishing biological diversity in a formerly simplified landscape – a practical application of ecological theory.

There are still large areas of improved pasture used for dairy cows, but the paddocks are now sheltered by windbreaks or woodlots. In the late 1980's the farm was used for potato production. All fruit and vegetables have been certified organic since about 1988 with the National Association for Sustainable Agriculture, Australia (NASAA – **http://www.nasaa.com.au**).

The orchards are now about 15 years old, producing an average of about 120 tonnes of apples each year. Even though no broad spectrum insecticide has ever been used, the level of crop damage from insects is miniscule – estimated at less than 1%. Yet apples are the second most chemical intensive crop in the world after cotton and tend to be subject to extensive damage by insects pests like codling moth that are generally difficult to control.

Codling moth problems have so far been avoided and have not required major management intervention. The resident population of codling moth is low because in nature "everything is food for something else." Many insectivorous birds nest in the orchards and dart above the canopy harvesting insects. At dusk tiny insectivorous bats disperse from hollows and during the day and night countless spiders, wasps and earwigs can be found throughout the orchard, all working, by going about their life's business.

The property was not "designed" precisely with detailed drawings of where each tree would be planted etc, but was developed by applying some broad principles like aiming to provide diversity of habitat and only devoting a few hectares to a single crop. This seems to have been sufficient to develop the natural checks and balances that support an efficient, agro-ecological system suited to organic production.

No formal scientifically rigorous monitoring has been undertaken (several rejected research grant applications are testament to the recognition of its value), but over the years the increasing diversity and abundance of birds has been noted. As a keen, amateur bird watcher, I have been encouraged by the range of species that have used the farm for breeding, including two predators – swamp harriers and black shouldered kites. Populations of grey fantails, wrens and many species of honey eaters thrive on the nectar, pollen and insects, seeming to utilise many of the edge areas – the interfaces between open spaces and the windbreaks.

One attempt at formal invertebrate monitoring in the orchards was abandoned after the entomologist declared that we had such a diverse population that he could do little to support improved pest management.

Populations of codling moth in the orchards had been monitored using standard commercial pheromone traps but has been discontinued in favour of eyeballing – checking out damage levels in the growing crop and the eyeballing of damage after picking. The extremely low levels of damage are testament to the value of ecological diversity in production horticulture and the capacity to design productive and self regulating systems.

Efficiency, substitution and design

Efforts to improve or reform agricultural systems tend to be based on the adoption of efficiency, substitution or design (Hill 1998). This framework was initially developed for assessing the different types of innovation in agriculture, but can also be applied in industrial ecology (Hill 2002). Each approach is fundamentally different but potentially highly complementary; however, proponents of innovation systems tend to focus on one at the exclusion of others. In contrast to some

Crowding and competition forces dominant species to grow tall, limiting the need for intensive pruning. Photo: Jason Alexandra

organic approaches permaculture is focused largely on a design approach.

To illustrate the different approaches, let me use the example of high crop losses in apple production due to codling moth. The efficiency paradigm is characterised by efforts to develop and promote solutions based on better technology – e.g. better sprayers which apply pesticides more efficiently or new generation pesticides. Much of the research and technological innovation in the 20th century has resulted in greater efficiency, including through better machinery, mechanised transport and material handling systems. The focus on efficiency has resulted in rapid increases in labour unit productivity and allowed for increasing specialisation. While many unintended social and ecological disruptions have also occurred, efficiency in production has resulted in increased capacity to deliver growth in the service industries, in R&D and education, and in raising the general standard of living for the majority of people.

Unlike efficiency, substitution relies on finding alternative solutions, for example, alternative pest controls such as plant extracts, a mass reared biological control agent such as Trichogramma wasps, or insect pheromones to disrupt mating. Solutions based on substitution don't require the redesign of the farming system, but often allow for gradual evolution leading to the use of more environmentally friendly production. Much organic farming relies on substitution of one kind of pest control product for another.

Design or redesign is a more fundamental and radical way to solve problems but often requires rethinking the nature of the system that is being managed. A farm which is developed to ensure sufficient habitat for predators has taken a design approach to problem solving and if successful makes many existing techniques and technologies redundant. This approach has been successfully trialled and demonstrated at our farm in Gippsland. Design or redesign of production habitation systems is fundamental to the permaculture approach (Mollison 1988) and deserves wider consideration in agricultural systems.

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Right: High value, chemical free apples derived from mixed plantings of shelterbelts and host species that provide habitat for predator species which control insect pests. Photo: Jason Alexandra

Below: Dairy cows graze amongst the shelterbelts and woodlots that were once open pastures. Photo: Jason Alexandra

An Australian Government Initiative

Joint Venture Agroforestry Program

Rural Industries Research & Development Corporation

Forest & Wood Products Australia

Land & Water Australia

Agroforestry and natural resource management – lessons from JVAP research over the past 15 years

Dr Rosemary Lott

Agroforestry allows land managers to enhance farming systems and the rural landscape, and explore the management of trees for conservation and profit. Agroforestry is about integrating agriculture, natural resource management and commercial tree and shrub plantings. Recent research demonstrates that this integrated approach has many positive benefits for natural resource management, and the potential to enhance individual landholder incomes and regional economies. Over the past 15 years, the Joint Venture Agroforestry Program (JVAP) has funded a wide range of research on farm forestry and agroforestry. Some key lessons from this program are outlined below.

Key messages from JVAP research

Biodiversity – Landscape – level wildlife research is showing that shelterbelts, plantations and other farm plantings provide a diversity of habitats and valuable linkages between remnant patches. Planted eucalypt woodlots support a large proportion of the vertebrate fauna species that inhabit nearby native forests, and a more diverse range of native birds and mammals than adjacent agriculture. Emerging research is also showing that mobile fauna such as bats and birds will use young plantings as feeding habitat, and that shelterbelts support a range of insect predators, which may be beneficial to adjacent agriculture.

Carbon – Agroforestry has great potential to sequester carbon to offset emissions from agriculture and industry. All trees and woody perennials store carbon as they grow. How much, and how fast depends on the species, their management and the site. Agroforestry not only increases the store of carbon in the landscape, but also provides the opportunity to move the carbon into a long term secure form as timber, or use it as an alternative fuel for energy thus reducing our reliance on fossils fuels. We now have growth data on a range of species and sites, but much remains to be done to improve predictions of carbon sequestration under different conditions.

Water – Trees used for multiple purposes strategically integrated with farming can control soil erosion, trap sediments and nutrients, reduce evaporation from pasture, reduce the risk of flooding, dry out waterlogged areas and lower threatening saline water tables. Understanding the processes of water flow and land degradation, and how trees use water, allows farmers to balance the positive and negative influences. Whereas tree water–use might be a problem in one part of the catchment, it provides a means of reclaiming productive land and protecting remnant vegetation in another. It's important to understand your local conditions because soil,

Trees planted for commercial returns can also serve multiple functions including stream-bank stabilisation, connectivity between remnant patches and stock shelter. Photo: Nadeem Samnakay

topography, geology, rainfall and surrounding land use will influence water flow, salinity, local demands and downstream use requirements.

Shelterbelts – Research has shown that well-designed shelterbelts orientated to block damaging cold or dry winds, can improve paddock-level pasture and grain yields, by reducing physical damage and soil evaporation. A key role of shelterbelts is risk reduction, especially where there are infrequent severe events. For example, tree shelter can improve lambing survival by up to 10 percent, and reduce heat stress in cattle.

Agriculture – Trees can enhance or compete with agricultural crops and stock. The key is to find ways of matching species and management to the agricultural needs and opportunities. Recent research in Western Australia has suggested that perennial pasture species such as kikuyu are more tolerant of tree competition. Some trees and woody shrubs such as saltbush and tagasaste can be grown for fodder to help bridge the autumn feed gap and improve year-round feed availability. Plantations can also assist with addressing some weed problems, such as the use of trees to shade out serrated tussock.

Products and markets – A recent analysis by URS Forestry concluded that in the medium to long term, emerging markets in carbon, ecosystem services, woody fodder and biofuels could provide significant opportunity for agroforestry. For existing large-scale wood-based markets, opportunities for agroforestry depend on the region's characteristics, such as products in demand, proximity to ports and processors, and scale of nearby plantation or native forest harvesting. Tree or fodder crops which bring an early return reduce the long term financial risk. Examples are leasing land for blue gum plantings (where an annuity is paid), planting fodder shrubs to supplement stock feed, using shelter to enhance lambing survival, finding a market for forest thinnings, or seeking payment for ecosystem services. Planting for carbon and sawlogs requires a longer time frame; trees must survive and be managed for end products involving a greater financial risk, and potentially a greater return.

People – Surveys by JVAP and others have shown that people get enormous satisfaction from planting trees, and seeing the landscape change in positive ways. The Master TreeGrowers program, funded by JVAP since 1997, organises regional programs to help landholders, extension and catchment managers to design farms and landscapes for multiple vegetation outcomes. This program is a valuable catalyst for creating and supporting regional people networks (See also article on page 28 in this issue by Rowan Reid).

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What's next for JVAP

JVAP is a partnership between Rural Industries Research and Development Corporation, Land & Water Australia, and Forest and Wood Products Australia. Over time a range of other agencies have also contributed funds, including the Natural Heritage Trust, the Department of Agriculture, Fisheries and Forestry, Murray-Darling Basin Commission, Australian Greenhouse Office, and Grains Research and Development Corporation.

JVAP's Five Year Plan extends to June 2009, and opportunities are being scoped for a future program, including agroforestry's role in carbon sequestration, water reform, bioenergy and ecosystem services. JVAP will also focus on communicating the wide range of research funded by the program over recent years.

High pruned trees for sawlogs will provide financial returns in the longer term but also serve to stabilise a revegetated stream-bank and enhance biodiversity values. Photo: Nadeem Samnakay

Facelift for a forest

By Fleur Flanery

Urban forests will have an increasingly important role as cities try to minimise their environmental footprint. Urban trees have been proven to improve air and water quality, help reduce pollution through direct absorption of gaseous contaminants, release oxygen through photosynthesis and they provide shade for houses and vehicles reducing air conditioning cooling and heating requirements. The ACT Government has taken a significant step in ensuring its urban forest is maintained into perpetuity by establishing the Urban Forest Renewal Program.

Since its inception, Canberra's city planning has focused on emphasising and enhancing the natural landscape with around 70% of the land in the ACT being set aside for open space, mainly in the form of native reserves.

Canberra's forest is the largest urban forest managed by one jurisdiction in Australia. It includes over 700 000 trees in the streets, parks and nature strips and more than double this number in the Nature Parks which surround the city. The forest contains over 300 different species of trees, many of which were planted in one of two of the primary building phases of Canberra; at the inception of the construction of the city in the 1920's and in the 1950's which saw major structural developments such as the construction of Lake Burley Griffin, Canberra's feature water body. Many of these trees are aging and by 2020, it is estimated that up to 70% of Canberra's urban forest will be in decline which is one of the primary reasons for developing the Urban Forest Renewal Program now.

Increasing costs of managing the forest

Over the next 25 years substantial numbers of trees will need to be replaced. Management costs increase as trees mature because they need greater levels of maintenance to remove branches to minimise the risk to community and property. Mature trees are however the most loved by the community and ones that provide the greatest environmental outcomes.

In addition to the issues associated with age are the effects of drought, a potentially drying climate, public perception and community needs. These issues increase the level of complexity for the renewal plan. No one wants to see mature trees removed but this will need to happen over time, to give the forest an opportunity to renew and be managed sustainably into the future.

The Urban Forest Renewal Program, which is coordinated by the Department for Territory and Municipal Services will review the state of the forest and develop priority actions for trees in existing streets and urban parks in poor condition, where unsuitable species have been selected. A plan will be developed that reflects zoning for conservation corridors, designated heritage precincts, landscape character and make recommendations about development of the urban forest in new developments.

Expertise

A reference group of experts has been appointed to provide advice on the various aspects of the program. The group comprises of members who specialise in ecology, forestry, landscape design, plant production, urban heritage, climate change and sustainable ecosystems. The members have discussed principles for the renewal program which include activities that maintain the distinctive landscape character of Canberra whilst looking for strategies that promote biodiversity and are aligned with climate change projections.

World Renowned Arboretum

Past experience will provide valuable lessons when planning for the renewed treescape. Canberra was originally planted as an arboretum and many streets contain species trials of varying ages. Information from these trials will be assessed when considering future planting considerations.

Research on Urban Forests

Research undertaken by the Fenner School at the Australian National University is also a vital part of the program. The university has calculated the value of Canberra's urban forest at more than $15 million annually including:

- $3.9m in energy reduction (less cooling and heating),
- $7.9m for pollution mitigation; and
- $3.5m for stormwater mitigation.

This research commenced in the mid 1990's and it assesses the health of the forest and projects maintenance needs depending on the age characteristics of the species and changing environmental conditions such as a dryer or wetter climate, all of which impact on tree growth. This information will be used to project future budget needs anticipating peaks in the workload over 10 –15 years.

In order to leave a legacy for future generations, there is a need to explore ways to care for the existing trees and plan for potential changes – like a dryer climate -–when planting new trees.

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Below: A view of native forest from Black Mountain overlooking Lake Burley Griffin. Photo: Andrew Tatnell Photography

Above: Bushland, parks and reserves comprise a diverse urban forest adjacent to Parliament House in Canberra as viewed from Red Hill. Photo: Andrew Tatnell Photography

Below: Mature trees in Grant Crescent, Griffith. Mature trees like these provide Canberra with its distinctive landscape character and will be carefully monitored under the Urban Forest Renewal Program. Photo: Andrew Tatnell Photography

Australian Government
Land & Water Australia

Biodiversity outcomes from waterpoint management in the rangelands – what can we achieve?

By Anita Smyth

Interest in artificial waterpoints, as a management tool for achieving biodiversity outcomes, stems from studies showing that waterpoints control stock behaviour. Domestic stock and feral herbivores need daily access to permanent water in the summer months and a few days at a time in the winter months. The risk to biodiversity and ecosystem function depends on the type of herbivore activity, its intensity and how long an area is exposed to intensive grazing.

The concept of switching waterpoints off and on throughout rangeland landscapes to allow the surrounding habitat to recover from grazing has the potential to become a powerful management tool for achieving biodiversity outcomes.

The South Australian government is under increasing pressure to show that waterpoint management does control grazing across rangeland landscapes. Under the *Native Vegetation Act, 1992*, a permit system for waterpoint installation regulates native vegetation clearance. The legislation is contentious because permit approvals can lead to a loss of resilience for an ecosystem through opportunity costs (costs to establish the waterpoint), production losses or a loss of biodiversity and ecosystem function (through clearance of native vegetation). In August 2006, we began a study involving participatory, desktop and field experimental approaches to look at whether waterpoint management can be used to manage biodiversity to maintain ecosystem resilience in the arid SA rangelands. In this article, we focus on the field experiments.

Field sites are located on two cattle properties and the Oodnadatta Town Common in the saltbush – grass vegetation community. We chose this community because it is the most favoured grazing country in the region. It has habitats providing a mix of ecosystem services, is sufficiently widespread and environmentally uniform to enable adequate replication and has been disturbed unevenly, giving a range of biodiversity outcomes from waterpoint management. The landform is uniformly plateaux dominated by gibber pavements interspersed with the more fertile soils of gilgais (heavy clay depressions). We have conducted three, three-week survey trips (two experimental and one calibration) in March, June and November 2007 to sample plants, resident ground-dwelling birds, small ground mammals and reptiles. Pilot surveys of the birds indicated that they needed to be sampled at a completely different scale to other biota and that reptile numbers were few and fluctuated widely between samples. Thus, we restricted our study to the plant and mammal biota.

So far, we have completed the 'before waterpoint closure' samples at two experimental sites under 'dry' and 'wet' conditions and cattle have been mustered out of paddocks so that waterpoints could be switched-off for the next 12 months or longer to see how the plants and animals respond to a rest from grazing. Only 'dry' conditions have been sampled at the calibration sites. At present our research has stalled due to an unseasonable lack of rain to the region.

What do we know so far…

Gilgais are the 'hotspots' of the stony desert systems. They are water run-on areas and form a patchwork of deep-rooted vegetation amongst a matrix of gibber pavement. No vegetation grows on the gibber pavement. Vegetation responds rapidly to rain even when the amounts are small. Up to 17 native grasses have been found in just one gilgai alone after reasonable rains. They are dynamic systems that appear to

The hard working project team from left, Anita Smyth (Project Leader), Tony Latz, Kirrily Blaylock, Robert Brandle (Field Leader) and Pamela Keil. Photo: Rick Davies

Above left: Digging holes for placement of pit-fall buckets in the Oodnadatta trial sites. Jackhammers were a welcome tool in the toolkit. Photo: Rick Davies

Above: Gilgais, or small natural depressions, hold water after rainfall and can sustain the lifecycle of a diverse community of plant species. Photo: Pamela Kiel

move through the landscape driven by processes akin to continental drift. When it rains, they become temporary waterpoints that spread the herbivores throughout the landscape, thus resting the permanent ones. Early impressions suggest these dynamics produce ecological communities that are resilient to present grazing pressures.

At the calibration sites, 72 native plant species have been recorded, of which 28 species were grasses. Over 130 native plant species were recorded at the experimental sites, with some gilgais having over 50 species. Only one species of weed (Spiked Malvastrum) was recorded, this being present at very few sites and in only very small numbers. Preliminary patterns for perennial cover and species composition at the different sites grazed regularly (1–2 km from waterpoint) and hardly ever grazed (> 4 km from waterpoint) during dry conditions and after rains were consistently similar prior to waterpoint closure. At this stage, we were not able to pick up a 'grazing pressure' effect on native plants, given the present stocking densities of cattle, feral herbivores and kangaroos.

A total of 10 species of small mammals and one House Mouse (*Mus musculus*) were recorded at the calibration sites under dry conditions. In comparison, at the experimental sites, under both 'dry' and 'wet' conditions and prior to switching off waterpoints, there were fewer small mammals (6 species) found but larger numbers of Forrest Mouse (*Leggadina forresti*), a species of conservation significance, were recorded along with sightings of the vulnerable Plains Rat (*Pseudomys australis*). Again, with the present grazing regimes, we were not able to detect a 'grazing pressure' effect on the ground mammals.

It is too early to interpret the significance of these results for waterpoint management to maintain biodiversity and ecosystem resilience.

Under current grazing management, grazing pressure might not be at an intensity whereby the ecosystem is pushed beyond a threshold where it has a discernable impact on biodiversity over and above that expected from natural environmental variation. The resilience in the landscape could be due to the gilgai movement and turnover inherent in these land types.

The next steps in the project are to carry out the 'after waterpoint closure' experimental field studies under 'wet' and 'dry' conditions over the next nine months. If 'wet' conditions are elusive, we will use results from glasshouse experiments on soil seed bank to model potential changes when there is no 'grazing pressure'.

The South Australian government and the pastoral companies will use information from this project to build on their knowledge of the resilience of gilgai ecosystems for livestock production and other highly valued ecosystems services such as carbon storage, methane reduction, nature conservation and Aboriginal culture. If closure of waterpoints does impact on plants and mammals, then policy makers will consider strengthening policies on waterpoint management as another intervention instrument for achieving biodiversity conservation. If the research concludes there is not enough evidence to decide whether waterpoint management affects biodiversity outcomes, then the SA government may implement long-term monitoring to assess biodiversity condition before improving existing policies. It is also likely that pastoralists in the region will continue with present grazing management until there is sufficient evidence to suggest adaptations are warranted to maintain ecosystem function and livelihoods.

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or visit the CSIRO project website at **http://www.csiro.au/science/waterpointmanagement.html**

This project is undertaken with in-kind support from the Department for Environment and Heritage SA, Department of Water, Land and Biodiversity Conservation SA, the SA Arid Lands NRM Board and CSIRO.

Australian Government
Bureau of Rural Sciences

Plantation forests: the facts revealed

By Mark Parsons

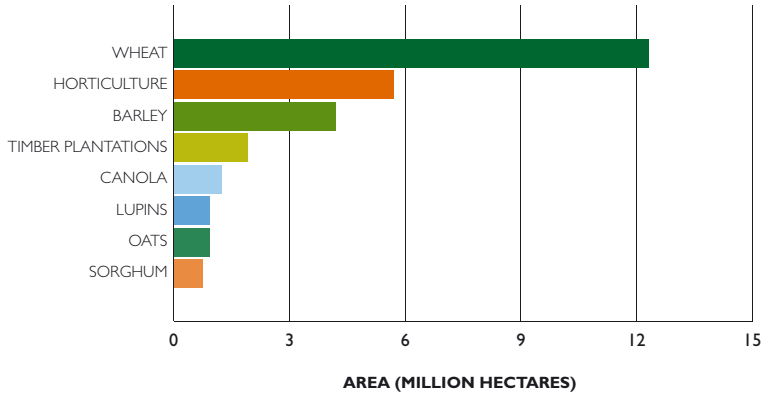
Natural resource managers, regional authorities, governments and communities all need reliable information about plantations. They need, for example, information about how much land they occupy, how fast they are expanding, how much water they take from catchments, their biodiversity, their impact on rural communities and their impacts on environmental values. The National Plantation Inventory, managed by the Bureau of Rural Sciences, can help with information on these and other plantation related subjects.

Plantations are crops not much different to most agricultural crops, although they take longer to mature. They have been grown in Australia since the 1870s, although most have been established since the 1960s. While most of them are established to produce wood, some are also used for environmental benefits such as salinity control. Each Australian uses an average of about one cubic metre of timber products per year in items like home construction, paper products and furniture. In Australia, two–thirds of the log supply to make these products come from plantations. Growing, harvesting and processing plantation timber employs tens of thousands of people across many regions.

How fast are plantations expanding?

The National Plantation Inventory found that Australia has about 1.9 million hectares of commercial timber plantations. That compares with 147 million hectares of native forests and woodlands and 440 million hectares used for livestock grazing. Figure 1 shows how the plantation area compares with other crops. In the ten years to 2007 the plantation area increased at an average annual rate of over 70 000 hectares. That rate is likely to decline soon. Current projections show the total area reaching less than 2.4 million hectares by 2020.

Figure 1 : Australia's major crops



How much water do plantations use?

Trees and other deep-rooted perennial vegetation use more water than annual crops and shallow-rooted vegetation. Clearing forests therefore reduces water use. This leads to rising water tables and, in some cases, soil and stream salinity. Conversely, reforestation increases water use and can reduce flows downstream. Whether this is a problem for downstream water users depends on the extent and location of reforestation and the particular circumstances. The National Plantation Inventory has data on where plantations are currently located. This data can be used to assess the relative significance of plantations and other land uses in water supply catchments. We can also advise on where expansion is likely to occur, which can help with modelling to assess the potential impacts of expansion.

Do plantations contribute to biodiversity?

Farmers would be puzzled if their farms were criticised for lack of biodiversity because they select crops and livestock for their production features, not for how much biodiversity they support. Trees in plantations are selected for the same reasons. We can compare biodiversity in plantations with biodiversity in native forests and in farmland. While native forests score better in that regard, there is ample evidence to show that plantations do support native species and have substantially more biodiversity than farmland. An example is shown in Figure 1.

Above left: A farm forestry trial site incorporating grazing and sawlog production, Dinninup, Western Australia. The site was established in 1988. Photo: Mark Parsons

Above: Timber-framed house: two-thirds of the logs used to make timber products in Australia are grown in Australian plantations. Photo: Mark Parsons

Is plantation expansion affecting rural communities?

The only thing that stays the same in rural Australia is that things keep changing. According to the Australian Bureau of Statistics, the number of farming families in Australia declined by 29% from 1986 to 2006. Because in some regions plantations are relatively new and have expanded rapidly, people tend to associate recent changes with the plantations. The National Plantation Inventory collects data on plantation expansion from year to year. This information can be compared with a range of social and economic trends at a regional level. For example, research by the Bureau of Rural Sciences showed that:

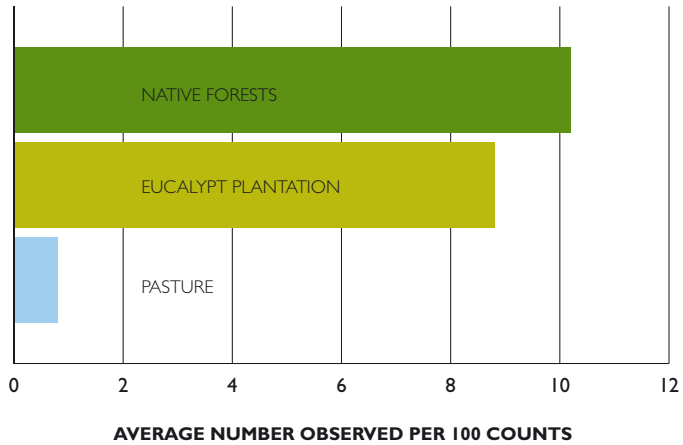
- In south–west Western Australia, the change in the number of farmers and farm managers where plantations expanded the most was apparently similar to the change in areas with little or no plantation expansion.
- In southern New South Wales, the population increased in the rural areas with a plantation timber processing industry in the neighbourhood but declined in areas highly dependent on agriculture.

What effect do plantations have on the environment?

As for other crops, plantation establishment and management involves site preparation, using mostly mechanical means, and tending to ensure efficient production. Pesticides are used to reduce weed growth when the trees are small and fertilisers are sometimes applied to boost growth. Plantation forestry is controlled by mandatory codes of practice that specify environmental protection requirements such as buffers along watercourses and soil erosion control measures. In general, plantation forestry uses considerably less chemical pesticides than other crops and causes considerably less soil erosion.

These are just a few examples of how reliable data and information can help our understanding of rural land use issues involving plantation forests.

Figure 2: Number of forest bird species observed in three habitats in north–east and central–west Victoria



Source: Loyn et al. (2006).

Visy Pulp and Paper's Tumut mill. The plantation industry employs an estimated 5885 people in the Murray Valley region. Photo: Michael F Ryan

2008 Inventory Update

The National Plantation Inventory (NPI) is a component of the National Forest Inventory, which is managed by the Bureau of Rural Sciences. NPI Updates are published annually to assess trends at a State and national level. Data reported includes best available information on total plantation area, new planting and ownership. This provides a realistic picture of the industry and timely information for strategic forest industry planning and decision-making.

Land use in catchment areas with above 600 mm average annual rainfall.

Land use	Plantations[5]		Agriculture	Native forest	Other uses
Catchment	Proportion of catchment	Proportion of all Australian plantations	Proportion of catchment	Proportion of catchment	Proportion of catchment
Millicent Coast	13.6%	8.8%	72.2%	11.1%	3.1%
Glenelg, Portland, Hopkins	7.2%	9.2%	74.9%	17.0%	0.8%
Lachlan, Macquarie-Bogan	1.5%	3.6%	73.9%	21.7%	3.0%
Murrumbidgee	4.0%	6.2%	53.8%	40.0%	2.2%
Upper Murray	2.5%	2.2%	27.1%	68.1%	2.5%
Northern Victoria[1]	2.2%	2.9%	43.1%	52.9%	1.8%
Tamar, Esk	4.1%	2.2%	29.9%	63.9%	2.1%
North-west Tasmania[2]	9.6%	4.4%	35.0%	54.1%	1.2%
Western Australia[3]	5.7%	16.3%	35.0%	58.1%	0.3%
South east Queensland[4]	2.5%	9.6%	47.5%	48.2%	1.8%

Australia's Plantations: 2008 inventory update is now available from

http://www.affashop.gov.au/product.asp?prodid=13940

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Notes

1. *Northern Victoria is the Goulburn, Broken, Ovens and Kiewa River catchments.*
2. *North-west Tasmania data are for the Smithton-Burnie Coast, Mersey, Rubicon and Forth River Catchments.*
3. *Western Australia data include all catchments in south west Western Australia from Perth to Albany.*
4. *South east Queensland data are for the Brisbane, Burnett, Noosa, Maroochy and Mary River catchments.*
5. *Based on plantation areas as at 2005.*

Australian Government
Department of the Environment, Water, Heritage and the Arts

Caring for our Country — managing native vegetation and improving ecosystem resilience

Caring for our Country is the Australian Government's new natural resource management initiative. This article focuses on the role of the National Vegetation Information System to inform the development of strategic actions to protect and conserve the biodiversity of native vegetation, in line with the direction of Caring for our Country.

Caring for our Country

Caring for our Country has been designed as an integrated package with one clear goal, a business approach to investment, clearly articulated outcomes and priorities, and improved accountability. The program commenced on 1 July 2008 and aims to better integrate the delivery of the Commonwealth's environment and natural resource management programs.

The goal of Caring for our Country is for an environment that is healthy, better protected, well managed, resilient, and that provides essential ecosystem services in a changing climate. The initiative focuses on achieving strategic results and invests in six national priority areas:

- a national reserve system
- biodiversity and natural icons
- coastal environments and critical aquatic habitats
- sustainable farm practices
- natural resource management in remote and northern Australia
- community skills, knowledge and engagement.

The Department of the Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry are working together to identify outcomes for these priority areas as part of the first Caring for our Country business plan (2009–10).

A wide range of activities will be funded across the six priority areas, particularly those that directly relate to the program's goal. The business plan — scheduled for release later in 2008 — will set the framework for strategic investments in the following years.

Managing native vegetation through Caring for our Country

The single goal of Caring for our Country, with its focus on resilience and sustaining ecosystem services, has clear application for the ongoing conservation of Australia's native vegetation communities. While there are many threats with the potential to impact on terrestrial ecosystem services and the biodiversity that supports them, addressing the impacts of declining extent and poor management of native vegetation remains a nationally important issue.

The past 200 years of native vegetation management in Australia has caused high levels of fragmentation and loss of spatial connectivity, particularly in areas developed for intensive agriculture. Combined with the impacts of invasive species and changed fire regimes, fragmentation in these areas has caused declines in both ecosystem services and the resilience of these landscapes to future pressures, including climate change.

While fragmentation of native vegetation is a less significant issue in the extensive land use zone (or rangelands), invasive species, fire management and total grazing pressure limit ecosystem services and resilience in a similar way.

In developing Caring for our Country as an initiative with clear priorities, the Australian Government is seeking to build on — at the national level — what regional natural resource managers have been doing for years.

Left: Rainforest, Mount Field National Park, Tas. Photo: Murray Fagg

Below: Acacia Open Woodland, Near Menindee, NSW. Photo: Murray Fagg

Given the realities of limited funds and a large continent, the Australian Government needs to better target investment if we wish to see measurable change. How can we prioritise our funding to best achieve Caring for our Country's goal? Do we have data and information of sufficient quality and reliability to support such bold thinking? Are our environmental data gathering systems up to the task of recording and reporting on what has been achieved through a number of investments?

Questions like these are helping to frame the ongoing development of Caring for our Country as an initiative with clearly articulated outcomes and priorities, and improved accountability. The good news is that we are not completely 'in the dark' in developing answers and insights in relation to these questions. Australian Government agencies house a number of continental datasets with good capacity to inform priority setting and monitoring.

The National Vegetation Information System (NVIS) is a good example.

Using the NVIS in Caring for our Country

Articles in *Thinking Bush* Issue 6 showcased the work of a number of Australian Government agencies in developing the NVIS in collaboration with all states and territories. The NVIS database now contains GIS-based, query-ready information for over 9000 native vegetation types across Australia and is unrivalled in its detail and completeness across the continent.

The database is compiled almost entirely from the states' and territories' latest and best available data, and is maintained by the Australian Government Department of the Environment, Water, Heritage and the Arts.

There are many possible applications of the NVIS, including the production of generalised national maps of major vegetation groups to provide a broad view of the diversity of Australia's unique native vegetation.

Further potential applications emerge when NVIS data is integrated with other information, such as identifying areas that may provide habitat for particular taxa, or estimating the continental extent of native vegetation at a particular time.

While the NVIS is highly valued for its continental coverage and application at that scale, it can also be used to support natural resource management decision making at a subcontinental scale.

The NVIS data provides a good basis for identifying zones of high fragmentation where there may be opportunities to restore landscape and ecological connectivity (eg through revegetation and improved management of remnant patches). When viewed together with other biodiversity data, such as the distributions of threatened species and communities, the NVIS data provides significant insights into the state of ecosystems across the continent and the areas where intervention is most urgently needed to address biodiversity decline.

The NVIS data can also be used to help identify areas where landscapes are reasonably intact but may be experiencing pressures, which — if unaddressed — could result in significant biodiversity declines in the future.

These high quality analyses will be used to inform biodiversity and ecosystem priorities for investment under Caring for our Country.

While the current NVIS is a powerful tool, it has limitations and gaps which leave room for improvement. One of the greatest challenges in improving the NVIS is the development of reliable information on the condition of vegetation. Another is the regular capture and storage of annual 'snapshots' of vegetation extent across Australia to assist in better monitoring of changes resulting both from natural causes and in response to management interventions.

The Executive Steering Committee for Australian Vegetation Information, (ESCAVI) through which all Australian governments have input to the improvement of the NVIS, is well aware of these challenges and is making steady progress towards addressing them.

For more information about Caring for our Country, go to

http://www.nrm.gov.au/index.html

For more information on the National Vegetation Information System, go to

http://www.environment.gov.au/erin/nvis/index.html

A view of Australia's native vegetation from the National Vegetation Information System (NVIS)

Ground-based estimates of hollow availability in eucalypt forests were checked against actual counts derived from climbing or felling representative trees. Photo: John Westaway

Australian Government
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Dynamics in tropical eucalypt forests.

John Woinarski and Brydie Hill

Some of Australia's, indeed, the World's most extensive intact forest systems occur in tropical northern Australia. Here, tropical open forests and savanna woodlands dominated by *Eucalyptus miniata* (Darwin woollybutt) and/or *E. tetrodonta* (Darwin stringybark) extend over 450,000 km2, about 6% of Australia's land area.

With frequent fire and cyclone disturbance, the dynamics of these forests are likely to contrast markedly with those of temperate Australia. Yet, it is these temperate forests that are largely seen as typifying Australian forest systems. For example, "old-growth" criteria are now reasonably well established in temperate forests, but there has been no consideration of comparable criteria for the tropical eucalypt forests and there is currently a pervasive belief that the very concept of "old-growth" may be inappropriate for these frequently disturbed forests.

Why worry about dynamics in these forests?

One reason is that they are now the main target for broad-scale vegetation clearance in northern Australia (and possibly the environment undergoing the highest current clearing rate in Australia). Clearing is occurring to accommodate forestry plantations, horticulture, residential development and pastoral intensification. The development stage of a tropical forest (i.e. whether "old-growth" or not) is not considered in assessment of clearing applications, yet it is very obvious that some areas of these forests have large trees supporting many hollows and associated hollow-dependent fauna, whereas other areas of the same forest type are of much reduced stature.

Another reason is that there is some need to assess the conservation value and characteristics of regrowth forest, in terms of how this should be treated in (re)clearing applications, in closure conditions for rehabilitation following mining or other impermanent intensive development, and for the design of linkages in landscapes now overly cleared. Another reason is that climate change is likely to increase the frequency and/or intensity of disturbance in these forests, so we need to understand the current dynamic in order to assess the likely impact of change. And yet another reason is that we should balance our understanding of Australian forest ecology through counterpointing the now well-known workings of temperate eucalypt forests with those of tropical eucalypt forests.

In this study, we examined a series of characteristics in these tropical eucalypt forests: the occurrence of hollows; the persistence of fallen logs; change in fauna assemblages following cyclones; and changing characteristics of fauna assemblages in regrowth vegetation. Our consideration of these different issues is linked by the themes of examining the applicability of characteristics that have been used to define "old-growth" elsewhere (e.g. hollow availability, coarse woody debris (fallen logs)) and variation in the faunal assemblage of these forests with forest age.

Typical tropical open forest of northern Australia, dominated by Eucalyptus miniata and/or E.. tetrodonta. Photo: Kym Brennan

Conventional wisdom of the dynamics of these tropical forests partly derives from, and is encapsulated in, a brief study of growth rates of eucalypt stems near Darwin, by Mucha (1979). He concluded that growth was rapid and that, because there were no large trees, "eucalypts of the Darwin region tend to be particularly short-lived ... the eucalypts of this region probably rarely reach the age of 100 years", whereas eucalypts in temperate Australia may live well over 300 years. However, Mucha's study was based on stems re-growing following clearance, and over estimates by up to 10-fold the growth rates of trees in intact forest. Large eucalypt trees in these tropical forests are instead likely to be substantially older than 100 years.

We measured tree size, forest stand attributes and hollow occurrence at 42 sites scattered across the substantial rainfall gradient occupied by *E. miniata – E. tetrodonta* forests in the Top End of the Northern Territory. Tree size, total forest basal area (a measure of the amount of wood per unit of area), and abundance of hollows increased substantially from lower rainfall to higher rainfall sites. However this relationship was disrupted at those higher rainfall (near coastal) sites that had (in this case, 33 years previously) been affected by cyclone, and was also significantly influenced by fire regimes.

Although forest basal area and tree size was substantially less than for eucalypt forests in temperate Australia, the availability of hollows in the tropical eucalypt forests was greater (especially at higher rainfall sites). This difference can be attributed to the much greater prevalence (or voraciousness) of hollow-forming termites in these tropical eucalypt forests.

Trees in these tropical eucalypt forests were more likely to develop hollows at smaller size than for trees in temperate eucalypt forests. In the tropical eucalypt forests, the first hollow accessible to vertebrate fauna is likely to be available in trees with diameter 20–25 cm, but large hollows (minimum diameter > 20 cm: suitable for owls, kookaburras and possums) form only when trees are >65–75 cm diameter. Such large trees are relatively rare, comprising <0.5% of all eucalypt stems >20 cm diameter. Using growth rates to convert these diameters to tree age, these tropical eucalypt trees are unlikely to have any hollows available until they are 25–30 years old (if growth rates are based on regrowth sites) or 65–150 years old (based on growth rates from intact sites), and unlikely to have any large hollows available until they are 60–75 years old (regrowth sites) or 220–500 years old (intact sites).

We also examined the persistence of fallen logs in tropical eucalypt forest, taking the opportunity presented by the destructive Cyclone Monica to measure decay rates in many fallen logs with known time of origin. Our initial assumption was that because of the high incidence of termites, humidity and rainfall and frequent fires, logs would decay rapidly. However, over the 2 year period examined, only 3 of 174 logs disappeared. Nonetheless many logs showed some decay, and the rate of this decay was related to the incidence of fire, tree species (with more decay in eucalypts than non-eucalypts), log size (greater rates of decay in larger trees) and degree of hollowness (with more decay in hollow logs).

In another component of this study, we examined the "succession" in fauna assemblages at sites ranging from cleared land through regrowth

of contrasting ages to intact forests. This aspect of the study was prompted in part by current debate about the degree of regulatory protection that should be afforded regrowth vegetation. Our study found that faunal assemblages in regrowth vegetation were intermediate between those of cleared lands and intact forest sites, but that they converged relatively rapidly to the reference faunal assemblage of intact forests. When regrowth vegetation exceeded about 8m height (i.e. about 20 years), their faunal assemblage was not significantly different to that of intact forest, with the notable exception of under-representation of hollow-associated species. For many species, land management factors (e.g. the incidence of fire, weeds and grazing) were more important factors governing abundance than was whether the vegetation had previously been cleared or not (i.e. was intact or regrowth).

Overall, this study provides major new insights into the dynamics of these important tropical eucalypt forests, particularly allowing comparison with the dynamics of temperate eucalypt forests. The study has important management implications. It is now possible to provide some explicit quantitative criteria for the delineation of "old-growth" in these forests (relating particularly to the incidence of larger trees, and the consequential abundance of hollows and hollow-associated fauna).

For regrowth vegetation, it is now possible to justify regulatory controls; although we recommend that if there is a need for choice, it is better to (re-) clear regrowth than to clear intact forest, better to clear younger than older regrowth, and better to clear isolated regrowth than regrowth that may form connections between otherwise isolated intact forest patches.

Reference

Mucha, S.B. (1979). Estimation of tree ages from growth rings of eucalypts in northern Australia. *Australian Forestry* **42**, 13-16.

For further information on this project contact:

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Or visit project TRC14 on the Native Vegetation and Biodiversity R&D program website, **http://www.lwa.gov.au/nativevegetation**

A more detailed fact sheet on this project is also accessible via the LWA products catalogue at **http://products.lwa.gov.au/** and searching for product code PN21601

Below: The dynamics of tropical eucalypt forests may be much influenced by frequent intense disturbance regimes: in this case, damage caused by Cyclone Ingrid. Photo: Kym Brennan

What is "old-growth"?

Foresters, ecologists and conservationists have long recognised that there is variation in the characteristics of forests as they age. Older forests have larger trees and these are more likely to form hollows and hence support hollow-dependent animal species; they may also have more epiphytic plants (i.e. plants that grow upon or attach to other living plants), and coarse woody debris (fallen logs and other "litter") and consequently more animals associated with the decay of organic material.

They may also provide habitat for plant and animal species that are disadvantaged by disturbance or prefer the particular microclimatic conditions deriving from a relatively tall, layered and dense canopy. Some have also ascribed particular aesthetic or spiritual qualities to forests made up of large tall and very old trees. The foundation document for the delineation of old growth forests in Australia is the "JANIS" report (*Nationally agreed criteria for the establishment of a Comprehensive Adequate and Representative Reserve System for Forests in Australia*, 1997, A report by the Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee). This defined old-growth criteria applicable for all Australian forests, with the single proviso that:

"These criteria apply to all forested regions except those in the Northern Territory where the vast areas involved mean a different set of criteria will need to be developed".

To a large extent, this study remedies this now long-standing deficiency.

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Making Connections: a Systematic Review of corridors also links researchers with managers

Veronica Doerr, Erik Doerr, Micah Davies

Systematic Reviews are a new approach to reviewing research outcomes that should help managers and policy-makers make decisions based on all available data. CSIRO Sustainable Ecosystems and Land & Water Australia are trialling the approach through a project that is trying to find out whether wildlife corridors and other connections in our landscapes really facilitate wildlife movement. The study is conducted through a specific line of enquiry asking – Does structural connectivity facilitate effective dispersal of native species in Australia's fragmented terrestrial landscapes?

A key challenge in natural resource management is to synthesise the diversity of research on a given topic to distil clear management recommendations. But when multiple studies give different conclusions, how can we decide what to believe and which management actions to adopt? Traditionally, these difficulties have meant that management decisions are often based on intuition and opinion to some extent, rather than just the available data – the hard evidence. However, the relatively new approach of Systematic Review could help decision making through a comprehensive analysis of data.

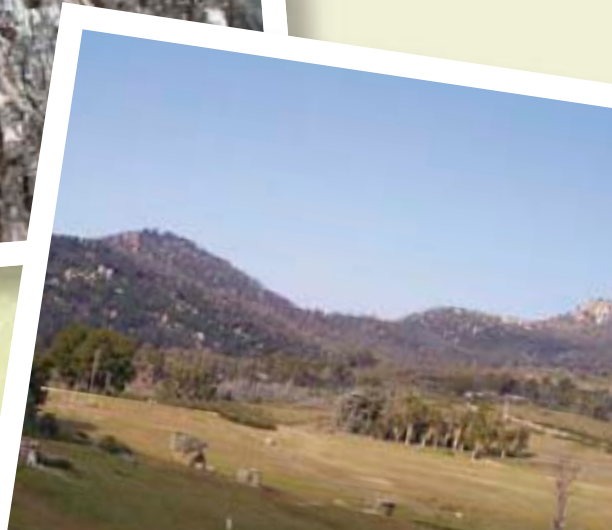
Originally developed in the field of medical research, Systematic Review differs from a traditional review of published research in that it:

- always has a practical focus—by asking whether or not specific management actions achieve their desired aims.
- develops thorough and explicit search protocols for finding information, including the difficult-to-find sources like unpublished Honours' theses and state government reports.
- uses a technique called meta-analysis to actually analyse ***data*** across multiple studies, rather than just providing a synthesis of different researchers' ideas.
- is well supported and coordinated through the Centre for Evidence-based Conservation (CEBC) in Wales (**http://www.cebc.bangor.ac.uk/**), so land managers, planners and policy-makers can easily access the results of these reviews anytime at no cost.

With funding from Land & Water Australia and support from the CEBC, we are in the process of conducting a Systematic Review aimed at understanding whether wildlife corridors and other connections in the landscape really do help Australian native species disperse and move through our fragmented landscapes. It is well-established that fragmentation of native habitat makes dispersal difficult for a large number of species, resulting in smaller populations that are more likely to go locally extinct. However, it is still unclear how we can encourage dispersal, aside from completely revegetating fragmented systems. Our project's overall goals are three-fold:

1) To gain a better understanding of appropriate ways of protecting and restoring connections in Australia's landscapes,
2) To identify critical knowledge gaps in research on connectivity, and
3) To trial the use of Systematic Reviews in Australia with application to NRM.

Left: The Antechinus is one of few mammalian genera for which data on dispersal actually exists. Photo: Sarah Knutie



Right: In addition to tree corridors, a number of features in a landscape may assist in providing connectivity for species dispersal including rocky outcrops, woody debris and tussocky grasslands. Photo: Teresa Oppy

Now that we're about halfway through the project, it seems like an appropriate time to share some preliminary impressions about the Systematic Review process – pros, cons, and surprises from our experiences thus far.

The review process requires researchers to set clear rules for deciding whether any given study will be included in the review or not. Thus, one of our challenges has been to clearly define what a "connection" might be. It seems obvious that a linear row of trees (a traditional corridor) could be helping animals disperse, but what about a few paddock trees? Or a couple of brush piles and some rotting logs in a paddock? And what does a corridor "look" like to a plant seed—is it just some soil with the right characteristics for germination? In reality, any or all of these things might help species move around in fragmented landscapes, so they all need to be included in the review.

One of the most valuable aspects of the Systematic Review approach is that it forces reviewers to make a clear distinction between hard evidence, based on data collected in the field, and the thoughts and intuitions of researchers and land managers. While intuition can be helpful, and should certainly guide management when no data or not enough data are available, it is important to base management actions as much as possible on real evidence of their effectiveness. While this might seem an obvious statement, our searches have revealed that there have been many more papers published on the theory or idea of corridors and connections than on real-world studies of them. And most management actions seem to be based on the 'idea' papers rather than any hard data. Given Australia's relatively large investment in restoring connectivity, and corridors in particular, we need to be sure we're doing something beneficial, not just something that seems like it should be beneficial.

Finally, the Systematic Review process also requires that reviewers engage with a wide variety of stakeholders throughout the entire review process, from university researchers to management organisations and non-governmental conservation groups. This is a great way to ensure that we consider a wide diversity of opinion and expertise BEFORE we actually do all the work of conducting the review and while our approach can still be modified to encompass new ideas. As a result, the final review should reflect broad consensus among experts in the field, and can be structured to meet the needs of the people making decisions on-ground. We received thoughtful feedback on our review protocol from over 20 different stakeholders in almost all states in Australia, and we are particularly impressed with the willingness of everyone to share ideas and even data in the interests of finding solutions to the problems of fragmentation.

We hope that our Systematic Review will provide some much needed evidence-based rigour to help policy-makers and land managers make decisions about restoring and protecting connectivity in Australia. Even if we find that there simply haven't been enough studies done in Australia to reveal clear conclusions, the comprehensiveness of the Systematic Review process will ensure we can identify the most critical knowledge gaps and work with our network of stakeholders to apply best-practice management based on the evidence we do have.

The results of this Systematic Review are expected to be available in January 2009 and will be publicly available on the CEBC website.

For further information on this review contact:

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or download the review protocol at **http://www.cebc.bangor.ac.uk/Documents/DraftProtocol44_000.pdf**

Land & Water Australia, through the Knowledge for Regional NRM program and Native Vegetation and Biodiversity R&D program are funding two trial Systematic Reviews. The first of these has commenced and the preliminary experiences of the review are discussed in the adjacent article by Veronica and Erik Doerr and Micah Davies, from CSIRO.

A second Systematic Review trial asks the question:

"What contributions to biodiversity are provided by grazed lands in modified landscapes and how is the biodiversity affected by land management?"

This review has just commenced and is being undertaken by Josh Dorrough, a Visiting Scientist with CSIRO Sustainable Ecosystems in collaboration with Sue McIntyre from CSIRO. A review protocol will be available for comment in November 2008.

In addition to both these reviews being made publicly available via the CEBC website, Land & Water Australia intends to use the trials to:

- Test the merits and limitations of Systematic Reviews as a tool for evidence-based decision making for natural resource management; and
- Raise awareness of the concept of Systematic Reviews and the processes and investments necessary to adopt evidence-based decision-making models.

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The Australian Master TreeGrower Program - adapting to a changing landscape

Rowan Reid

Background of the MTG program

The Australian Master TreeGrower Program (MTG) is a national program hosted by the University of Melbourne. It aims to encourage and support landholders through the development and management of revegetation projects for both conservation and profit. Since 1996, more than 1500 landholders across Australia have participated in one of the 80 regionally based programs.

The name is important. Many participants come to our programs expecting answers to simple questions like: What species should I plant? Or, What's the best spacing? Although they leave with more questions than answers, they do have a better feel for the opportunities and seem genuinely excited about the role they might play in developing sustainable and profitable farming landscapes.

The MTG is usually presented as an 8-day course delivered locally over a period of 2 or 3 months. A normal day would involve one or two 'expert' presentations in the morning then a field trip to farms, local business, research sites, native forests or private plantings. Where possible the group, with invited experts, visit the participants' own properties to work through the opportunities on the ground. Many courses also include social events and overnight trips.

Back in 1996, we began with a strong emphasis on farm forestry, however, where landholders had other interests, such as stock shade and shelter, salinity control or biodiversity, these were also covered. In effect, the program reflected the research being undertaken by the Joint Venture Agroforestry Program (JVAP) which has supported the program since 1997. Land & Water Australia's Native Vegetation and Biodiversity R&D Program, is now a joint national sponsor of the MTG program. This support has allowed us to expand into areas that are not generally seen as suitable for commercial tree growing and to engage with those regional partners who would otherwise shy away from anything that smelt like commercial forestry.

The year ahead

To date, 2008 shows the breadth of the Master Tree Grower concept. Already this year three regional Australian Master TreeGrower programs have been completed in Moree, Dorrigo and Hunter Valley. These programs highlight the potential of the MTG model to adapt to the local interests of landholders, Catchment Management Authorities (CMAs), and interest groups:

The Dorrigo MTG course was like many we have run before. Delivered in partnership with the Mid North Coast Farm Foresters with funding from the Northern Rivers CMA, the course focused on helping landholders design and manage planted forests on cleared farmland. With excellent rainfall and deep soils many of the farmers were interested in commercial species, particularly the establishment of mixtures of high value native timbers.

Participants from the Dorrigo program showing off their Master Tree Grower signage. The backdrop shows a log of yesteryear that some may aspire to produce.

The Moree course was supported by the Border Rivers-Gwydir Catchment Management Authority and Greening Australia's Exchange program. It was something new for the MTG program as it focused on enhancing regional biodiversity. It soon became clear that the participants saw potential for native vegetation, including grasslands, to also support agricultural production by providing habitat for predatory insects, sheltering stock and crops, trapping spray drift and controlling land degradation. It's hard tree growing country. Yet, participants told me their landscape needed more trees and they felt it was their responsibility to learn more and encourage others by their example.

The Hunter Farm Forestry Network course was different again. The network obtained funding through their local Landcare group for a course that focused almost entirely on the management and protection of native forests on private land. Whilst the region has many of Australia's most highly valued eucalypt timbers, the participants clearly saw other values in their forests. I was pleased to hear the discussion about how silvicultural management could be used to enhance their biodiversity values, stimulate regeneration and release growth potential. This was a revelation for those who had come to think of native forests as something that should be locked up rather than managed.

The success of these courses can be attributed largely to the regional coordinators of these programs who shoulder the responsibility for organising participants, speakers and sponsors.

Building Tree Grower Communities

Many MTG participants talk about the course being the start of a life-long journey of learning. To support their 'long walk in the forest', the MTG works with groups of landholders, agency staff and industry members so as to build lasting relationships and information networks. Whilst I and other 'experts' might fly in and out, the landholders continually tell me that what they learn from others within their group is just as valuable.

We've now taken the community learning concept further and are trialling the delivery of the Peer Group Mentoring program developed by the Otway Agroforestry Network (See **http://www.oan.org.au**). Pilot programs are underway in Western Australia with the Australian Sandalwood Network (and AVONGRO) and Trees South West (locally funded by the South West Catchment's Council). If these prove successful the concept will be expanded nationally.

The mentor project acknowledges that farmer-to-farmer communication occurs and does impact on what landholders do on their land. The training package of 3 or 4 sessions over the course of a year, and the payment of farmers for their time, improves the quality and quantity of community discussion about trees. It also has a role in enhancing the role of the researchers who are able to work with a small number of experienced growers.

How to run a MTG program

All our programs are delivered as partnerships. The regions, with the support of their Catchment Management Authority, government agencies or local sponsors, are responsible for organising participants, venues and local presenters. We provide support for specialist presenters and provide participants with hats, signs, tapes and books. For more information download: *Who are the Australian Master TreeGrowers?: Guidelines for the development and delivery of regional Australian Master TreeGrower course* from **http://www.mtg.unimelb.edu.au/coordinators.htm**

Forthcoming courses

MTG courses being planned for the coming months include: Bendigo (Northern United Forestry Group and the NCCMA), Heytesbury (Otway Agroforestry Network and the HOC Tree Group), Tasmania (NRM North and Private Forestry Tasmania), Central Queensland (Northern and Western AFG Branch) and more.

If you, or your group are interested in exploring how the MTG program might work with you, contact:

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The Hunter Valley MTG program looked at the management of native forests including their value for commercial timber. Photo: Rowan Reid.

Australian Government
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Mapping priorities
Planning re-vegetation in southern NSW using a new decision-support tool

Rob Lesslie
Bureau of Rural Sciences

Hamish Cresswell
CSIRO Land and Water

Where to re-vegetate for NRM benefit?

Deciding where to invest in natural resources management is not a simple process. Apparently straightforward questions such as 'Where should we invest in re-vegetation?' raise complex issues of equity, economic performance, and biophysical impact. Usually there is no 'right' answer. Re-vegetation, for example, may have benefits for biodiversity, water quality and amenity, and costs associated with reduced water supply and agricultural production. An informed decision requires the combination of disparate data and information (environmental, social and economic), value judgements, opinion, and policy and management goals. In the end, justifiable conclusions depend on systematic and transparent analysis.

Facilitating the decision-making process

A practical catchment scale natural resource management planning process needs to focus on indicative zones for investment in landscape change, consistent with maximising multiple environmental outcomes. In a regional context an effective prioritisation process provides for

- the best possible use of existing data sets and the technical expertise of participants
- integrating knowledge and balancing landscape options in a transparent and objective way and at a level that allows prioritisation of on-ground works
- incremental improvement over time, bringing together new information to help decision-making.

Multi-criteria Analysis (MCA) is a decision-support process that provides for the measurement and aggregation of alternatives or options, involving a variety of qualitative and quantitative information, including opinion and value judgment. Well developed MCA approaches generally share a number of characteristics. They are:

- highly flexible
- able to capture quantitative and qualitative data and issues
- relatively simple for clients and stakeholders to use
- allow the development of many alternative scenarios
- allow the exploration of tradeoffs
- enable stakeholders to factor results into their decision-making process to the desired degree.

Putting theory into practice – assessing re-vegetation options

CSIRO Land and Water and the Murray Catchment Management Authority (CMA) recently worked together to identify priority areas for re-vegetation in the West Hume region of southern NSW (Hill et al. 2006). The project showed how to prioritise locations for regional NRM investment using a simple MCA approach, readily available data and a strong participatory process. The project also took advantage of an innovative new spatial multi-criteria decision support tool developed by the Bureau of Rural Sciences – the Multi-criteria Analysis Shell for Spatial Decision Support (MCAS-S).

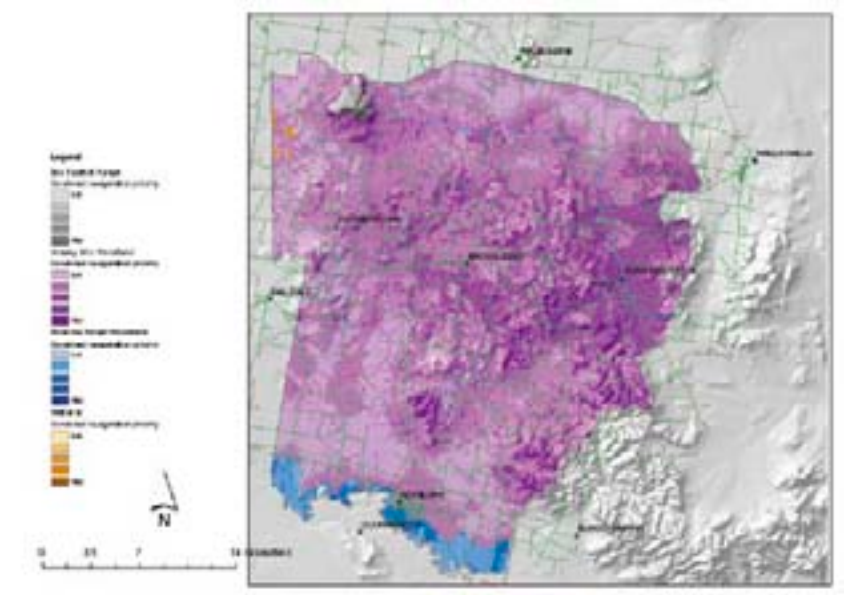

Figure 1. Prioritisation for re-vegetation in the West Hume area (Murray CMA)

This work translated the Murray CMA regional investment strategy into mapped priorities by focussing on identifying where multiple environmental outcomes and production benefits could be achieved, at minimal cost.

Results of the West Hume study provide a basis for allocating investment according to relative suitability in a catchment context. Further decisions on siting re-vegetation work are made in the context of local farm plans and farmer land management objectives.

MCAS-S

MCAS-S is an easy-to-use spatial multi-analysis decision-support tool specifically designed to help people with a stake in land use and investment decision-making – this includes natural resource management groups, agricultural scientists, policy makers and land management researchers.

The tool is freely available, reads standard data formats, is easy to use by non-specialists, and is designed for use in participatory processes. GIS (geographic information systems) programming is not required, removing the usual technical obstacles to non-GIS users.

MCAS-S promotes:

- insightful desktop combination and study of different types of mapped information
- understanding of the relationships between the decision-making process and the available spatial data
- interactive 'live-update' and mapping of alternative project scenarios.
- investigating suitable landscapes for acquisition of areas for conservation

New plantings on the West Hume study area have benefits for both biodiversity and salinity management. Photos: Mark Glover, CSIRO

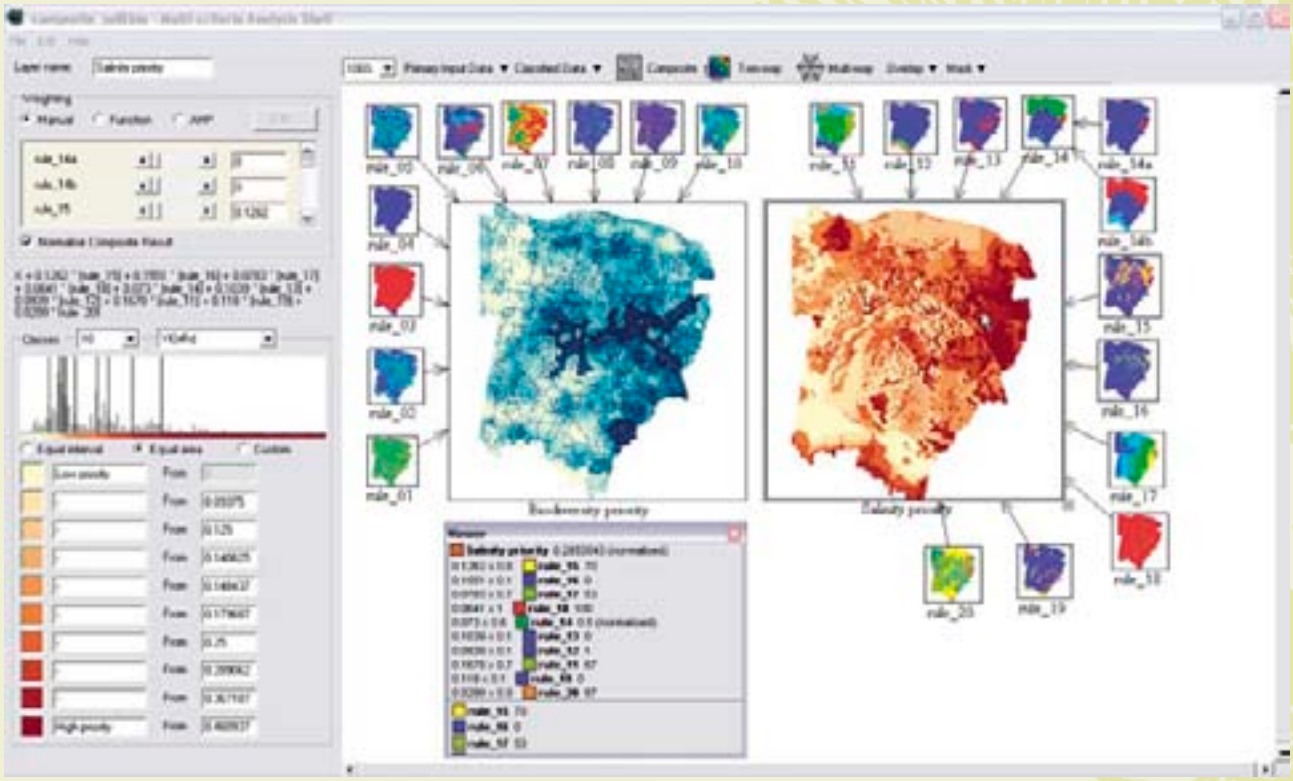

Figure 2. Using MCAS-S to link spatial criteria prioritising re-vegetation in West Hume for biodiversity and salinity outcomes.

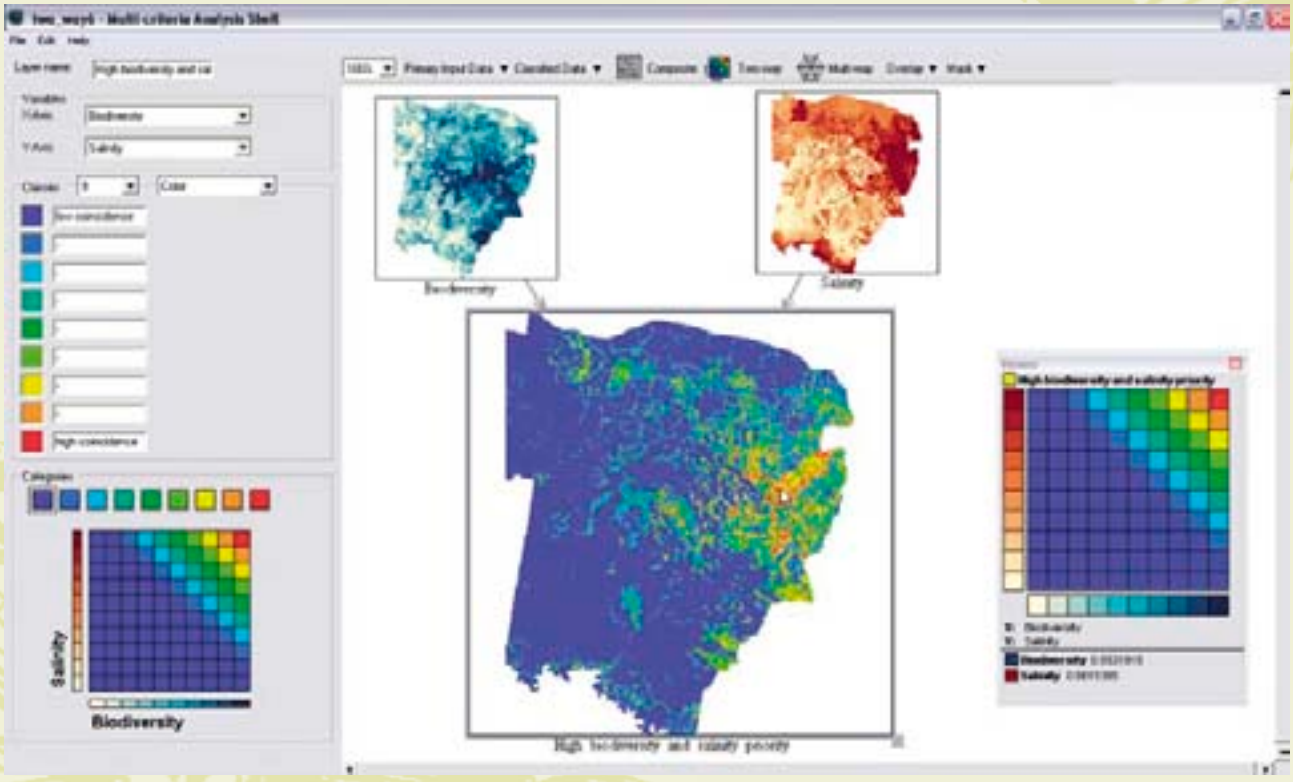

Figure 3. An MCAS-S 'two-way' analysis combining biodiversity and salinity to show where there is a co-incidence of re-vegetation priorities.

Can the West Hume process be translated to other regions?

Skills and technology

Implementation of a regional MCA similar to that applied in the West Hume area requires staff with some GIS skills (or access to GIS support), awareness of multi-criteria analysis procedures and technical understanding of relevant land management principles. Staff should also be capable of running a local community participation, reporting and communication process.

Data preparation, guideline formulation, and criteria weighting can generally be competed by local agency and regional staff with minimal external support.

Technical input in disciplinary areas requires a technical reference group.

Data needs

The West Hume study demonstrates that sound outcomes can be achieved with commonly available spatial datasets. Key spatial data requirements include:

- historical rainfall and temperature;
- elevation (and derivatives, e.g. slope);
- soil landscapes and profile classes;
- soil water holding capacity;
- current (or recent) land use;
- pre-settlement vegetation;
- threatened species (point) data;
- groundwater pressure and quality data;
- groundwater flow systems mapping;
- drainage networks, stream flow and water quality;
- cadastre and the location of important assets or infrastructure such as towns and roads.

The relative importance of each data set is dependent on the particular mix of themes and guidelines in the analysis. Good quality climate, soil, land use, and hydrological data will usually be important.

Outcomes

The adoption of a regional planning process such as that used in West Hume can substantially improve the effectiveness of investment in natural resource management through improved targeting of on-ground works expenditure. The process relied on readily available data inputs. Guidelines were generic and may be applied to other areas with minimal change.

The use of MCAS-S also makes spatial MCA much more straightforward, reducing the cost of implementation. MCAS-S means the investment decision-making process can be incrementally updated or improved, and is transparent to users. The cost of analysis is very small in comparison to the potential advantages from improved targeting of investment.

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Lesslie, R.G., Hill, M.J., Hill, P., Cresswell, H.P. and Dawson, S. (2008) The Application of a Simple Spatial Multi-Criteria Analysis Shell to Natural Resource Management Decision Making, in *Landscape Analysis and Visualisation: Spatial Models for Natural Resource Management and Planning*, (Eds. Pettit, C., Cartwright, W., Bishop, I., Lowell, K., Pullar, D. and Duncan, D.), Springer, Berlin, pp 73–96.

More information on MCAS-S, including software download and user guide, can be found at **www.brs.gov.au/mcass**

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What does vegetation do for me?

'Ecosystem services' is an emerging concept that supports sustainable and profitable agriculture and improved natural resources management. Ecosystem services look at all of the benefits that society receives from production landscapes – not just agricultural commodities, but also biodiversity, water supply and carbon storage benefits. It provides a framework to maximise the net benefits that society receives from agro-ecosystems.

Vegetation, both domesticated and wild-grown, has a crucial role in all human societies as a source of food, fuel, fibre and medicines. It also provides structural aspects to the landscape, holding soil together and moderating weather. Many cultural and recreational activities are also connected with vegetation.

The Bureau of Rural Sciences has recently published a useful information leaflet that explains the ecosystem services we obtain from managing vegetation. The brochure discusses what ecosystem services are, the role of vegetation, the value of ecosystem services and some management considerations.

Copies are available on line at:

http://affashop.gov.au/product.asp?prodid=13955

and further information can be sourced from:

http://www.daff.gov.au/brs/forest-veg/Ecosystem_Services

Australian Government
Bureau of Rural Sciences

Five yearly report card on the state of Australia's forests

By Phil Pritchard

***Australia's State of the Forests Report 2008* (SOFR 2008) is the third five-yearly report on Australia's forests. It presents data obtained from a wide range of sources, including the public and private sectors. Previous reports were published in 1998 and 2003. Released in May 2008, *Australia's State of the Forests Report 2008*, provides the most comprehensive review of Australia's forests. It canvasses the situation in all the forests of Australia, including the tall forests of eastern and south western Australia and the open forests and woodlands of northern and interior Australia. It provides the most comprehensive review yet of the state of our forests. A summary of findings from the report follows.**

- Australia's ability to estimate its forest extent continues to improve with the increasing availability of high-resolution, remotely sensed data and improvements in methods for identifying forest types. This largely explains the revision of estimated total forest area from 164 million hectares reported in 2003 to 149 million hectares reported here; little of the change is due to real forest loss.
- There is an increased representation of forests in nature conservation reserves and continued high levels of old-growth forest reservation. The area of Australia's native forest in formal nature conservation reserves has increased by about 1.5 million hectares to 23 million hectares. Over 73% of known old-growth forests is now within conservation reserves. There has also been an increase in the area of privately

Deongwar State Forest in South East Queensland covers approximately 490 hectares and is connected by a number of other forested tenures along the Great Dividing Range: Photo: Nadeem Samnakay

ForestrySA's Kuitpo pine plantation forest reserve is certified under the Australian Forest Certification Scheme. Photo: ForestrySA

managed forest managed for conservation objectives.

- While clearing of native forests is significant, the rate of clearing is declining. The net loss of woody vegetation (mostly forest) estimated by the Australian Greenhouse Office was 260,000 hectares (0.25%) per year between 2000 and 2004, due mainly to clearing for agriculture and urban development.
- Processes are in place to maintain water quality and supply from forests with over 30 million hectares of public forests (20% of the total forest area) managed primarily for protection, including soil and water values; most are in nature conservation reserves. In most jurisdictions, codes of practice or other management instruments are in place.
- Large areas of Australia were affected by severe drought over the reporting period. Fire, including very intense fires in southern Australia, burnt an estimated 24.7 million hectares of forest from 2001–02 to 2005–06.

- The area of plantations increased from 1.63 million hectares to 1.82 million hectares over the reporting period. In 2007, the area of plantations increased to 1.90 million hectares. Nearly all the increase was in hardwoods (mostly for pulpwood), which grew from 503,000 hectares in 2000 to 807,000 hectares in 2006. Plantations now produce two-thirds of the country's log supply.
- Australia's forests sequester more greenhouse gases from the atmosphere than they emit and therefore help to offset Australia's contribution to global greenhouse gas emissions. Plantations offset about 3.5% and managed native forests about 5.5% of total national greenhouse gas emissions in 2005. Additional storage in wood products offset a further 1% of emissions. Australia's native forests store over 12 billion tonnes of carbon in biomass and soils.
- In a number of jurisdictions, the total harvest volume from public native forests declined over the period because of reductions in the area available for harvesting, increased harvest restrictions, and revised downward estimates of sustainable yield. In the five years to 2006-07, the volume of logs harvested from native forests declined by 14% while the volume of logs harvested from plantations increased by 28%.
- Total national employment in businesses dependent on growing and using timber in 2006 was estimated to be about 120,000 people. Dependence on the forestry industry as the primary source of employment declined in some regions.
- The legal framework was strengthened during the period through the continued implementation of regional forest agreements and new measures governing vegetation clearing and the allocation of water to land uses such as forestry.
- There has been a rapid expansion of third-party forest certification and auditing of forest management leading to better management practices. Most multiple-use public forests and some private native forests are now managed in accordance with externally accredited environmental management systems, which provide a structured approach to the planning and implementation of forest management. Nine million ha of native forests and plantations were certified by September 2007, mainly under the Australian Forest Certification Scheme.

The report, prepared by the Montreal Process Implementation Group, and coordinated by the Bureau of Rural Sciences, represents a highly successful ongoing partnership between the Australian Government and state and territory agencies with an interest in the management of our forests.

Australia's State of the Forests Report 2008 and related products, including the stand alone executive summary, fact sheets and recent reports including, *The Changing Face of Australia's Forests* are available on the new Forests Australia website – **www.brs.gov.au/forestsaustralia** Full details of contributing authors can be found in the publications and on the website.

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