Farm forestry for green and gold:
Australian experiences of linking biodiversity to commercial forestry

Edited by **Digby Race** & **David Freudenberger**

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The **ANU's School of Resources, Environment & Society,**
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and **CSIRO's Division of Sustainable Ecosystems,**

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We hope this publication will appeal to a range of landholders and growers, as well as policy and project managers, and so make a useful contribution our collective understanding of how we can make forestry work for 'green and gold'.

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March 2003.

Disclaimer

The views expressed in this publication are those of the designated authors, and do not necessarily reflect the views of ANU Forestry, CRC Sustainable Production Forestry, CSIRO Sustainable Ecosystems, Environment Australia or other people and organisations who contributed to the project. The authors acknowledge that alternate views of the material presented in this publication may be held by others.

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Rod Bird is a research scientist based at the Pastoral and Veterinary Institute in Hamilton, Victoria. Rod has a background in animal science, obtaining a PhD in sulphur metabolism of ruminants from the University of WA in 1972. He worked in Victoria on beef cattle/pasture production research from 1973-1985. Since 1982, Rod has worked on shelter effects on agricultural production, salinity, revegetation research, farm forestry and biodiversity on farmland. Rod and his team have conducted research since 1982, specialising in the evaluation of species and management for the production of high-value clearwood from woodlots and timberbelts that have been integrated into the farming system to also produce other benefits, including land protection, shelter and improved biodiversity.

Robert Downie and his family have been involved in farm forestry over the last 30 years. Robert owns and operates *Hazelwood*, a 2,050 ha property 50 km east of Hobart in Tasmania. The property's extensive areas of dry sclerophyll native forest are managed for both commercial production and conservation. Robert plays an active role in farm forestry development, and currently works for Greening Australia managing the Tasmania component of Farm Forestry Support, a national project funded by the NHT through AFFA, which provides advice and support to landowners who are interested in farm forestry, specifically in the low rainfall areas. He is also Managing Director of Copping Timber Company, Vice-President of TFGA Forestry, and on the Advisory Committee for Tasmania's Private Forest Reserve Program.

Richard Finlay-Jones is the Manager – Forest and Land Management for GHG Management Pty Ltd (GHGM) in the Hunter Valley of New South Wales. Richard has qualifications in agriculture, forestry, business and education with local and overseas experience in teaching, agribusiness and environmental consulting. Richard was the Executive Officer with the Regional Plantation Committee and Project Manager for the regional Farm Forestry Project from 1997-2000.

David Freudenberger is a Principal Research Scientist and Group Leader with CSIRO Sustainable Ecosystems' Agricultural Landscape Program. David leads a Canberra based research group that includes projects aimed at providing Landcare groups and Greening Australia with vegetation enhancement guidelines in the wheat-sheep zones of southern and western Australia. David had a particular interest in how the patch and landscape scale habitat requirements of woodland birds can be used to prioritise and guide agroforestry and native vegetation protection programs. David obtained his PhD from the University of New England in 1985.

Ian Hanson works as a Forest Officer with Queensland Parks and Wildlife Service in Rockhampton. He has a bachelor and master degree in forest science from the University of

Melbourne and has worked as a professional forester in Victoria, New South Wales and Queensland. He met the Campbells while working as a Forest Extension Officer with the Department of Natural Resources in Rockhampton, and maintains an active interest in Central Queensland's growing farm forestry industry.

Don Jowett grew up in the Eastern suburbs of Melbourne and after attending Agricultural College began farming in 1968. On moving to Hamilton, south-west Victoria, in 1987, Don and Jann purchased their current home farm. While living near Hamilton, Don also spent 10 years working with Geoff Saul and Rod Bird on pasture productivity and farm forestry projects at the Pastoral and Veterinary Institute and on farms in the district, which gave Don an insight into the environmental, social and economic benefits of integrating these two aspects of farm production into their own business. Their farm has expanded into a 1,000 ha business that has resulted in a dramatic increase in biodiversity, reduced chemical use and increased profitability – and Don and Jann believe they now have a sustainable farming system that will survive into the foreseeable future.

Sylvia Leighton is the *Land For Wildlife* Officer for the Department of Conservation and Land Management and is based in Albany. Her work covers the south coast region of Western Australia. Sylvia grew up on a farming property and helped her parents clear the native bush from their farm for wool production during the 1960s and '70s. In 1995, her parents established a large blue gum plantation in response to the emerging commercial prospects in the region. She has also been a participant in a Master Tree Grower's course.

Digby Race is Lecturer and Research Fellow (Community & Farm Forestry) at ANU Forestry – the Australian National University and a member of the Cooperative Research Centre for Sustainable Production Forestry. His PhD was, and current research focus is, on analysing the socio-economic outcomes of farm forestry development for regional Australia, and exploring the social dimension of community-based forestry internationally. Digby has several research contracts analysing the socio-economic contributions of farm forestry to community development. In his capacity as Senior Consultant, he is contracted to evaluate the community benefits of national environment and forestry programs.

Gary Sexton is a Farm Forestry Research Officer, North Queensland Afforestation Association Inc., based in Cairns, Queensland. Gary coordinated the CRRP from 1994 and continues to work on the Program in his current position providing silvicultural information on farm forestry in the tropics. He has a strong belief in the concept of small owner-growers concentrating on high value, mixed species plantings using a range of native and exotic species.

Sue Vize was the Manager of the North Queensland Afforestation Association Inc., based in Cairns, Queensland. Sue has a Bachelor of Forest Science from the University of Melbourne and completed a PhD in Community Forestry working with village communities in Fiji. She has a strong interest in the social and community aspects of farm forestry and natural resource management projects.

Section 1: Overview

Bridging the commercial and ecological divide

The loss of native biodiversity is one of the most pressing issues facing Australia – affecting both urban and rural people alike (State of the Environment Advisory Council 1996). At the same time, the commercial forestry sector is expanding at an unprecendented rate, with an average of 85,000 hectares of plantations being established each year during 1995-2000. Of this plantation area, it is estimated that between 5-20% is being established as farm forestry (4,000-17,000 ha/year) (Wood *et al.* 2001). To date, commercial forestry and biodiversity conservation have largely been treated as separate agendas.

Given the loss of native biodiversity and the need for more trees on farmland, many are asking whether we can bridge these two phenomena for mutual benefit. This issue – combining commercial forestry and biodiversity conservation – is of great interest to a range of research scientists, ecologists, foresters, policy makers, project managers and growers/farmers throughout Australia (eg. Land and Water Australia's new publication *Thinking Bush*, July 2002).

About this publication

This publication his arisen from an 18-month project funded by the Commonwealth's Natural Heritage Trust through Environment Australia's Bushcare Program during 2001-'02. The project brought together are range of research scientists, extension officers, extension officers, project officers and others interested in exploring how forestry can combine commercial and biodiversity goals – a 'win win' situation for forest growers and the environment. Many landholders and forest growers around Australia are already making forestry achieve this 'win win' goal.

This publication has profiled 8 of these landholders and growers, so we can learn from their experiences and the latest research on native biodiversity. We felt it important to have the experiences of the 8 case studies told with, and by, extension officers who work closely with the landholders and growers. These extension officers all have many years of experience about how best to create forestry that provides a 'win win' outcome in the local context, and combine diverse backgrounds (see 'Biographies of authors').

Guidelines for increasing native biodiversity

There is a growing pool of research about how to make plantations, farm forests and farm landscapes more sympathetic to native biodiversity, much of this recently reviewed by Salt *et al.* (2003) – so it wasn't the purpose of this publication to review this information in detail.

For instance, David Lindenmayer (ANU CRES) has developed guidelines for biodiversity conservation in new and existing softwood plantations, based on research conducted at Tumut in southern New South Wales (Lindenmayer 2000). Andrew Bennett (Deakin Uni) and Stephen Platt (DNRE) have developed guidelines for vegetation planning at the farm and landscape levels to support the needs of wildlife (Bennett *et al.* 2000; Platt 2002). Also, Bill New and Martyn England (PIRSA) have drawn on South Australian experiences to develop guidelines for increasing the biodiversity value of farm forestry plantings (New & England 2002).

There is also a growing number of environmental management systems (EMS) for agriculture, as a means of benchmarking farming against a range of 'best practice' criteria. Some of the emerging EMS are designed as self-assessment tools for farmers, such as that compiled by Geoff McFarlane and Kathryn Trewick in Victoria (McFarlane & Trewick 2002).

David Salt (ANU CRES), Richard Hobbs (Murdoch) and David Lindenmayer (ANU CRES) have recently summarised a large body of research and identified the main elements of vegetation that determine its value for native biodiversity, which includes:

- location (eg. adjacency, connectivity, landscape context, protection of waterways);
- configuration (eg. size & shape of plantings);
- species composition (eg. species diversity, local species);
- physical complexity (eg. structure, time & age, patchiness); and
- ecological management (eg. stimulating natural processes).

Analysing the benefits and trade-offs

This publication also brings together information generated at the project's national workshop – which developed an analytical framework to assist people understand the opportunities and trade-offs when mixing commercial forestry and native biodiversity at the paddock level.

There are few comprehensive frameworks or tools to help people analyse the trade-offs and opportunities when combining commercial forestry with biodiversity enhancement, at the paddock or property scale. A national workshop – *Farm Forestry: Linking biodiversity to business solutions*, held in September 2002 in Beechworth, Victoria, brought together 40 people with a range of expertise to develop a tool to help design forestry that brings commercial and biodiversity benefits (workshop participants listed in Appendix 1). The framework developed at the workshop is presented and discussed in Section 4.

Section 2: Learning from the case studies

Understanding the context

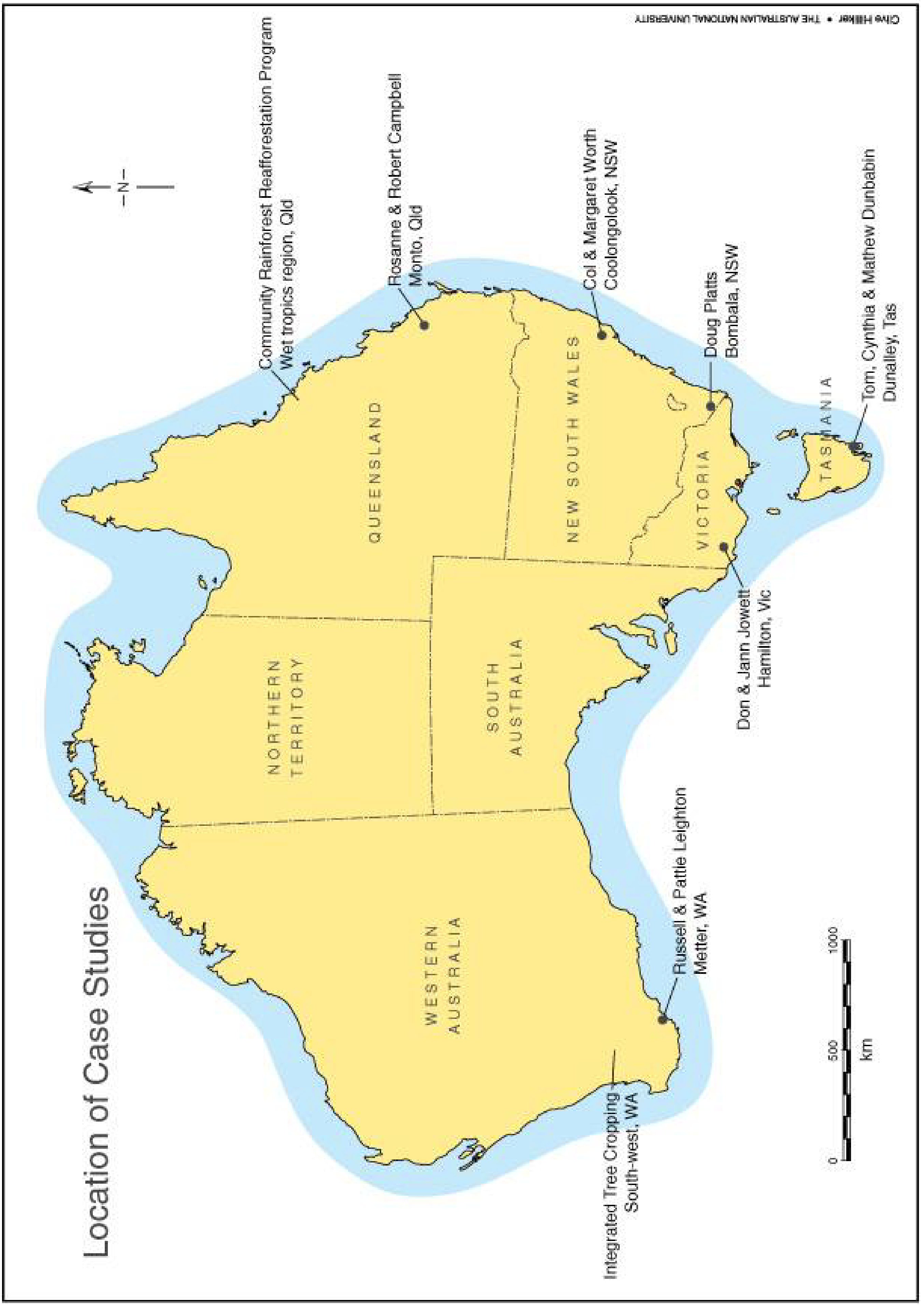
Farm forestry can be defined in many ways, however we have adopted a broad definition as the management of trees and shrubs integrated with agricultural systems designed for multiple products and benefits. Many landholders and other growers develop forestry to meet a wide range of objectives, with determining 'success' forestry often equally varied (Guijt & Race 1998). It is common for landholders to pursue forestry for production and native biodiversity, yet at first glance some people would think these two goals to be mutually exclusive. However, on closer analysis it appears that many forest growers are able to use forestry to achieve commercial and conservation outcomes.

The case studies in this publication illustrate that much of the practical wisdom attained by the forest growers over a number of years is now supported by recent science – highlighting the need for landholders and scientists to continue to inform each other. However, there are still many unanswered questions about how we translate general principles and experiences from outside our local context to a specific situation. In this context, this publication hopes to add to the ongoing discussion about how we can make forestry achieve commercial and biodiversity goals.

In making the selection of case studies, we aimed to include a diverse mix of forest types and management, biodiversity values, ownership contexts, locations – as well as the landholder or forest grower having:

- an appreciation of the concepts and practicalities of integrating biodiversity and production farm forestry within a farm/land management setting;
- a genuine willingness for, and experience of, integrating biodiversity and production values, through farm forestry;
- made an assessment (anecdotal and/or scientific) of the biodiversity and production benefits and trade-offs associated with their approach to farm forestry; and
- a willingness to share their story and ideas in a public domain.

The map on the following page illustrates the general location of the case studies profiled in this publication.


Location of Case Studies
N
Community Rainforest Reafforestation Program
Wet tropics region, Qld
Rosanne & Robert Campbell
Monto, Qld
Col & Margaret Worth
Coolongolook, NSW
Doug Platts
Bombala, NSW
Tom, Cynthia & Mathew Dunbabin
Dunalley, Tas
Don & Jann Jowett
Hamilton, Vic
Russell & Pattie Leighton
Metter, WA
Integrated Tree Cropping
South-west, WA
QUEENSLAND
NORTHERN TERRITORY
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA
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Clive Hilliker • THE AUSTRALIAN NATIONAL UNIVERSITY

Case Study 1:

Col & Margaret Worth
'Iona Park'
Coolongolook, NSW.

By Richard Finlay-Jones

Introduction

Col and Margaret Worth's property *Iona Park* has been in the family for over three generations. Col's father was a bullock driver, while his brother was a sleeper cutter who earned his living from the 'broadaxe' and the forest, the property is now predominantly cleared for grazing. Col has first hand experience of the problems caused by overclearing and overgrazing. Col's interest in farm forestry stems from his love of the appearance of trees in the landscape and the benefits that they bring to their farm enterprise and way of life.

Iona Park is approximately 200 hectares (ha) and located near Coolongolook on the mid-north coast of New South Wales, 1.5 hours travelling time north of Newcastle. Col is a retired headmaster from Newcastle who now resides in the coastal town of Tuncurry in the Great Lakes Shire.

Over clearing and continuous grazing: Perspectives from the birds

Woodland birds are disappearing. Many species of robins, thornbills, warblers and honeyeaters are no longer found in regions that have been more than 70% cleared. What remains are isolated clumps of trees paddock trees, dry forests on stony ridges and a few strips of roadside woodlands. This remnant vegetation suffers from continuous grazing that wipes out any regenerating trees and shrubs. The millions of paddock trees are getting old and suffer from persistent insect attack. The habitat values of remnant vegetation are declining, threatening the viability of a wide range of native animals including at least 20 species of small insectivorous birds.

Further reading: Ford *et al.* (2001).

Their farming context

Biodiversity to Col is about encouraging many different types of trees to grow and flourish, and provide habitat for other plants and animals. Farm forestry to Col is about providing his property and lifestyle with many different types of benefits including commercial, environmental and social outcomes. The Worth family own and operate *Iona Park* for yearling cattle production destined for the European Union market, along with over 12 ha of farm forestry. The farm is owned and managed by the family with little other external labour, and returns a modest income which justifies their investment to maintain production and improve the appearance and values of the property.

Col's family, while living and working in Sydney for employment reasons, provide assistance with pruning and other farm forestry activities. They will ultimately benefit from the income from timber production on the farm forestry block – the major farm forestry block was established in 1997 as a production woodlot and species trial.

Approach to farm forestry

Col's approach to farm forestry is to develop blocks and rows of trees. Col plants about 300-400 trees every 18 months or so, in clusters. The main block of trees is a complete paddock that allows for simple management, whilst the other planted areas are fenceline or windbreak designs. The rationale behind this approach is establishment of tree clusters instead of sole trees. The evidence of dieback on the property in the older native and paddock trees is apparent. Where trees have been isolated, the effects of dieback are more obvious than where clusters of trees have been retained for shade and shelter.

The environmental benefits of Col's approach to farm forestry are obvious from the moment one enters the main 12 hectare plantation block. Col has utilized over 12 species of north coast NSW hardwoods on this particular paddock, primarily to take advantage of the diversity of high value north coast NSW hardwoods, but also in an attempt to simulate the species of trees that may have existed. To increase the commercial potential of the block, Col has incorporated a number of exotic species such as Gympie messmate (*Eucalyptus cloeziana*), which has had some success in plantations in south-east Queensland.

As part of the management system, Col has pruned all of the trees, primarily to reduce the risk of fire, but also to enhance the potential long-term value of the timber. As a consequence of the reduced canopy, the pasture that has been retained in the inter-rows remains for valuable feed for the livestock. Col has invested the land, establishment costs, fencing, trees and his occasional labour since 1995. The timber value might be conservatively estimated at approximately $25/m^3$ for low value timber, so with a harvest of 100 tonnes/ha an average return could be $2,500/ha or $50,000 gross income for 20 ha. High end returns may see values up to $100/m^3$ for up to 10% of the timber, resulting in an improved gross return of up to $10,000.

Note that these figures are estimates based upon current timber values and conservative growth rates of about 10 m^3/ha/year. Since the timber values are not critical to the success of the farm forestry project, these financial estimates have not been estimated using typical plantation management regimes.

Figure 1: Col Worth with his tallowood windbreak, planted in 1995

The Benefits

Environmental benefits

The obvious direct environmental benefits achieved through the network of trees planted for farm forestry are the reduction of soil erosion problems, particularly tunnel erosion, and the increase in bird and fauna populations.

A further benefit to the environment is that the local Council (Great Lakes Shire) has, as a result of the establishment of this plantation, changed its policy from one requiring a fee and Development Application for farm plantings (even a small area of planting) to one where farm plantings are exempt from such requirements. Thus, further farm plantings are encouraged.

Many of the soils in the region are prone to tunnel erosion due to the dispersible subsoils that exist. The establishment of trees on susceptible slopes seems to have contained the tunnel erosion through deep root penetration and stabilization.

Col has noticed that the variety and frequency of bird and fauna visits has increased with the age of the plantation. Col now has visits from crimson rosellas, galahs, cuckoos as well as kangaroos and wallabies that now camp in the plantation area, probably due to its protection and shelter benefits.

Col also feels that the trees that he has established have improved the appearance and the feel of the property.

Habitat values change with woodlot age

Woodlots planted with a diversity of native eucalypts and wattles provide habitat for an amazing diversity of Australian birds. Superb Fairy Wrens and Yellow-rumped Thornbills are the first to colonise young plantings. As woodlots grow, more structure (layers of vegetation) is produced providing habitat for a greater diversity of birds including canopy feeders such as Striated Pardalotes that feed on lerps (sap-sucking bugs on leaves). The habitat values of planting will continues to change for hundreds of years, because it takes that long for a healthy tree to grow old enough to provide tree hollows.

Further reading: Taws (2001).

Financial Benefits

It provides an obvious sense of satisfaction to Col to know that the trees are growing and benefiting the potential real estate value of the property, despite the fact that it may never be sold.

Perhaps the most important commercial benefit to Col is the ability of the plantation block to provide winter feed to the cattle, without any reduction in the property's carrying capacity. Col now has a guaranteed supply of sheltered winter pasture in the plantation block for the younger stock. With mainly summer growing pastures which are subject to frost damage in the region, such a source of sheltered nutritious winter feed is of great value. This is particularly so this year, where late rainfall has left many properties with a shortage of winter feed and has resulted in depressed cattle prices.

The trees in the plantation provide a sheltered winter paddock where frost and wind has difficulty penetrating, while sunlight can still strike the inter-row areas, since Col has embarked on a rigorous annual pruning program.

The first farm forestry plantings established on the property were designed to increase shelter from strong westerly winds in winter. Col established tallowood (*E. microcorys*) as his species of first choice due to its attractive appearance and high quality timber. Tallowood is one of the highest value decking timber available in the region fetching prices of over \$100/m^3 for sawn clearwood product.

In the cleared areas of the property, pasture weeds such as fireweed, carpet grass and giant parramatta grass are a potential problem. The establishment of trees appears to have greatly reduced the risk of weed penetration.

The farm forestry plantings on *Iona Park* while providing on-ground benefits, are also expected to provide Col's family with a long term and sustainable timber production value. Within the plantation Col has included a range of high value timbers including rosewood (*Dysoxylum fraseranum)*, red cedar (*Toona ciliata*), red mahogany (*E. resinifera*) and white mahogany (*E. acmenoides*).

Costs

Initial establishment costs were in the order of \$2,000/ha. Ongoing costs are difficult to estimate due to Col's labour being uncosted, however he spends about 2 weeks a year planting and pruning. Col prunes all trees once per year to reduce fire risk and increase clearwood production.

Some lessons

Col has learned a number of lessons from tree planting and management on *Iona Park*. These include scale, weed control, establishment techniques and goals. Col's motto is "… *only plant what can be managed, and start small and learn gradually. It is better to manage a few trees very well, rather than many trees poorly*."

Keyline ripping (3 degrees off slope) is a more successful technique on erodible soils than contour ripping. Shallow ripping (compared to deep ripping) may be preferable for duplex soils with a clay pan, as clay brought to the surface can be detrimental in affecting an aerated and friable root bed.

However, more research is required into pest and disease control mechanisms. Col's trees have experienced a variety of attacks such as tip moth in cedar (*Toona* spp), black soot and borer in tallowood (*E. microcorys*), and Christmas beetle in flooded gum (*E. grandis*).

Conclusion

To Col Worth, his approach to farm forestry successfully integrates biodiversity and commercial outcomes. Col is of the belief that if he does not continue to establish strategic farm forestry plantings, his property will suffer the ill effects of weed competition, land degradation and reduced effectiveness of stock management.

Col is a strong advocate for farm forestry and regularly conducts field days and workshops on his property for local landholders and field researchers.

Case study 2:

Rosanne & Robert Campbell

'Goondicum Pastoral Co.'

Monto, Queensland.

By Ian Hanson

Introduction

The Campbells of the 'Goondicum Pastoral Company' have a simple reason for managing and selectively harvesting their native forest. According to Rosanne Campbell: *"In bad years, if we didn't have timber we wouldn't be here. It's a commercially important proposition to manage our timber so that we can periodically harvest it"*. The Campbells have engaged in native forest management since the mid-1950s. This management has taken the form of forest establishment, thinning and selective harvesting, both to increase the productive capacity of their pastures and to provide for a range of forest products.

Their property

Goondicum is situated 30 km due east of Monto, and has an average annual rainfall of 680 mm. It straddles the boundary between the bioregions of the Brigalow Belt and Southeast Queensland, and consists of 7,000 ha of freehold and leasehold property. Cattle grazing and timber production are the main agricultural enterprises. The Campbells run on average 1,500 head of cattle (Brahman cross and Belmont Red cross), and manage 5,600 ha of native forest. With a large proportion of the property being mapped as remnant, much of the Campbells' forests are subject to the provisions of the *Vegetation Management Act 1999*[1]. Approximately 20% of the Campbells' income is derived from native forest timber production.

Goondicum was taken up as a pastoral holding lease in 1860 by early members of the Campbell family, and freeholded in 1975 (Rosanne has revised this date. It is now 1971). Two hundred and fifty ha of the original lease are still held as a special lease. Rosanne Campbell arrived from the Gin Gin/ Mount Perry area (Moolboolaman Station) in 1957, and currently manages the property with her son Robert.

According to Roseanne Campbell, the majority of *Goondicum* was ring barked in the 1920s and 1930s, in line with conditions specified under the pastoral lease. One section, however, supporting narrow-leaved red ironbark (*Eucalyptus crebra*) and yellow stringybark (*E. acmenoides*) was purposely set aside as source of fencing material for on-farm use (this area is now covered by the special lease). Rosanne recalls that some of the ring barked trees – remnants of the original native forest, were still standing when she arrived on Goondicum in 1957. The size, form and quality of these dead trees suggested that the original forest had been relatively healthy and productive.

[1] A tree clearing application would be required for any proposed clearing of remnant native forest on Goondicum. An application is not required for harvesting operations in remnant native forest where they comply with the 'forest practices' provisions of the *Vegetation Management Act 1999*.

By the mid-1950s *Goondicum* supported little native forest. The Campbells investigated how they could increase the environmental health of their property and maintain or increase its economic viability. They looked at the potential role native forests could play in helping achieve these two broad objectives. Both Rosanne and her husband were familiar with the writings of Richard St Barbe Baker[2], and applied some of his theories to their own property.

The Campbells made the decision in the 1950s to return areas of their property to native forest. They believed that the property could support a productive native forest, and that this forest could make a substantial contribution to the commercial and environmental well being of the property.

Since 1957, the Campbells have strived to retain as much tree cover as possible while chemically treating selected areas for cattle grazing and timber production. Most of *Goondicum*'s existing forested areas have been treated and/or logged since the 1960s.

The treatment gangs that periodically re-treat Goondicums main cattle grazing areas have always been instructed to leave commercial timber and shade trees. The Campbells are conscious of retaining a diversity of tree species in their forested areas. Non-commercial species are appreciated for their contribution to animal and pasture health and biodiversity, and are retained for shade, shelter and habitat.

Fire is also used as a thinning tool. Low intensity fires are put through the property every second year (usually between August and January, depending on the season). Usually the tallest and healthiest individuals survive controlled burns in the first four to five years of age, after which time most of the trees are resistant to low intensity fire.

The forest

The soils of the Goondicum Crater and surrounds support uneven aged, mixed species eucalypt forests. These forests contain a range of forest communities:

- Forest red gum (*Eucalyptus tereticornis*) and Moreton Bay ash (*Corymbia tessellaris*) on alluvial soils;
- River sheoak (*Casuarina cunninghamiana*), black tea tree (*Melaleuca bracteata*) and weeping bottlebrush (*Callistemon viminalis*) on streamside sands, clays and gravels;
- Gum-topped box (*Eucalyptus moluccana*), gum-topped bloodwood (*Corymbia erythrophloia*) and rough-barked apple *(Angophora floribunda)* on the margins of the alluvial soils and lower slopes (on reddish brown, loamy-clay soils);
- Narrow-leaved red ironbark (*Eucalyptus crebra*), yellow stringybark (*E. acmenoides*) and silver-leaved red ironbark (*E. melanophloia*) on the upper slopes (volcanic soils);
- Some semi-evergreen vine thickets; and
- Narrow-leaved red ironbark and spotted gum (*Corymbia variegata*) on the surrounding hills and ranges (on thin, relatively infertile soils). According to Robert Campbell, spotted gum is the best commercial performer in terms of growth rate.

The nature of their farm forestry enterprises

Experience has given Robert the skills necessary for species identification, volume estimation and product assessment. An appraisal of tree health and tree diameter (the circular reach of his arms, equating to approximately 45-cm diameter at breast height, DBH) is used when deciding

[2] Richard St Barbe Baker, founder of The Men of the Trees, advocated vegetation retention and strategic revegetation.

whether to retain or remove trees during selective harvesting operations. Degraded trees with diameters less than the circular reach of Robert's arms are removed. Healthy trees that look like they may produce more valuable products in the future are retained.

Thinning: Improving timber & habitat values

Thinning of regrowth or plantings can have significant benefits to wildlife as well as improve timber values. Thinning opens up the canopy, allowing understorey grasses and shrubs to flourish. A 'messy' understorey of fallen thinnings, tussock grasses and a low growing wattles is quality habitat for many ground feeding birds like the Speckled Warbler. Thining can improve "habitat complexity" which is important for native mammals and birds. A messy understorey also traps leaf litter and fine soil particles that can otherwise be washed away during a summer down pour of rain.

Further reading: Bennett *et al*. (2000).

The timing and location of harvesting operations is dictated by the flow of cash from other enterprises (cattle) and the logistics of the operations in question. If cattle prices are low, forest products are harvested in order to supplement the Campbells income. If Robert is operating in a particular area, for example, if he is fencing, he will harvest some timber if he does not think he will be in that area again.

The Campbells operate on a flexible 15-year logging cycle. Areas are selectively logged, encouraged to regenerate and only revisited after 15 years. Most of the property has been selectively logged over the last 40 years.

In the past, the Campbells have negotiated Stanton-type agreements with local sawmill representatives before commencing each operation. A Stanton-type agreement is a standard legal document that may contain provisions specific to the property and the proposed harvesting operation. The Campbells included timing of operations, descriptions of the work area boundaries, and diameter limits for sawlogs. These diameter limits were greater than 50 cm DBH for an operation undertaken in 1978, and greater than 45-cm DBH for an operation in 1985. Under these agreements, contractors were confined to specific areas and could only move into new harvest areas when the Campbells had checked their work and were satisfied with the condition of the remaining forest. In 1991 a sleeper cutter commenced work and cut 70,000 sleepers over the following seven years.

In 1994-95, 300 m^3 of sawlogs (forest red gum, narrow-leaved red ironbark and gum-topped box) were harvested and sold to a local sawmill. Robert undertook all aspects of the harvesting operation, including falling, sectioning, snigging, loading and haulage to mill, because the returns for the delivered timber far exceeded the returns for the standing timber. In addition, Robert wanted to control as many aspects of the operation as possible. For example, he had more control over the placement of access roads and snig tracks and he believed that he could cut more timber from the harvest area than would have been the case had contractors been employed. He had the equipment to undertake the entire operation himself (a D5 bulldozer for snigging, an 85 hp tractor for loading and a truck for hauling).

In early 2000, another 300 m^3 of sawlogs and sleeper/landscape logs were selectively harvested from an area of 40 ha. Once again, Robert undertook the entire operation. The most recent harvesting operation occurred in June 2000. This was a selective harvesting operation designed to thin the forest and salvage deteriorating timber. Sleeper logs and sawlogs were harvested by

Robert and sold to a sleeper mill near Monto. The operation ran over a period of three weeks and the stand was left to regenerate. In the types of forest found on Goondicum, merely opening up the stand can result in regeneration through stimulation of lignotuberous growth.

In addition to timber harvesting, the Campbells occasionally undertake thinning (chemical treatment) operations in their forest red gum and spotted gum stands. Robert believes it is very important to thin spotted gum to reduce competition for moisture and nutrients, particularly during periods of drought. This improves both tree growth and pasture production. They intend to continue managing timber into the future, and are aiming to ensure that there is always some timber of commercial size left somewhere on the property. This will be used to supplement their income from cattle. They do not intend cutting any timber if the income isn't required.

Markets and returns

Current markets for the Campbell's timber are located in Monto (approximately 60 km by road). They negotiate and plan harvesting operations by first contacting local sawmills and enquiring as to the products and species currently in demand by those sawmills. Timber harvesting and sale only occurs if the time suits, and if the cattle side of *Goondicum*'s operations permit. The size of each harvesting operation depends on the size of the order, where the Campbells' equipment is, and how the operation fits in with *Goondicum*'s other enterprises. The Campbells then decide if they have the volume and products sought after by the mill, negotiate a price with the mill for delivered products, and then proceed with the harvesting operations. Alternatively, local sawmills contact Robert regarding orders. Robert aims for the highest value product. For example, he doesn't specifically harvest landscape materials. He gets these out of the timber remaining from cutting higher value products.

Figure 2: Loading logs from one of the harvests

One of the reasons Robert undertakes most of the harvesting himself is because the economics make sense. The Campbells can receive $50/m^3 for sawlogs if they employ a contractor to undertake the entire harvesting operation. They can receive $78/m^3 if they undertake felling, sectioning and snigging to a log landing. According to Robert, the costs to them of carrying out this extra work are considerably less than $28/m^3. The Campbells can receive up to $98/m^3 if sawlogs are felled, sectioned, snigged, loaded and hauled to the sawmill.

The June 2000 harvesting operation was unique in that the Campbells entered into an agreement with a sleeper mill in Monto whereby they received part payment for the sawn timber produced. These payments amounted to approximately $110/m^3 for the sawn timber. The Campbells undertook the entire harvesting operation (falling, sectioning, snigging, loading and haulage). Instead of receiving payment from the sawmill for the delivered sawlogs, the sawmill deferred payment until they had sold the sawn timber and then paid an amount equating to one half of their monies received for the sawn timber.

Environmental and sustainability considerations

The importance of native forest to the Campbell enterprise extends beyond the direct commercial benefits of harvesting and selling timber. Indirect benefits are also recognised, in terms of the role forests play in protecting soils and maintaining healthy pastures. On the property's western slopes, increased pasture production is evident for the first five to seven years after broadscale clearing, but this initial surge is followed by a rapid decline. According to Robert "… *you definitely get more grass if you leave some trees because of reduced heat stress*".

> ***Trees support valuable pasture***
>
> Trees don't necessarily suppress pasture growth. It depends on the number of trees. A study near Gunnedah, NSW found that the pasture output was at its highest level when the proportion of tree cover across a farm was 34%. This moderate level of tree cover enhanced pasture production because trees cut down on wind driven evaporation and some highly productive and palatable grasses grow better in the cooler and more fertile soil under an open canopy of eucalypts.
>
> *Further reading:* Walpole (1999).

The Campbells keep their gully and stream banks vegetated and maintain wildlife corridors that extend across their property. They try to leave at least 25% of their timber standing when chemically treating and they endeavour to leave hollow bearing trees and a range of age classes in their harvested forests. These age classes support the sustainability of their operations in terms of supplying timber for future use. Trees are felled away from watercourses to minimize erosion and reduce mustering problems and are also felled away from young trees to reduce the risk of damaging future crops. Steep gullies are not harvested. Buffer strips 20-30 m in width are kept around breakaway gullies. If necessary, snig tracks are sown with grasses to minimize erosion, as are log landings that are ripped before sowing.

The Queensland pebble-mound mouse (*Pseudomys patrius*) and three known colonies of brush-tailed rock wallabies (*Petrogale penicillata*) are known to exist on the property. The Campbells have made a conscious decision not to disturb the habitat of these species, and as a result, some country has been set aside for the habitat of these animals. The Campbells are participants in the Queensland Land for Wildlife Program and Rosanne is a member of the Monto branch of the Australian Forest Growers.

Case study 3:

Russell & Pattie Leighton

Mettler, Western Australia

By Sylvia Leighton

Introduction

Russell and Pattie Leighton own a 1,214 ha property in south-west Western Australia, which they purchased in 1962 on the condition that they cleared the property of its bush for conventional agriculture. Clearing of the mallee heathland (containing 14 species of eucalypt) occurred between 1965 and 1980 for pasture establishment to graze sheep for wool production. By the mid-1980s, remnant bush covered just 11% (135 ha) of the property. It was at this time that the concepts of Landcare were being promoted, which included encouraging landholders to protect soils from wind erosion. In response, Russell and Pattie fenced off all the remaining native vegetation and planted shelterbelts in highly exposed areas.

Their property is located at Mettler, a small farming district four kilometres from the coast and about 100 kilometres north-east of Albany. The annual rainfall is about 600mm, with 30% of that falling between November and March (Crossing *et al*. 2001). The district is predominantly agricultural land with a significant area of nature reserve and privately owned remnant vegetation. The majority of clearing of the bush in the Mettler district was carried out around 1970.

Figure 3: Overview of the Leightons' property (highlighted)

Farm forestry activity

In the early-1990s with the economic down turn in the wool industry, Pattie and Russell were looking for new farming options. The opportunity became available to lease parts of the property to the Albany Plantation Forest Company (APFC) to plant bluegums for paper production. Between 1994 and 2000, 806 ha of the property were planted to bluegums at a planting density of 1,200 trees per hectare.

In 1996 and 2000, the Leightons negotiated with APFC to allow the contractors preparing the plantation site to prepare additional areas for some biodiversity plantings (at the Leighton's expense). The Leightons have established about 20 ha of interconnecting wildlife corridors adjacent to the bluegum plantations, also linking with some of the remnant vegetation. They estimate it cost about $3,000 to establish the 20 ha.

Connectivity: Not just shelterbelts

The effects of habitat isolation can also be reduced by woodlot 'stepping stones', particularly for woodland birds. Various studies by CSIRO have shown that some birds rarely occupy patches of woodland more than about 1 km from other patches of woodland at least 10 ha in size. Unbroken connections created by shelterbelts, roadside woodlands and riparian vegetation would be great, but aren't essential for mobile species like birds as long as the hop from one wooded patch to another is not too great. In heavily cleared country, woodlots in sizeable blocks (eg. 10 ha) may be more useful and cost effective than kilometres of shelterbelts connecting the few distant patches of woodland and forest.

Further reading: Watson *et al*. (2001); Freudenberger (2001); Freudenberger and Stol (2002).

Benefits

The agroforestry diversification on Pattie and Russell's property has provided economic, landcare and social benefits – satisfying the three-pointed triangle coined 'eco-health.'

Economically the plantation trees provide an improved income for the Leightons, shielding them from the low returns in the wool industry. Most of the hidden costs of farming are removed, but so of course are the occasional bonanzas too. The plantation industry has also provided job opportunities for local community members to fulfil some of the site preparation under contract.

Aside from the immediate 'on farm' landcare benefits of reduced wind erosion and a reduction of recharge into the rising watertable, the growth of the plantation industry in the Mettler district has brought in new ideas associated with plantation research and landscape surveying. This information has provided the local community with more knowledge on the physical components and functions of their landscape than they had previously.

The change across much of the property from open pasture to a forest canopy has also encouraged large native mammals, like kangaroos, and larger birds, like, currawongs, magpies and the ground foraging bronzewing pigeons, to slowly move back into the area. Smaller birds like golden whistlers, thornbills, fly catchers have been observed on the edges of the plantation.

Bringing back the birds

Woodlots and shelter belts planted down to a diversity of native plants can bring back an amazing number and variety of birds. Surveys by Greening Australia and the Canberra Ornithologists Group in 100 replanted sites on the Southern Tablelands recorded more than 9,500 individual birds made up of 103 species. Of the 20 most frequently recorded birds, many of them were small insectivorous birds like wrens and thornbills that help reduce insect pests that can damage trees. Even regionally threatened birds like the Brown Treecreeper, Speckled Warbler and the Hooded Robin were found in these fairly young plantings. A similar return of birds have been recorded at 'Lanark', a grazing and agroforestry property in Victoria's Western District.

Further reading: Taws (2002); O'Neill (1999).

There is also a large variety of fungi growing on the plantation floor which may attract other fauna species.

More than just mushrooms

Ever noticed the toadstools, truffles and puff balls that spring up under trees after a wet season? Surveys in just 35 patches of woodland in southern NSW found over 133 species of fungi over just two seasons of surveying – many of these were new to science. These fungi are the fruits of key species keeping trees growing and healthy. Most of a mushroom or truffle is under the ground most of the time. They are fine white filaments that help break down dead plant material and recycle nutrients. Some of these species also form close associations with tree roots. The tree provides sugars, in return the fungi scavenges soil minerals for the tree. These fungi effectively increase the trees roots thousands of times over.

Many different kinds of bacteria are also found in the soil. Some of these are key partners with native legumes such as wattles. The bacteria capture the abundant nitrogen in air and convert it to a form that the plant can use to build the proteins in their plant tissues. Some of these bacteria may be missing in replanted sites. Research by CSIRO have identified strains of these nitrogen fixing bacteria that allow wattles to grow up to 10 times faster. CSIRO is currently conducting field trials with Greening Australia to innoculate these bacteria into long cultivated paddocks being planted to shelter belts and woodlots.

Further reading: Freudenberger and Stol (2002); Thrall *et al*. (2000).

The social benefits from plantation forestry of this type have included the opportunity for Pattie and Russell to remain on their property even though semi-retired from farming. They also have a close involvement and interest in the plantation, as they have a share in the financial returns at harvest.

For other properties nearby which were purchased by plantation companies, the new 'homestead' legislation allows the farm house and a small surrounding area of the farm to be subdivided, retaining people on plantation properties.

The introduction of agroforestry onto the Leighton property has also attracted interest and support from other Landcare agencies wanting to install trial plots of alternative plant species; a 2 ha plantation of a tall local eucalypt called the flat topped yate (*Eucalyptus occidentalis*) established by APFL, maritime pine *(Pinus pinaster*) on the sandune areas with CALM, Sandalwood *(Santalum spicatum)* through Green Skills and Baxter's Banksia (*Banksia baxteri*) as a local NHT community project to revegetate the sand dune areas (Leighton 1999).

Concerns

Loss of groundwater

The major concern on the Leighton property relates to the dramatic change in water usage – from almost 30 years of low water usage by annual pasture to much higher water usage by the large area of bluegum plantation. Groundwater levels in the Mettler area are measured by the Department of Agriculture, and using the HARTT (Hydrograph Analysis using Rainfall and Time Trends) method show an average rate of rise by groundwater under pasture of 0.10 metre per year. Groundwater levels under bluegums are dropping at rates between 0.11 and 0.33 m/year (Crossing *et al*. 2001).

Examination of moisture levels down the soil profile under native vegetation and pasture appear to be similar. Although, under the native vegetation the top 2 to 3 m are drier indicating that native vegetation mostly utilises recent rainfall and surface moisture. Moisture levels under the blue gums were significantly lower although they varied depending on the soil profile characteristics, tree density and the age of the trees. Blue gums do not utilise large amounts of soil moisture up to the 3 years of age. However, by the time the trees are 5 years old, the roots on healthy trees have grown extensively and can be drawing moisture from a depth of at least 12 m, with just 5 to 20% moisture remaining in the profile above 10 m (Crossing *et al*. 2001).

Another study examining the key biophysical relationships that underpin bluegum growth in a dry climate indicated that approximately 40% of the water used by 5-year old bluegums on the Leightons' property was from long-term water storage (ie. water accumulated during the years prior to tree establishment). The trees peaked in mean annual increment (MAI) at the age of 5 years, with growth rates slowing as water stress gradually increases (White *et al* 2002).

Blue gum roots are growing down to a depth in the soil where the roots of natives plants species rarely penetrated. The long-term effects of drying out the soil profile under blue gum plantations is unknown. It is not known what period of time would be required to replenish soil moisture levels to enable the site to be rehabilitated with native plant species.

Use of pesticides

Another major concern is the impact of the pesticide spraying of the blue gums on the surrounding biodiversity. Two aerial sprays were undertaken by the plantation company on the blue gums to overcome the leaf tier (*Phlactaeophaga froggatti)* attacks. The two pesticides used can kill all invertebrates and are highly toxic to fish and aquatic crustaceans. Low toxicity has also been detected in birds. Animals, particularly invertebrates, play an important role in ecosystem functioning, so much so that they are regarded by some as the 'drivers' of ecosystems, where as most of the vertebrates can be considered as 'passengers' (Majer & Recher 1999).

Researchers from CSIRO Sustainable Ecosystems and Murdoch University, explored the value of blue gum plantations in terms of biodiversity conservation during 1999-2000. The project measured some of the biota found in remnant vegetation, blue gum plantations and open pasture, particularly focussing on the abundance of harmful and beneficial insects. One trend which was apparent from initial results was that the species found in the plantations were often different from those found in the remnant vegetation, indicating that the plantations provide different habitat conditions. It was also apparent that there was lower diversity but greater abundance of insects in the plantations than in the remnant vegetation (CSIRO & Murdoch University 2001).

The leaf litter produced under a eucalypt plantation also differs substantially from that of the native bushland – both in its physical structure and chemistry, posing a range of problems for the native decomposer fauna. If microarthropod diversity is reduced, nutrient cycling which contributes to soil fertility could be impeded under eucalypt plantations (Majer & Recher 1999).

Future Developments

The Leightons establish their biodiversity plantings by collecting native seed from the remnant bush, germinating it in a nursery and then planting it out into the ripped and mounded sites. This may not be the most cost efficient way to rehabilitate a site with indigenous plants compared to direct seeding. However, at the time they were establishing the biodiversity plantings, the equipment for direct seeding was not available.

The Leightons' view the bluegum plantation on their property as the first stepping stone towards more sustainable farming systems in their region and hope one day some local plants can be grown commercially. However, Russell has some very strong views on farm forestry:

> "Our soils are too fragile for traditional farming which is akin to mining and is very short-term. Farm forestry in our situation means plantations because that is where the economics are. Agroforestry must be financially rewarding or it cannot take off. A 30-year lead time for sawlog production is just not suitable and means it can only be a part-time interest. The volume is not there and the economics are going backwards. Farming today is about producing more for less. If you don't do that then your days are numbered.
>
> Biodiversity is largely academic in our situation. We have extremely diverse natural bush here and having once got rid of it to plant pasture, we cannot put back quickly what took many thousands of years to evolve. We only have the knowledge and skills to replant some of the species and hopefully over time the other species will come back naturally.
>
> There are some people that would be more attracted to buying this property because of the biodiversity plantings. However due to the economic bottom line and the culture of broadacre farming in this region the ecological features of a property would only be of about 5% of the prospective purchasers perspective."

Case study 4:

Don & Jann Jowett

Hamilton, Victoria

By Rod Bird & Don Jowett

Introduction

Don and Jann Jowett have four properties, of which *Danengate* was bought mid-1987. The farm plan on each property differs according to the primary enterprise. The aim is to establish or regenerate up to 15% of the area of each property with indigenous native forest and up to 20% of each property to be developed for a farm forestry sawlog regime. The farm forestry element will provide buffers and shelter integrated into and across the property for the benefit of the major farm enterprise. It will also add to the biodiversity afforded by the native vegetation.

Danengate and *Helmsden* combined are 150 ha of basaltic country with 680 mm mean annual rainfall. Trees now occupy more than 30% of the farm with a prime lamb enterprise carried out on the balance on pastures that are improved, fertilised and productive (averaging 28 DSE[3]/ha). The other properties have been acquired since then, using proceeds from *Danengate*. *Helmsden*, a property of 56 ha, was purchased in 1999, and is under development as a prime lamb/farm forestry enterprise. The aim is to use lessons learnt on *Danengate* to make each of these properties a more profitable farm business, while linking farm forestry and shelter plantings to improve biodiversity and the sustainability of the enterprises.

Figure 4: Aerial view of one of Don and Jann's properties after several years of planting

[3] Dry Sheep Equivalent (DSE) is a term used to describe the livestock carrying capacity of farmland. The number of DSE equates to the number of adult 'dry' sheep that can be maintained on 1 hectare for 1 year.

Opportunities to grow blue gums under a Forest Property Agreement on a 20-year, 2-crop rotation with the only market-based company situated in western Victoria, has enabled the purchase of *Riverleigh* in 2000, on the Wannon River, where 65% of the property is planted to blue gum (*Eucalyptus globulus*) and on *Nareen*, a property of 360 ha near Casterton, where 66% of the property is planted to blue gums. These properties have native forest systems, creeks and the Wannon River dissecting them; they have been grazed by livestock for over 150 years. Using the blue gum treecrop as the temporary major business enterprise, all stock have been removed from these properties, regeneration of the native forest areas is happening and planting adjacent corridors/buffer strips that will dissect the properties has begun. The commercial enterprise has enabled the properties to be deep-ripped and the deep-rooted perennial treecrop will reduce recharge to groundwater and, hopefully, reduce soil salinity and saline discharge to the streams in the low-lying areas. It is anticipated that the properties will be re-sown to improved pasture which, together with a well established and diverse native forest/agroforestry system and remnants integrated across the properties, will protect watercourses and add to the long-term sustainability of the future farm enterprises.

This case study focuses on the two adjoining farms, *Danengate* and *Helmsden*, in what was an open manna gum-swamp gum woodland, with only 21 of the original trees remaining on *Danengate* and 4 on *Helmsden*.

Farming context

At least 30% of each property is being planted to trees, with 5-10% permanently fenced and regenerated or planted to, where possible, a diverse planting of local indigenous native species. The balance will be planted to species suited to the production of high-quality saw logs for production of feature-grade timbers (if possible). Each property must be socially, environmentally and economically viable from the owner's perspective as documented in this case study.

Size matters: The influence of woodlot size on habitat values

Bigger is generally better. The size of a woodlot matters to wildlife. Many woodland birds are rarely found in small patches of trees that are isolated and that have little understorey. Numerous studies have shown that most small insect feeding birds are rarely found in woodlands and forest patches less than about 10 ha in size. For example, the Eastern Yellow Robin was never found in remnant patches less than about 20 ha during surveys in the Boorowa area of central NSW. The likely importance of the size of remnant vegetation also applies to planted vegetation.

Further reading: Barrett *et al*. (1994); Freudenberger (2001).

Farm forestry is a new opportunity that is likely to provide a significant and sustainable financial return to the farm business in the future, while producing immediate social and environmental returns, and complements the development of a highly productive prime lamb enterprise. *Danengate* has been developed in this context, with potential for increased future returns from timber. At the same time the farm has been transformed into a workplace that is attractive, easy to manage, provides protection for stock and a significant increase in fauna diversity and numbers. By 2000, over 30,000 trees had been planted across the 91 ha at *Danengate*, including a gross return of $51/DSE in 2001-2002 from the prime lamb enterprise.

Helmsden is developing and will be in a positive income stream as of 2002. The developing corridors on this property will link *Danengate* with native vegetation on an adjoining disused railway and localised geographic features.

The farms are managed by Don and Jann, with their children contributing occasional labour, business, design and management skills.

The benefits

Environmental

In 1947, *Danengate* had over 600 remnant eucalypts. In 1987 only 37 remained and by 1993, just 24 were left and the health of these was very poor due to overgrazing by insects, termites, possums and possibly stock. In 2002, 24 still remain, healthy (or as healthy as 200-year-old swamp gums and manna gums can be).

In 1987–1992, pastures required regular spraying for cockchafers and red-legged earthmite. Since 1992, the pasture has not required spraying. In 1989–90, all plantations required spraying for spitfires, leaf blister and looper caterpillars. Since then, trees on *Danengate* have not been sprayed for insects, nor have they required it. Some plantations on *Helmsden* required spraying in 2001 to reduce the effects of leaf-eating insects. Don and Jann have concluded that their revegetation activities have improved the biological control of pest insects on pastures and trees.

On 1 December 1987, an unusual weather event (snow, rain and wind) killed 50,000 sheep in the area surrounding the property. Today, sheep off-shears can be placed into any paddock on Don and Jann's property with safety. In the early 90's, lamb losses were significant in the exposed western areas of the farm, and that precluded the use of these paddocks for lambing. Today, ewes are lambed in all paddocks with few, if any, losses from cold stress.

After winter rainstorms, groundwater leaving the property is clear and clean, while groundwater leaving the neighbours property is cloudy and carries significant silt loads. Protection of degraded watercourses has been achieved by installing troughs in all paddocks. Don considers that all carbon emissions by the family, stock and vehicles are sequestered within the farm. Earthworm numbers are consistently over $400/m^2$, an indication of a healthy soil fauna.

As a result of replanting on *Danengate* and linkages with adjoining remnant vegetation along disused railway lines, volcanic wetlands and across the now treeless plains, there has been an appreciable increase in numbers and diversity of fauna (insects, birds, mammals and others) on the farm. Isolated remnants have been restored to health and natural regeneration is also occurring. *Danengate* is now becoming a vegetatively-linked property, as distinct from the isolated oasis it has been since 1987.

Value of corridors

Agroforesty can reduce the isolation of remnant vegetation caused by nearly two centuries of selective clearing and agricultural intensification. Shelter belts and other strips of trees including stream bank vegetation can assist in the movement of animals and plants from one patch of suitable habitat to the next. Riparian corridors can also improve water quality and reduce streambank erosion. Many organisms need to move to and from breeding and feeding sites, to disperse as juveniles or to recolonise areas that may have lost species due to disturbances such as fire or drought. However, corridors can also cause problems. They may facilitate the spread of unwanted species such as foxes and weeds. Corridors may also act as 'sinks' drawing out dispersing individuals from large remnants, but leading them into unsuitable habitat – corridors to nowhere. Narrow plantings can also be costly. It takes 4 km of new fencing to protect a 10 ha shelterbelt that is only 25 m wide beside an existing fence. It only takes about 650 m of additional fencing to protect a 10 ha square block of trees in the corner of an existing paddock.

Further reading: Bennett (1999).

The numbers and species of birds have increased substantially, including a visit from 3 Brolga's for a week in 2001. Birdlife on *Danengate* has responded to the treeplanting. The spotted gums in the agroforestry planting (established 1991) have flowered profusely, attracting a multitude of musk lorikeet, purple-crowned lorikeet, rainbow lorikeet, New Holland honeyeaters, yellow-faced honeyeaters, white-plumed honeyeaters, red wattle-birds and other species. On one occasion (7 Feb 2001) when trees in the 1-ha circle (1995 planting) were being measured, 11 species of birds were noted over a period of about 30 minutes. These were: magpie, grey currawong, little raven, common boobook, grey fantail, brown thornbill, yellow-rumped thornbill, New Holland honeyeater, yellow-faced honeyeater and striated pardalote. Red-rumped parrots and common bronzewings are often seen now at *Danengate*, although not so common elsewhere.

Other fauna include a resident koala and her young (plus the occasional grunting mate), a permanent population of 3 grey kangaroos, a resident black wallaby that grazes on the house lawns and back porch (unfed), and many visits by other fauna, including tortoise, echidna and reptiles.

Financial

The farm was re-fenced, a laneway system introduced and all paddocks resown to improved pastures since 1989. In 1988, pastures consisted of silver grass (*Vulpia* sp.) and other annual grasses, together with onion grass (*Romulea* sp.), storksbill (*Erodium* spp.) and a minor component of perennial ryegrass (*Lolium perenne*). The carrying capacity at that time was 215 ewes and 15 cows. In 1996 there were 665 adult sheep on 62 ha of improved pasture. The improved pasture comprised mostly perennial ryegrass, phalaris and Trikkala/Leura subterranean clover, direct-drilled in autumn after a rigorous weed control program over the previous year. Fertiliser was applied at sowing and maintenance amounts added annually thereafter.

Jann and Don run mobs of 100 ewes set-stocked after lambing in each of the small paddocks. The lambing percentage is averages 125% and 665 first-cross ewes are mated for a June lambing. The eventual target is 1000 ewes, or 30 dse/grazed ha (assuming 1 ewe = 2.5 dry sheep) on 150 ha, which includes 50 ha of habitat/shelter/farm forestry. Prime lambs are sold at 20 weeks, prior to Christmas.

Don attributes the high production levels to six factors:

- improved pastures and sensible fertiliser applications
- adequate stocking rates and management of pastures on the smaller areas
- improved genetics and management of sheep
- provision of shelter - with reduced environmental stress from wind and cold/wet weather.

- improved productivity related to improved biodiversity and the flow-on benefits of increased numbers of natural predators
- a more attractive and better work environment for the owners

Overall, Don has no doubt that the productivity of the property is greater now than it was before areas of the farm were retired from grazing to grow trees. His figures indicate a 320% increase in sheep numbers despite 33% of the original area of pasture being devoted to trees.

Paddocks on *Danengate* are surrounded by fenced corridor/shelterbelt plantings, and some also have small woodlots (mainly circles of 0.4-1 ha) within. The shelterbelts and woodlots will provide the timber, shelter, biodiversity and landscape elements, while the pastures and stock provide the annual cashflow. This property provides a model for the separation of the biodiversity and production elements, although Don has an agroforestry planting (spotted gums amidst lucerne, 2 ha) and a block of mixed species (pine, cypress, eucalypt spp, 6 ha) that provides a more intimate integration of functions. Don believes that it is not the best economic result to try and integrate scattered trees among the pasture. He has perimeter belts (2 or 3-row wide) and fenced clumps within the paddocks. Stock are allowed access to some timber woodlots after a few years. In defining areas that will not be fertilised, sprayed or otherwise treated, Don believes that better attention can be given to pasture areas, greater productivity resulting and better management of agroforestry planting is also achieved. With small paddocks, shelter is always close at hand and birds appear to exploit insects and seeds in the nearby pasture from the safety of the perimeter shelterbelts and woodlots.

On average, 1-2 ha of timber trees have been planted each year since 1989. These include blackwood (*A. melanoxylon*), black wattle (*A. mearnsii*), drooping sheoak (*Allocasuarina verticillata*), river sheoak (*Casuarina cunninghamian*a), swamp sheoak (*C. glauca*) Monterey cypress (*Cupressus macrocarpa*), Mexican cypress (*C. lusitanica*), manna gum (*E. viminalis*), mountain grey gum (*E. cypellocarpa*), Sydney blue gum (*E. saligna*), river red gum (*E. camaldulensis*), spotted gum (*Corymbia* spp.) and radiata pine (*Pinus radiata*).

Don established an agroforestry planting of spotted gum on 2 hectares of lucerne pasture in 1991. Trees were established by direct-sowing in spring along sprayed rows 8 m apart. Thinnings were made in 1994, 1996 and 2001, leaving about 300 trees/ha. This was successful and the trees have been pruned and thinned over the years (see Figure 5). The eventual aim is for 100-200 trees per hectare.

A planting of blackwood was done in 1993, as a joint project with Department of Natural Resource and Environment (NRE), to examine variation among 20 provenances of blackwood. Cypress plantings, of several seedlots, were initiated with joint projects with NRE in 1992. Later plantings were continued by Don.

Sheoak blocks were planted in 1993 for high-value clearwood production. Don planted a local (Mount Napier) manna gum block in 1994 and two koalas were seen there in 1997. Pines were planted in 1995 and these have been subjected to a clearwood pruning regime.

A provenance trial of spotted gums, incorporating a comparison of various ripping treatments, was planted in 1995, in conjunction with NRE. These have been pruned and thinned to provide clearwood sawlogs. The trees are part of a 1-ha circular block that is situated towards the corner of a paddock, to provide shelter for lambing ewes. Other circles, 0.5-0.75 ha in size, containing cypress, pines, manna gum or sheoaks, have been planted in adjacent paddocks.

In 2000, a block of hybrid and cloned eucalypts was established in partnership with CSIRO, and in 2001 a 2.5-ha *C. maculata* seed orchard comprising 120 seedlots was established with NRE, as part of the Australian Low Rainfall Tree Improvement Group (ALRTIG) program.

Figure 5: Sheep grazing below spotted gum, planted in 1991

Other benefits

In spite of the perceived higher fire risk, the agroforestry plantings on the north-west paddocks of the farm buildings have been established as the major fire control asset of the farm plan. *Helmsden* is currently being developed from the lessons learnt on *Danengate* and previous experience.

The costs

Don has given me the following details of costs and what he considers are real impediments to farm forestry.

Local seed sources	lack of sufficient local seed and diversity of original vegetation cover.
Loss of grazing land to trees	30% (50 ha)
Tree establishment	@1000 trees/ha, 35,000 trees, heaps of $s!!
Pasture development	around $200/ha.
Fencing	most paddocks are double-fenced for shelterbelts.
Neighbours	complaints about increased habitat for vermin (?)
Community	that mad B!?@! on the hill with all the trees.
Local Government	Increased property value = increased rates. Planning restrictions for tree planting, not for other enterprise.
Red tape	Permits, development notices, roading costs, etc.
Valuer General	Native Vegetation is valued at $800/ha in Shire of Glenelg, but at $200/ha across the fence for the same forest type in the Shire of Southern Grampians, and each attracts the same rate in the dollar.

CFA	Requirements to meet industrial plantation standards for fire protection, control, industry brigade legislation, setbacks, increased donations to local brigades due to perceived increased risk, as agroforestry operation now exceeds 500 ha over all properties.
NRE	500% increase in rental if unused Govt road reserves are planted to trees. Native Vegetation Legislation - in 10 years what can we harvest? Vermin and noxious weed management is monitored very closely on private land, yet impossible to get action on adjoining Govt land.

Other costs/uncertainties include:

- increased maintenance issues related to trees over fences
- increased workloads as agroforestry management issues grow (increased numbers to prune, thin, etc.)
- zero initial cash-flow - while planting and tending 1-2 ha of trees per year is viable from a work-load perspective, there is a 20-50 year wait before the first substantial economic return. This is difficult for the pioneer but great for those who benefit once the cycle of planting and harvesting is in balance.
- species choice - will those chosen achieve a high value sawlog?

Development

The aim is to plant 1-2 ha/year of agroforestry while establishing the shelter/corridors as soon as economically practical. The agroforestry establishment rate has increased in recent years, with improved cash flows from improved agricultural returns allowing the ability to employ contractors to handle the greater areas of annual planting and pruning.

The majority of trees are planted as seedlings in spring, due to limited suitable seed supplies and better control of vermin (hares) that otherwise destroy the seedlings.

Danengate has been developed over 15 years, while *Helmsden* will be developed over 5 years.

Knowledge

Don considers that the most valued source of information is the N.Z Farm Forestry Association and the NRE Farm Forestry Section at PVI, Hamilton. Other main sources of information include the *Agroforestry News* magazine and industry journals related to his position as a field manager with a major overseas plantation investor.

Literature on related topics of biodiversity, farm management and enterprise productivity is also an important source of information, as the Jowetts' are keen to maintain productivity at high levels, and regularly compare the performance of their farm against other benchmarks. They seek inputs from family members who are trained in specific areas of expertise.

The lessons

- Shelter belts and windbreaks need to be wider than 3 rows.

Corridors: Width matters

A 1-3 row wide shelter belts supports fewer species of birds than five or more rows. Research by Celia Kinross (Sydney University) on the Central Tablelands of NSW found that shelter belts and woodlots needed to be at least 25-30 m wide, in order to support the small insect-eating birds that otherwise only occur in sizeable patches of remnant woodland. Narrow shelter belts have native birds in them, but they are usually the common farmland birds such as Galahs, Rosellas and Magpies.

Further reading: Kinross (2000).

- Plantings should be along water courses, along contours and break-of-slope to maximise benefits.
- Biodiversity planting must have linkages, water, blocks of a diverse range of species that are of sufficient density and of a size that will allow permanent habitat for some species.
- Biodiversity/permanent shelter plantings must contain not only a diverse range of species but also all levels of forest cover from ground cover to tall canopy to be fully effective.
- Single rows of natives around agroforestry planting do not provide adequate habitat - these should be planted as blocks within or adjoining agroforestry plantings.
- Monocultures of trees provide greater diversity of fauna than pastures.
- Straight lines of trees do not necessarily provide easier management of a grazing enterprise.
- Retention of pruning litter and old, dead trees, while creating an untidy appearance, is not detrimental to management – it is necessary for biodiversity.
- Planting density provides high selection choices but also increases costs and work loads – 500 or 600 stems per ha is usually sufficient with most species for adequate selection, especially with improved seedling genetics.
- Consideration of wide-spaced trees at row widths of up to 10 m should be investigated for agroforestry – 8-m spacing is too close for ease of many farming operations.
- 1-2 ha per year is easy to plant but management problems accumulate and compound when a wide range of species has been planted - be prepared to use contractors to catch up on management.
- The best sites grow the best trees - any old bit of land will NOT do.
- Isolated remnant trees, including standing dead trees, should be integrated into new plantings of agroforestry, shelter or habitat.

The living dead: A last chance for paddock trees

Time is running out for the millions of scattered paddock trees that typify farming and grazing country. These trees are ageing relicts of 150 years of clearing. They have many values including habitat for thousands of insect species which are feed for dozens of birds and bat species. Some birds and bats also nest in the scarce hollows these trees provide. But paddock trees are slowly disappearing. The density of paddock trees in central NSW has declined from 0.37 trees/ha to only 0.3 trees/ha over the past 50 years. Often these trees represent a large proportion of the total remnant cover left in fertile farming country. These trees are declining because they are unable to replace themselves. Seed production from isolated yellow box trees is nearly 50% less than the same species in large blocks of remnant vegetation. The few seeds that are produced are only 38% of the number of viable seeds from trees in large patches. The few viable seeds that do manage to hit the ground are then rapidly preyed upon by the thousands of harvester ants that dominate the disturbed conditions in a paddock. The final blow to regeneration is continuous livestock grazing that eat the few seedlings that occasionally manage to germinate.

One of the few hopes for paddock trees is incorporation into a woodlot, protected from continuous grazing, but give these old trees enough room to eventually produce some seedlings.

Further reading: Ozolins *et al*. (2001); Burrows (2000); Gibbons and Boak (2002).

- All plantations must have a gate to allow access for management operations.
- The most fashionable species are not necessarily the most viable, or will even grow on the site you have selected.
- We cannot return our woodlands to the diversity and density pre settlement – however, we can protect what we have, restore it to health and expand some areas.

Conclusion and suggestions for future research

The Jowetts' have calculated that, across all their properties, red tape, direct increased costs and charges, and lost productivity, costs this farm forestry operation over $50,000 per year in lost income when compared to losses and restrictions that would be imposed on any other broadacre agricultural pursuit of similar scale. They consider that these issues are major impediments to farmers.

Some areas of the native vegetation on the Jowetts' properties (particularly river frontage and flood plain) should be placed under a covenant on the title that will provide permanent protection. However, Don considers that they, and future owners, have restrictions placed on their use of these areas while still being required to control vermin and noxious weeds, pay rates and taxes, fire levies, public liability insurance etc. They receive no compensation for loss of capital asset, or reduced (or zero) Shire rates for that land. Yet they provide a valuable and substantial community benefit by protecting areas of unique vegetation or intact native flora communities, while also improving downstream environmental conditions. Clearly, there is a need to address these issues.

Grazing as part of the system

Young trees and livestock don't mix. Grazing can destroy young tree seedlings and regenerating understorey shrubs and grasses. However, grazing may benefit the habitat values of older woodlots. Without grazing, either weeds or a few native grasses can dominate the understorey. Occasional grazing can open up a thick grassy sward, creating small bare patches for wildflowers, including orchids. Open patches in an otherwise grassy understorey can also create space for many ground feeding birds, like the threatened Speckled Warbler.

Enhancing biodiversity values of agroforestry is about creating lots of different habitat patches in space and time. Open patches and thick patches, on the ground and up through the trees, now and in various places in the future. Ideal conditions for one group of animals may be hostile country for another. Scattered trees are great habitat for Galahs and Magpies, but far too open for little woodland birds that suffer from constant predation. A dense planting may create terrific habitat for canopy feeding insects and birds, but poor habitat for ground feeding creatures. An approach to conserving biodiversity is to create a wide range of patch types at the scale of a woodlot, a farm, a neighbourhood of farms and across a catchment.

Further reading: Bennett *et al.* (2000); Platt (2002).

Case study 5:

Harvesting in Doug Platts's remnant regrowth forest

'Baringa'

Bombala, NSW

By Jürgen Bauhus

Introduction

The total area of Doug Platts' property – *Baringa*, is 240 hectares (ha). Doug has had an interest in forest management and landscape conservation for some time. This is reflected in his joint venture plantations with State Forests of NSW and Harris Daishowa, and the environmental plantings on his property. In addition to these the property includes 49 ha of native forest distributed in two patches. Since Doug has to pay rates for these native forest areas, he was interested to get some economic return from them through sustainable forest management. In a first step, one patch of remnant native forest of 15 ha was harvested using a group selection approach. Doug's major management aim was to improve the productive capacity of the forest. To achieve this, understocked areas were regenerated, and trees of low value were removed to concentrate site resources on trees of higher value. The latter was combined with the establishment of new openings for regeneration in the form of gaps. Some of the natural features of that forest, the rationale for the silvicultural system, the approach used for management of this remnant forest and some results on the regeneration achieved are described below.

Natural features of the property and the remnant native forest

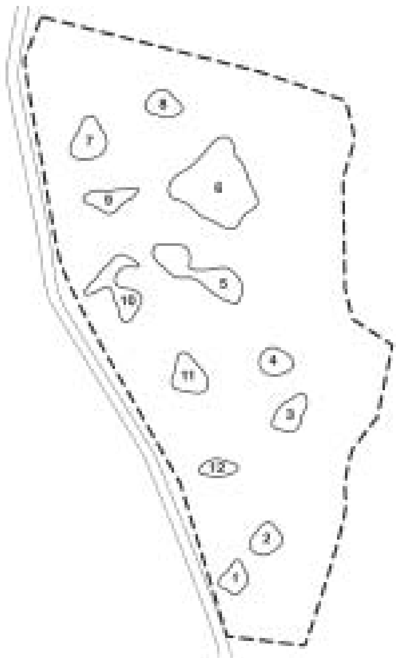
Most of the original vegetation of the property has been cleared for grazing. The remnant vegetation suggests that prior to European settlement the vegetation consisted of open forests dominated by snow gum, ribbon gum, brown barrel, mountain grey gum, and swamp gum. The majority of the property has been cultivated and sown to improved pasture.

The forest area that was selectively harvested is a ca. 80-90 year old native regrowth-forest, which developed following clearing early last century. The forest type is a typical Moist Tableland Hardwood at high altitude (870-890 m), and the specific vegetation community is adequately represented in the public reserve system. Mean dominant height of the stand is between 30-40m and the dominant tree species are: *Eucalyptus cypellocarpa, E. viminalis, E. radiata, E. obliqua, and E. fastigata*. The contribution of those species to the basal area of the stand is 35, 32, 26, 5, and 1% respectively. The terrain is flat to undulating and the forest understorey is dominated by grasses, sedges, and ferns. Before harvesting the stand was not fenced and open to live stock. Very limited harvesting had taken place since the original clearing.

It is impossible to say how far the actual species distribution reflects the original composition of the forest, since the unusual circumstances under which the forest has regenerated, may have favoured one over the other species. It is obvious that a substantial proportion of the trees must have regenerated from coppice. At the time of regeneration the stand density must have been very low, because many trees exhibit habits of open grown trees, such as low forking and the signs of large branches on the lower part of the trunk. In addition, a significant proportion of the block did not regenerate at all, leaving gaps scattered throughout the block. The understorey in these gaps consists mostly of grasses and ferns, which are a strong impediment to the establishment of natural eucalypt regeneration, particularly in the cool winter climate, which prevails at the site. These gaps were targeted as the starting point of harvesting activities. It was envisaged that by extending these gaps and preparation of a favourable seedbed, natural regeneration could be achieved, and the forest be brought into a more productive condition. At the same time, this would increase the structural diversity, and would be the first step towards the creation of an uneven-aged forest.

Some existing gaps carry advance growth. In smaller gaps this regeneration is dominated by narrow-leaf peppermint (*E. radiata*), which is the most shade tolerant of the eucalypt species on the site. This indicated that the gap size needed to be large enough to permit regeneration of all species. Field observation suggested that gaps of ca. one to two tree heights (of the surrounding stand) in diameter should be the minimum size. The gaps that were created are of different size and shape to avoid a uniform pattern, and to create or increase spatial heterogeneity in the stand (Figure 6). The gaps are distributed over the entire forest block and do not interrupt the existing forest edge. It was assumed that this would allow the favourable forest microclimate to prevail, and might minimise weed invasion from the surrounding pasture. In addition, the location and distribution of gaps ensures the continuity of habitat in both overstorey and understorey. Seed trees of all species were retained around the gaps to ensure that all species could potentially regenerate.

Figure 6: Distribution and shape of gaps in the 15 ha forest block



It is noticeable that despite the relative young age, there is a significant number of hollow bearing trees in the forest. It is normally assumed that hollows only form in older trees (> 150 years) at a time when large primary branches break off mature trees. In this forest the process of hollow formation might have started earlier because of the low initial density of the stand, which promoted the development of large branches earlier than this would have been the case in a more densely stocked forest. All trees with hollows were set aside as a significant habitat resource.

Hollows: A critical resource

Tree hollows are used by a lot of wildlife. About 13% of frogs, 10% of reptiles, 15% of birds and 31% of Australian mammals use tree hollows some time during their lives. Overall, over 300 native species are known to use tree hollows, that's 15% of all land based vertebrate species. There may not be enough tree hollows to support viable populations of wildlife. A tree has to be healthy and strong enough to survive at least 120 years of droughts and floods before decay and weather damage begins to form hollows suitable for small wildlife. It may take over 200 years for hollows to form that are large enough for possums and cockatoos.

Further reading: Gibbons and Lindenmayer (2002).

Action research

Before harvesting commenced, fauna and flora surveys were carried out, the standing timber was assessed and potential yields calculated. In addition, a search of the NSW National Parks and Wildlife Service archaeological data base for any significant Aboriginal sites was carried out. These surveys were carried out to provide information for an application to clear vegetation under the Native Vegetation Conservation Act 1997. The proposed management was very likely to meet the conditions of an exemption under this Act. However, an application was submitted to the Department of Land and Water Conservation (DLWC) NSW to ensure legal compliance and also to engage with the DLWC in a discussion about approaches to native forest harvesting on private land.

The area of gaps created is 3.2 ha, equivalent to 21% of the forest area, and the average gap size is 0.27 ha, ranging from 0.11 to 1.13 ha. Harvesting removed about 1,200 m^3 of wood, of which over 200 m^3 was in sawlogs. The remainder was sod as pulpwood. The focus of the research activities since harvesting has been on the establishment of regeneration. The regeneration of grassy eucalypt forests at high altitudes has been often problematic. The grass layer in these forests is a strong impediment to regeneration of eucalypts, which do not germinate well in a grass sward and are sensitive to competition from grass. In addition, a grass sward changes the microclimatic conditions around eucalypt seedlings, reducing the minimum temperatures significantly, resulting in increased occurrence of frost damage and death in seedlings.

Ground disturbance: Stimulating regeneration

At least some eucalypts need a bit of a thrashing now and then to regenerate. Donna Windsor found that the most effective way to stimulate regeneration in White Box and Yellow Box is to scalp away the top 10 cm soil and give the rest a good tickle (scarify). There appears to be too much competition supported by the high fertility under trees, for seedlings to germinate and survive in the weedy sward that is often found under paddock trees. Fire and herbicide treatments weren't as effective as this mechanical disturbance. This was the case for these paddock trees on Central Tablelands and slopes of NSW. Much more needs to be learned about stimulating natural regeneration of trees, hopefully an option that will be far cheaper than planting tubestock or even direct seeding.

Further reading: Windsor and Goldney (2002)

The specific purpose of this trial was to investigate, how germination of eucalypt seedlings and their subsequent establishment and growth can be improved through different methods of ground preparation. These different methods of ground preparation included: slash burning, soil disturbance through movement of harvesting machinery, deliberate soil scarification, removal of understorey using a herbicide, and no disturbance. The harvesting took place in winter 2001. Soil scarification with an excavator shovel was carried out immediately after harvesting. Harvesting residues, such as crowns and branches, were heaped within gaps and burnt in winter 2002. The burning was confined to the slash heaps to protect the remainder of the forest from burning. In addition, some patches within gaps were sprayed in spring 2002 with Roundup to remove understorey. In this situation, grazing by live stock has been excluded through fencing of the entire forest block.

Fallen timber: More than dead wood

Where ever possible, fallen timber should be retained within a woodlot. Branches and logs provide a home to an amazing variety of fungi which provides food for insects which are then fed upon by many different kinds of birds and small native mammals. Birds Australia's Birds-on-Farm project found that for every 10 fallen trees in a farm site, the number of species of ground feeding birds increases by 30% and the number of bark foraging birds increases by 70%! Fallen timber also provides a slow-release organic fertliser and provides soil and leaf litter traps when heavy rains move these material across the soil surface.

Further reading: Barrett (2000).

Regeneration was monitored in November 2002 along transects in gaps, and at permanent survey plots representing the different types of ground disturbance: no disturbance, disturbance caused by movement of logging equipment (machine-disturbance), and deliberate soil scarification. The creation of ashbeds from debris burning and the spraying of weeds occurred too recent for regeneration to establish, and these sites could therefore not be included in the analysis.

The transects across gaps showed that two thirds of the gap areas were stocked at a seedling density of greater than 625 stems/ha. Regeneration in permanent survey plots showed that the probability of regeneration occurrence as well as the density of regeneration were lower in undisturbed plots than in machine-disturbed and scarified plots. This could be explained by the density of ground cover, in particular the cover of grass and litter, which was highest in undisturbed plots. Scarification increased the cover of herbaceous vegetation, which consisted largely of wind-dispersed weed-species, such as thistles (see Figure 7). However, the density of herbaceous vegetation had no influence on presence or density of eucalypt regeneration at this stage. Results on site preparation clearly indicate that some level of soil disturbance is required, and that soil-disturbance from harvesting machinery may be satisfactory. It may even provide better results than scarification because it does not lead to the same proliferation of ruderal weeds.

Figure 7: Proliferation of ruderal weeds, such as thistles, where the ground has been scarified in gaps

A very large proportion of seedlings that had germinated in autumn 2002 were browsed (74%), indicating that some control of browsing animals such as wallabies may be warranted. At this stage the regeneration does not represent the original species composition, in particular *E. obliqua* and *E. fastigata* were under-represented. Supplementary planting of these species may be considered, but only if additional measures are being undertaken to control browsing. In most gaps, receptive seedbed is still available which may allow further establishment of regeneration. Thus, additional regeneration surveys should be carried out.

Outlook

It is intended that the site be used to increase community awareness regarding forest management issues, and be used as an example of maintaining conservation values whilst providing landholders with production opportunities through the sustainable management of their forests. In addition, this site will help setting new standards for the management of native forest on private land. In helping to remove some of the uncertainties surrounding native forest management on private land, more landholders might take up active management, which in turn will help to sustain a value adding industry based on this resource in the Eden Region. In addition to teaching and demonstration values of the proposed activities, the site will be used to address some important research questions related to the regeneration of high altitude forests with grassy understoreys.

Case study 6:

Tom, Cynthia & Mathew Dunbabin

'Bangor'

Dunalley, south-east Tasmania

By Rob Downie

Introduction

Bangor is a unique property. Firstly because of its location with an extensive coastline and significant areas of high conservation value coastal areas and forest types.

Secondly, because it has a significant place in Tasmania's early history. It was a significant hunting and gathering area for Tasmanian Aborigines, and the coastal areas are rich in artifact scatters and shell middens. The Dutch explorer Abel Tasman first landed on the Tasmanian coast on the shores of *Bangor* in December 1642 and the early agriculture development of the property in the 1830's was to supply beef for the penal colony at Port Arthur.

The third special aspect of the property is the deep understanding and appreciation that the current and previous owners/managers have for the environment that they work in, and the need to balance that with the sustainable production of a profitable farming business.

Tom and Cynthia are enthusiastic about their environment at *Bangor* and are dedicated to acquiring an intimate understanding of its ecology. The differing geology and resultant landforms provide a variety of botanical ecotypes and animal habitats. Sustainable management has ensured the conservation of these features.

The property and business

The Dunbabin family first bought a part of *Bangor* in the 1890s and now the property covers an area of 6,200 ha. The property is comprised of:

- 1,000 ha of improved pasture,
- 2,500 ha of bush for seasonal grazing and timber production (includes 40 ha of Tasmanian blue gum, *Eucalyptus globulus,* woodlots),
- 1,600 ha as Covenanted Forest Reserves,
- 700 ha retained as coastal bush and wetland areas (not in production), and
- 400 ha retained as native forest (not in production).

The grazing enterprises have a total production equivalent to 16,000 DSE[1] and are comprised of:

- 40% super-fine wool merinos,
- 40% beef cattle, and
- 20% fat/prime lambs.

[1] Dry Sheep Equivalent (DSE) is a term used to describe the livestock carrying capacity of farmland. The number of DSE equates to the number of adult 'dry' sheep that can be maintained on 1 hectare for 1 year.

The native vegetation includes wet and dry sclerophyll forest, grassy woodlands and coastal bush and wetlands. Tom and Cynthia are passionate about *Bangor*'s environment and do all they can to acquire an intimate understanding of its ecology. The diverse geology and terrain supports a variety of eco-types – for plants and animals. The family's careful management of the property has ensured the conservation of its special features.

Whole Farm Planning

Tom developed a whole farm plan (WFP) for *Bangor* when a course was first offered in Tasmania during the mid-1980s, with the plan continuing to evolve over time. Tom believes that an appropriate WFP should be the basis of all natural resource management decisions and has included a layer on their plan that places an environmental value on every hectare of the property – with the areas of improved pasture generally having a very low score and the wetlands and coastal areas rated highly.

Areas with higher environmental value are managed to maintain or enhance the existing biodiversity values.

Native grasslands

Beginning in the 1950s, significant areas were cleared for pasture development and some areas were deforested (by ring-barking) to increase the native grasses for pasture. The production of the more fertile areas of native pasture has been increased with the introduction of clovers and use of fertiliser.

The native grasslands are actively managed to maintain and enhance both production and biodiversity, and they form a mosaic pattern with the rocky knobs, hilltops and riparian areas all retaining shrubby native bush and forest.

No trees please: Value temperate grasslands

Trees can be planted in the wrong areas. Not all open grassy country is a consequence of tree clearing. Even in areas of fairly high rainfall natural grasslands have persisted over thousands of years. Grasslands in cool country of southern Australia, including Tasmania, formed and persist for many complex reasons. In some cases, valley bottoms are treeless because they are frost hollows, too cold for most eucalypts. In other areas, cool climate grasslands are a result of long-term fire and grazing histories that keep invading trees at bay. Great care needs to be taken when designing woodlots in area that still support native grasses, forbs and orchids. Cool climate grasslands are amongst the most threatened plant communities in Australia1. Today, there are few reasonably intact (few weeds) in patches any larger than a few 100 ha. Trees can grow in these native and semi-native grasslands, but they are the last places in which to plant trees.

Further reading: Kirkpatrick *et al.* (1995).

The grazing of native grasslands and grassy understorey in the forests plays an important role for livestock production by providing rough fodder for cattle over winter and the super-fine wool merinos.

Protection of Priority Forests

The Tasmanian Regional Forest Agreement (RFA) established a Private Forest Reserve Program for 'priority forests'. The Dunbabins received financial support to help them establish a conservation covenant over 1,600 ha of *Bangor*. The covenant mainly protects the areas of *Eucalyptus tenuiramis* forest and grassy *E. globulus* forest.

As a part of the covenanting process, they also developed management plans that will allow periodic grazing of the *E. globulus* forest to maintain the grassy understorey and will allow small building envelopes within the *E. tenuiramis* reserve for eco-tourism.

Farm shelterbelts and woodlots

A mixture of native species predominate in the many shelterbelts that form a network across the areas of improved pasture. They provide shelter for livestock and habitat for small birds. The design of the shelterbelts is in accordance with the WFP.

Recently, several small woodlots of blue gum have been established, with a total of 40 ha. One area has converted native forest to plantation and the others are on areas of ex-pasture. These are seen as providing some shelter and links with other vegetation, yet are primarily for timber production.

Native forest management

For generations, the property has been a source of logs for the local hardwood sawmills, and for on-farm use for fencing and buildings. Commercial forestry became far more significant to the family's income when the export woodchip market emerged in Tasmania in the early-1970s. Since 1972, a program of selectively harvesting the previously degraded forest has led to a significant improvement in the quality and productivity of the timber stands.

Forest harvesting is done in accordance with the Tasmanian Forest Practices Code, which requires a high standard of environmental assessment and management. The Dunbabins plan their harvesting to achieve multiple goals, consistent with their WFP. This has helped to protect riparian areas, habitat areas for threatened flora and fauna, such as the Wedge Tailed Eagle and Swift Parrot, and preserve important archaeological sites like Aboriginal middens and the Abel Tasman landing site.

Fencing for production and biodiversity

Much of the bush that has provided only a marginal benefit for grazing have been fenced off and are reverting from an open forest with a grassy understorey to a forest with a thicker shrub layer. Fire has traditionally been used to generate 'green pick' in some areas of bush for occasional grazing, but this practice caused significant damage to the quality of the native forest. Now, fire is used when it can achieve a balance between ecological needs and the likely increased production from timber or livestock.

Rotational grazing: giving plants a break

Grazing has been a part of Australia's landscapes for millions of years. What's changed is the intensity and duration of grazing. Prior to livestock supported by water troughs and farm dams, the native kangaroos and wallabies numbers would have built up during wet years and rapidly declined in dry years due to the lack of drinking water and feed. Today, grazing grinds on year and year out thanks to unlimited drinking water and supplementary feed. The over application of wooly herbicide (sheep) has cleaned out the understorey, reducing the habitat for the many species that live and feed below the canopy. Grazing needs to controlled long enough for perennial grasses, shrubs and trees to regenerate. A spell from grazing may need to last for years until regenerating trees and shrubs are tall and tough enough to with stand livestock and kangaroo grazing. In other times and places, grazing may only need to be removed a few months in late spring to allow native grasses to recharge their root reserves and put down seed. Livestock and agroforestry can be partners, as long as the grazing is used as a tool to achieve key outcomes – well grown trees that support a diversity understorey plants and animals that in turn help to keep the trees healthy.

Further reading: Wilson *et al*. (1997).

The Dunbabins have an ongoing fencing program aimed at allowing better management of livestock – on areas of pasture and when amongst the forest. New fence lines are planned to protect further riparian and coastal areas, as well as improve livestock management.

Eco-Tourism

The Dunbabins recently engaged a consultant to survey over 1,000 past visitors to *Bangor*. A significant result was that most would have liked to stay longer and 80% equated the experience to visiting a national park.

They are currently developing a business plan to commercialise the eco-tourism potential. They intend to build eco-friendly accommodation units that provide a quality environmental experience that is easily accessible by an increasing number of tourists. As Tom says "… *Hobart is only a one-hour flight from Melbourne and within an hour of landing you could be well settled into this unique natural environment. Often people travel or trek for days to reach similar destinations."*

Community involvement

Both Tom and Cynthia have been a driving force in raising community awareness about environmental and sustainability issues for the last 20 years. They have made their property an outdoor learning centre for tourists, farmers, school kids, university students, academics and researchers, and provide guided tours, catered functions and field days.

They have also converted an old farm shed into a natural resource management learning centre for use by the Bangor Landcare Group, which operates a devolved grant scheme in the south-east of Tasmania. In1996 the Dunbabins' years of hard work was recognised when they won the National Landcare Award for Nature Conservation.

Tom (BAgSc – Hon) and Cynthia (BSc - zoology & botany) share a keen interest in the latest research in agriculture, forestry and natural resource management. Mathew has recently completed a degree in agriculture in Western Australia and has returned home to take a more active role in the management of the property.

Tom believes that there has been a cultural shift in the way that farmers and land managers value both native forest and environmental issues. He explained that *"… each farmer needs to go through the individual learning and that often needs to be repeated each generation. A whole range of methods are required, backed up by regulation to enforce the really important stuff, such as threatened species."*

By having a keen understanding of the surrounding eco-system, Tom believes that their management has been able to focus on the important issues and added that *"… land managers should not strive to harvest or graze every hectare. The best returns will be achieved by increasing the intensity of management of the best agricultural areas."*

Conclusion

The Dunbabins's property demonstrates that agricultural production systems can be integrated into the natural environment to enhance both financial returns and improved protection for biodiversity. While *Bangor* is a unique property, it is the people – their understanding and empathy with the natural environment – that have developed it into the special place that we can see today.

Case study 7:

Integrated Tree Cropping's
commercial plantations in
south-west Western Australia

By Sylvia Leighton[4]

Introduction

Over the last decade, blue gum (*Eucalyptus globulus*) plantations for paper production have become a major industry in the south coast region of Western Australia. There are now 120,000 ha planted in the Denmark, Cranbrook, Plantagenet and Jerramungup Shires of theis region *(pers. comm. J. Levinson* 2002). Since 2001, harvesting has begun on the first experimental plantations, a new woodchip mill has become operational, and the first two shipments of bluegum woodchips have left Albany for Japan. Future production from this resource is expected to rise from 400,000 tonnes to 1 million tonnes per annum *(Great Southern Development Commission*, 2001).

Representatives from Integrated Tree Cropping, South Coast Sharefarms and Great Southern Plantations recently explained that their companies have a clear and immediate focus to implement environmental management systems into their 'on ground' practices. Already, many of the local plantation companies undertake environmental reviews or audits to assess their environmental performance. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures to foster environmental protection, and an increasing concern from communities about environmental issues related to plantation development. International Standards covering environmental management are intended to provide organisations with the elements of an effective environmental management system to achieve environmental and economic goals. Many of the local companies are seeking forest certification from the Forest Stewardship Council (*FSC*, 1996) or the AS/NZS 14001 (*Australian/New Zealand Standard*, 1996).

One blue gum plantation company – Integrated Tree Cropping (ITC), has always endeavoured to incorporate practices that reduce the impact of their activities on the remnant native vegetation on the property which they have leased or purchased. ITC has been keen to set a high standard for minimising the environmental impacts from plantation forestry for the wider industry.

[4] Grateful acknowledgement for assistance with information for this case study:

- Tim Mitchell - *South Coast Sharefarms*,
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- Gavin Ellis – *Great Southern Plantations.*

Bluegums to the horizon: Limits of monocultures

Large scale blue gum plantations in south-west Western Australia don't seem to provide much wildlife habitat. A recent study found that there were almost twice as many species of birds, mammals, reptiles and frogs found in nearby remnant vegetation than in blue gum plantations. Abundance of wildlife was also lower in the plantations. These blue gum plantations simply did not provide much habitat complexity. There is very little understorey of tussock grasses, shrubs and fallen timber under dense plantings of blue gums. A few more species used the edges of plantations that link with remnant vegetation compared to the interior of the plantations, however the difference was minor.

Further reading: Hobbs *et al.* (2003).

ITC has always had a policy of retaining all paddock trees and remnant bush at the proposed plantation site. They have also not allowed sheep grazing in to any of their plantation sites in the past. This was to protect any unfenced remnant bush from further degradation by grazing livestock. However, grazing of plantations may be reintroduced as a way of reducing the amount of second year weed control herbicide that is being used. This is provided the significant areas of remnant vegetation or riparian zones are fenced off. The Forest Stewardship Council (FSC) requires companies and or managers to investigate ways of reducing the amount of chemicals being used in the production of timber products provided it is economic to do so.

The recent acquisition of the Australian Plantation Timber Company estate by ITC brings with it a history of grazing that will be re-assessed in light of FSC requirements. Another issue for managers of large plantation forests is how best to reduce the level of grass and plantation debris that contribute to damaging wildfire. Grazing assists managers in lowering the level of grass in the plantation without resorting to the use of herbicides. ITC may choose to adopt grazing of stock within plantations to protect the important plantation assets as well as protecting the increasingly valuable remnant vegetation estate from damage by wildfire (*pers comm. R. Banks* 2002)

ITC have carried out fox baiting and some feral cat control on selected properties in the Albany region where there are large patches of remnant bush on a property owned by ITC. They also sponsored the fox control program on a property leased by ITC in Victoria where a population of the endangered Eastern Barred Bandicoot occurs.

ITC have not carried out any pesticide spraying for insect control in the plantations for the last two years even though there is reduction in wood volume production where insect attack is severe (ITC have, however, retained the right to spray if absolutely necessary). Agrotoxins used to combat pests can impact on the local wildlife and cause deleterious effects in the environment (Majer & Recher 1999). Public pressure from local communities, concerned about impacts on human health, forced the WA State government to ban the use of a systemic pesticide spray (*Dimethoate*) in the aerial spraying used to control the insect pests of blue gums.

Insects are biodiversity too

Woodlands and forests support an amazing variety of insects. A comparative study in Western Australia and the New England Tablelands (NSW) identified more than 1,600 species of insects from just 40 trees. That variety of insects is nearly as many species of birds, mammals, reptiles and frogs on the entire Australian continent! Some of these insects can be pests and damage trees, but they are all food for the dozens of birds and bat species that can be seen feeding from the bottom of trees to the top canopy within any healthy forest or woodland.

Further reading: Majer and Recher (2000).

Some blue gum plantation companies now spray with a pesticide called Alphacypermethrin which is not mobile in soil and has a half-life of 2 to 4 weeks. It is rapidly hydrolysed in local soil conditions (pH = 9), but in acidic and neutral soils the hydrolysis half-life can be extended by another 20 to 29 days. However, Alphacypermethrin is considered highly toxic to fish and aquatic arthropods, slightly toxic to birds (*FMC International AG*, 1998), as well as possible side-effects for people.

In its earlier days, ITC established a few native plants in key landcare sites, like creekline areas, on some of the properties where they had plantation plantings. ITC have also assisted any landholders who requested additional site preparation for establishing a wildlife corridor/native species planting nearby to the ITC blue gum plantation. The landholders usually cover all 'on ground' costs for this additional planting. ITC will be establishing small areas of enrichment plantings this year on some properties. This year, a trial of a number of species will be planted on land previously unsuitable for traditional plantation forestry for the purpose of providing wildlife corridors and lowering watertables on sites low in the landscape (*pers. comm. R. Banks*, 2002).

ITC had also agreed to register some of their (company-owned) properties with the *Land For Wildlife* scheme, however the current company restructuring has delayed this move. Registration with this scheme would provide ITC with the opportunity to have the remnant native plants recorded and management advice to support the species long-term survival.

ITC have also provided financial support (along with other bluegum plantation companies) for the joint CSIRO-Murdoch University (2001) study into the biodiversity which is found within bluegum plantation sites. It has also sponsored many local Landcare activities and the 'Spirit of the Forest' art show.

Case study 8:

Community Rainforest Reafforestation Program
Wet Tropics Region, Queensland

By Sue Vize & Gary Sexton

Introduction

The wet tropics bioregion in Queensland is famous for its natural assets with World Heritage listed rainforests and coral reef systems. The region has traditionally been a predominantly agricultural-based economy, although tourism has now taken over as the single largest industry.

The farming sector in the region is dominated by sugar cane production, with smaller industry sectors of horticulture (predominantly bananas but including a range of tropical fruits), beef cattle, dairy cattle, small cropping (melons, peanuts, corn, tobacco), fishing and aquaculture. Forest plantations occupy a relatively small area (around 20,000 ha) but are locally significant. The bulk of the plantations are state-owned and are dominated Caribbean pine (*Pinus caribaea*) and hoop pine (*Araucaria cunninghamii*) with smaller areas of Queensland maple (*Flindersia brayleyana*) and red cedar (*Toona ciliata*).

Most land holdings are relatively small (less than 30 ha on the floodplain and 50-70 ha on the Tablelands), with a large proportion of farmers being over 60 years of age. The majority of farms are family businesses operated by a single person with minimal use of external labour apart from harvesting (eg. banana and other fruit picking).

Farm forestry programs

There has been substantial interest in farm forestry generated through government programs such as the Community Rainforest Reforestation Program (CRRP), and more recently through the interest of commercial companies.

The CRRP assisted in the establishment of some 2,000 ha of farm forestry owned by over 500 landholders. The plantings are predominantly mixed species and include a range of local native species (eg. quandong, Queensland maple and kauri), other Australian species (eg. blackbutt, southern silky oak and Tasmanian blackwood) and exotics (West Indian cedar *Cedrela odorata*, African mahogany *Khaya nyasica*). Most of the plantings are very small, although a small number of growers have continued to expand on their plantings and have reached upward of 20 ha.

Other farm forestry schemes in the region have promoted the establishment of Caribbean pine (Treecare Program in the 1970s and 1980s) and large-fruited red mahogany (*Eucalyptus pellita*) (DPI Joint Venture Scheme (JVS) in the mid-1990s). The areas planted under these programs are also typically quite small (less than 1 ha under Treecare and around 30 ha under JVS). The total private forest plantation estate is estimated at 2,300 ha.

The largest group of CRRP growers is people with off-farm income (mainly professionals), while farmers make up only around 20% of growers. Up-take of the CRRP was higher on the Tablelands where farm sizes are larger compared to the floodplain areas.

One major difference of the CRRP compared with previous farm forestry programs was the integration of biodiversity and production as one of its four main objectives. A number of plantings have been established with no intention to ever harvest them and others have been established with the clear intention of trying to develop a 'clean, green' product image. As biodiversity and conservation issues are generally high on the agenda in the region and the large number of professionals entering the CRRP, the appreciation of incorporating biodiversity into planting design has always been well recognised.

Contributions to biodiversity

There has however been less understanding of how forest plantings can contribute to the maintenance of biodiversity, both from forestry technical staff and landholders involved. The establishment of a mixed species plantation in a riparian zone is an example of an activity that is often thought to have good outcomes for biodiversity, but in fact has far less impact than is claimed. Weed control is about the only effective outcome that such plantings have achieved.

To achieve improved functionality of the stream and a functioning riparian corridor requires a closely spaced planting (around 3,000 trees per ha) providing full canopy closure and a mixture of species providing structure and functionality to the canopy. Farm forestry is an ideal buffering land use but cannot take the place of environmental rehabilitation in all situations. The integration of farm forestry into farm activities and with environmental rehabilitation in appropriate places, has the potential to transform land management practices in the region as well as generating additional farm income.

Benefits that have flowed

The benefits of farm forestry in the region can be demonstrated through cost savings in both on farm management and reduced environmental repair works. Some of the substantiated benefits include reducing harbour for rats and other pests, stabilising soils to prevent erosion and sedimentation (through minimisation of tillage and use of deep-rooted species), weed control, carbon sequestration and provision of shade for dairy cattle (increased milk production).

Reforestation and Rats

Rainforest trees can be good rat traps. Canefield rats need dense grass for food and shelter, particularly after the cane has been harvested. Rather than continously trying to poison rats, or burn out the grasses, fast growing rainforest trees can smother out grassy rat habitat in a couple of years. Streambank planting does the same job by reducing rats, as well as improving water quality and water flows otherwise blocked by dense growth of para and guinea grasses. Woodlots in cane country, given time and a few nest boxes, can attract owls and other predators of rats. An owl family needs about 2,000 rats a year to feed their hungry youngsters. The one risk of woodlots is that they can support a whole lot more climbing rats that also damage cane. All the more reason to plant a diversity of trees to attract a diversity of rat predators, such as canopy snakes.

Further reading: Canegrowers (2001).

The reduced need for pesticides and increased diversity of land use are additional benefits that have not been quantified. Keenan *et al*. (1997) have also demonstrated the increase in biodiversity in a forest plantation compared with a monoculture agricultural crop. Vegetation in upper catchment areas also has significant implications in the size and rapidity of flood events in the wet tropics. Farm forestry planting may be able to assist with better infiltration of rainwater in the upper catchments and reducing flood peaks.

Financial modelling undertaken by Herbohn and Harrison (2000) have demonstrated the potential for reasonable commercial returns from mixed species plantings based on the CRRP model, with predicted internal rates of return ranging between1.2 to 8.3% (only a small number of scenarios have so far been modelled). To date there has been little realisation of financial returns from the plantings as the oldest are only now approaching 10 years. We can now confidently predict returns to growers at the ages of 10-12 years, 15-18 years and 20-25 years, compared with predictions of 80 plus years prior to the work of the CRRP.

The region has recognised the benefits of farm forestry, especially given the significance of the two World Heritage Areas. There is widespread support to promote the expansion of farm forestry with native species as an appropriate land use from conservation groups and agencies responsible for conservation and World Heritage management.

Figure 8: A 1-year old planting of eucalypts and acacias on a formerly degraded grazing property on the Atherton Tableland, Queensland.

The costs and investment

Over the life of the project, the plantings average establishment cost was $5,500/ha including all administration, research, extension services and information products (reports, training, manuals, newsletters) but not including labour market contributions (which are very variable and sometimes without outcomes). From this, the estimated realistic cost in a commercial environment is $2,500/ha for mixed species plantation establishment.

The first three years of the CRRP (1993-1995) were dedicated to establishing small farm forestry plots. The objective of this phase was to generate initial interest from farmers and to develop some demonstration sites that would be suitable for later activities such as extension, promotion and training. During this phase DPI staff working with NQ Afforestation Labour Market programs, were fully responsible for planting and maintenance of plantings.

Phase 2 (1996-1998) involved the introduction of a landholder fee-for-service which was introduced on a sliding scale starting at $200/ha and increasing to $600/ha over three years. It was planned to continue this sliding increase until landholder fees had reached full cost recovery, estimated to be around $1,600 per ha, but all planting ceased in 1998 prior to reaching this target. The second component of this phase included the introduction of a CRRP newsletter, field days, training workshops and a series of practical manuals on forest management techniques including pruning, weed control and thinning.

The CRRP contracted the Queensland Forestry Research Institute to develop silvicultural management systems for mixed species, tropical plantations, herbicide and fertiliser regimes, propagation methodologies and to investigate the commercial potential of suitable local and exotic tropical species. The information generated through these studies provided details on wood qualities, growth rates and general performance of different species and mixes that formed the basis of the CRRP Species Notes series. Longer term data on the CRRP plots is still being collected and analysed.

Over these activities and 10 years (1993-2002), CRRP has been a substantial investment in farm forestry with $5 million in Commonwealth funds, $6 million in State funds as well as DEETYA funds through labour market programs and in-kind assistance from the State and Local Governments and NQ Afforestation.

Farmers in the wet tropics have been under significant pressures of late with the downturn in both the dairy industry and declining production in sugar cane in addition to pressure for the introduction of more sustainable land management practices that minimise harm to the Great Barrier Reef. Farm forestry is often seen as a possible alternative land use and the prospect of carbon credits and timber production with annuity payments generating further interest. In the past long investment periods prior to the realisation of returns have always been a major impediment to the expansion of the industry.

The lessons

There is generally an avid interest in finding out more about the prospects of farm forestry but unfortunately there has been no clear or authoritative advice available to landholders, and in some cases differing advice has been confusing and difficult to deal with. There has been little differentiation between advice that provides clear information on species performance, management costs or silvicultural methods, compared with that which provides advice on plantation design and planning which can be largely subjective depending on the objectives of the planting and the philosophy of the person providing the advice (eg. someone promoting small-scale mixed plantations compared with someone promoting medium-scale monocultures).

Farm forestry schemes have typically concentrated on the establishment phase of farm forestry providing silvicultural information and, sometimes, planting subsidies. Management and maintenance activities receive some attention through pruning workshops and practical manuals, but harvesting, marketing and other aspects of successful farm forestry ventures, typically receive very little assistance. Obviously dealing with this issue is difficult as at the commencement of new farm forestry schemes it can be too premature to develop harvesting, processing and marketing strategies. In the wet tropics in particular, where there is only a small total plantation area, these will require services that do not currently exist in the region. Long term planning is a fundamental requirement of success for farm forestry programs with commercial objectives and needs to be part of the advice provided to potential growers.

Conclusion

Farm forestry has been demonstrated to have great potential in the wet tropics with a wide range of suitable species and high interest from farmers and other landholders. A solution to the lack of an established industry into which landholders can supply product at a reasonable financial return appears to be some time away, as the current size and scope of forest products supplied from small plantations is both very small, diverse and widely scattered.

Mixed species and tropical farm forestry remain areas that require significant investment in research to better determine suitable silvicultural systems, solutions to issues such as tip moth borer in red cedar and investigation of products and potential end uses. CRRP-funded research has made a start in this area but has been only a very small-scale research effort. In particular, species mixes and silvicultural regimes for the drier regions of the tropics are largely unknown though they have huge potential across northern Australia.

Addressing the other major stumbling block to the expansion of farm forestry in north Queensland will require the development of systems that address short term income needs of farmers that encourage investment in farm forestry. The lack of farm income over a number of years during the establishment phase of forestry activities makes it non-viable for landholders dependent on farm income for their livelihood.

Lessons from case studies

1. Forestry that is able to meet commercial and native biodiversity objectives is typically developed with a long-term perspective (ie. success may come slowly) to provide a range of benefits and uses.

2. Investment should be made incrementally, which allows forest growers to:
   - learn from their own and others experiences for adaptive management,
   - increase the 'patchiness' of vegetation over time,
   - develop forestry that is within the family's financial and physical capacity.

3. Landholders usually have acquired an intimate knowledge of their property's physical characteristics, which allows them to optimise forest/vegetation management to meet a potentially complex mix of objectives.

4. Forestry with commercial and biodiversity objectives offers farmers the opportunity to intensify resilient landscapes (ie. those areas that can tolerate intensive farming) and relieve fragile landscapes (ie. allowing native vegetation to re-colonise degraded areas).

5. Establishing forests/vegetation in riparian areas will usually add relatively more value for native biodiversity (ie. waterways are biodiversity 'hot spots'), than in dry areas.

6. Mixed species plantings will tend to increase the vegetation's complexity and ecological resilience.

7. Establishing new vegetation close to remnant native vegetation will tend to offer more value for native biodiversity, rather than in isolation.

Section 3: Getting the right balance

Framework for assessing trade-offs and opportunities

This section incorporates much of the material generated for the project's 2-day national workshop, which was prepared by Digby Race with input from Geoff Borschmann, Denis Martin, Philippa Noble, Royce Sample and Anthony Walsh. Participants at the workshop discussed that a framework or tool for assessing the commercial and biodiversity values should be developed if we are to be better informed when planning farm forestry for multiple benefits. If we can gauge the costs and benefits, then we can compare different design options for future plantings, or modify or enhance existing forestry.

An assessment framework could also be important for developing and applying cost-sharing principles where a mix of private-public funding is needed to develop forestry at a scale and/or location than is otherwise occurring. The *Bush Tender Trial*, a pilot trial offered by DNRE in north-east Victoria, is one example of how the value of native biodiversity is used to calculate the financial payments to landholders for delivering management outcomes. The Queensland Environmental Protection Agency is also developing a detailed approach for assessing and mapping biodiversity (EPAQ 2002).

If we have a clear understanding of the trade-offs and opportunities between the commercial and biodiversity values of forestry, then we can be more accurate in our design and management of forestry so it provides the values we wish to obtain.

For the purpose of the workshop, native biodiversity was defined as the variety of living organisms (eg. plants, mammals, insects) and the environmental functions (eg. hydrology, nutrient cycling), which form the natural ecosystem. Commercial forestry was defined as the management of forests for the financial return from the sale of products and/or services (ie. may not just be timber production).

There is a range of components or variables that comprise the commercial value of forestry (Box 1). Similarly, forest biodiversity is comprised of a set of variables (Box 2). While the information in Box 1 and 2 was compiled from a range of sources prior to the workshop, it is similar to the range of key components identified during the workshop.

Some of the components or variables of commercial forestry directly correlate to, or influence, the components of the biodiversity value. Also, changes in one component can cause changes, positive and negative, in other components within the overall value of commercial forestry or biodiversity. Through greater knowledge, we are more likely to understand the implications of changes to an individual or several components to give a higher overall value. It may also be possible to increase the commercial value of a forest and enhance biodiversity simultaneously – a 'win win' situation.

For instance, the structural complexity of a forest can be promoted by mixing species and planting at time-intervals that provide a mix of age classes in close proximity. This could be done by matching the forest type to site quality, which often varies across a property. As such, commercial forests could be planted and managed on sites of high quality and biodiversity plantings could be established on sensitive or low productivity sites (Dames & Moore 1999).

Another option for regions where thinnings have low economic returns might be to use nurse trees that can be felled or killed and left standing, thereby providing an extra habitat component. This technique has been trialed successfully in South Australia for blackwood

(*Acacia melanoxylon*) and blue gum (*Eucalyptus globulus*) production using black wattle (*A. mearnsii*) and golden wreath wattle (*A. saligna*) as 'nurse' trees, of which half are culled and left standing at 4 years and the remaining trees culled at 8 years. The dead trees provide habitat for a range of insects, which in turn feed bandicoots and birds (Dames & Moore 1999).

Box 1: The commercial value of forestry is calculated from:

Costs

- Preparation of forestry plan,
- Establishment (eg. technique, planting density),
- Species (and how these meet markets for products/services),
- Silviculture,
- Growth rate,
- Current size,
- Area of forestry,
- Harvesting cost (eg. extent & ease of operation),
- Haulage cost (both on & off-farm),
- Transaction cost (eg. obtaining permits, marketing agent),
- Opportunity cost (eg. use of resources for other farm enterprises),
- Finance rate (eg. rate of borrowing),
- Proximity to similar forest resource.

Returns

- Prospective/received financial returns from markets;
- Benefits to other farm or landscape objectives.

Box 2: Native biodiversity value of forests includes an assessment of:

Site level

- Habitat suitability (for organisms of interest),
- Structural complexity,
- Species diversity,
- Presence of endemic species,
- Size, shape and age,
- Adjacency and connectivity to native vegetation,
- Integrity of aquatic ecosystems,
- Similarity of natural and human disturbances.

Landscape level

- Landscape heterogeneity,
- Landscape context.

The workshop's assessment tool

The workshop largely met its aim, which was to develop a user-friendly tool to help us understand the relative importance of the components that comprise commercial forestry and native biodiversity at the farm scale. From this, we can begin to assess the magnitude of trade-offs or benefits at a given site when we alter various components.

A user-friendly assessment tool is unlikely to be a definitive in-depth framework to accurately quantify the trade-offs and gains between commercial forestry and native biodiversity across Australia. As with the approach to ecological assessment using the Habitat Hectares framework and the subsequent Biodiversity Benefits Index in Victoria, the relative weighting and scoring of each component needs to be determined at the local level (eg. what was the native biodiversity of this site in the year 1750?). Similarly, the relative importance and score of each component of commercial forestry is site/option specific.

Recognising these points, the assessment tool below aims to assist people understand the relative importance of the broad components of commercial forestry and native biodiversity, and highlight the areas where there might be common ground and, therefore the issues to be explored in more detail in terms of choices/decisions. The tool allows the relative importance of the broad components and the scoring to be defined by the user.

Here is a suggested process for using this farm-scale assessment tool:

- identify the 5 most important components of commercial forestry (eg. species selection, size of planting, silviculture – drawn from the list identified above, Box 1);
- give a relative weighting of each component using a total of 100, and
- use your judgment to score each of the components you have identified (ie. achievement against potential) – with the sum score representing the value commercial forestry has achieved, in your view, from the site's potential.

Repeat this process for native biodiversity.

Figure 9: Farm-scale tool to assess commercial forestry and native biodiversity

Commercial Forestry				**Biodiversity Value**		
Component	Weighting	Site score		Component	Weighting	Site score
Other?				Other?		
Total	100%			Total	100%	

It is important to note that we are not trying to provide a definitive assessment of the relative values of commercial forestry and native biodiversity for a given site. Also, other people may identify different components, weight the same components differently, or score the same components differently – depending on interests and objectives. This assessment tool is simply designed to inform our understanding of the potential trade-offs and gains between commercial forestry and native biodiversity at the farm scale, based on our relative assessment.

Local knowledge

To strengthen the assessment tool's accuracy (ie. key components, weighting of components, scores), its development and use should be informed by in-depth local experience – from commercial foresters, ecologists and farmers/tree growers. Ideally, the tool should act as a mechanism for a discussion between people that combine this range of expertise. The tool needs to be developed with local expertise, and will only be as good as the local information it draws upon (experienced local people, and baseline commercial and ecological data) to determine the key components, weightings and site scores.

The workshop indicated that people found it difficult, and were reluctant, to score for components they didn't fully understand. Also, the workshop showed that the definition of the key components often required extensive discussion, to ensure everyone was using the same meaning for the key terms. Several participants suggested that a half-day session would be needed in each region to develop and field-test the tool for use in the local context.

Using this assessment tool

Using the results from the workshop field exercises (Workshop Day 2), we've combined similar components identified by participants, and used the 5 or 6 most common components/categories and respective weightings as an example of how the assessment tool could be used (Figure 10, below).

The results from the workshop's field exercise indicated that while some components have broad acceptance of a clear definition, other components used by people could be interpreted with a variety of meanings. This highlights the need for an in-depth discussion amongst people that combine commercial forestry, ecology and tree growing expertise to ensure users within a specific locality are all using components with a common definition.

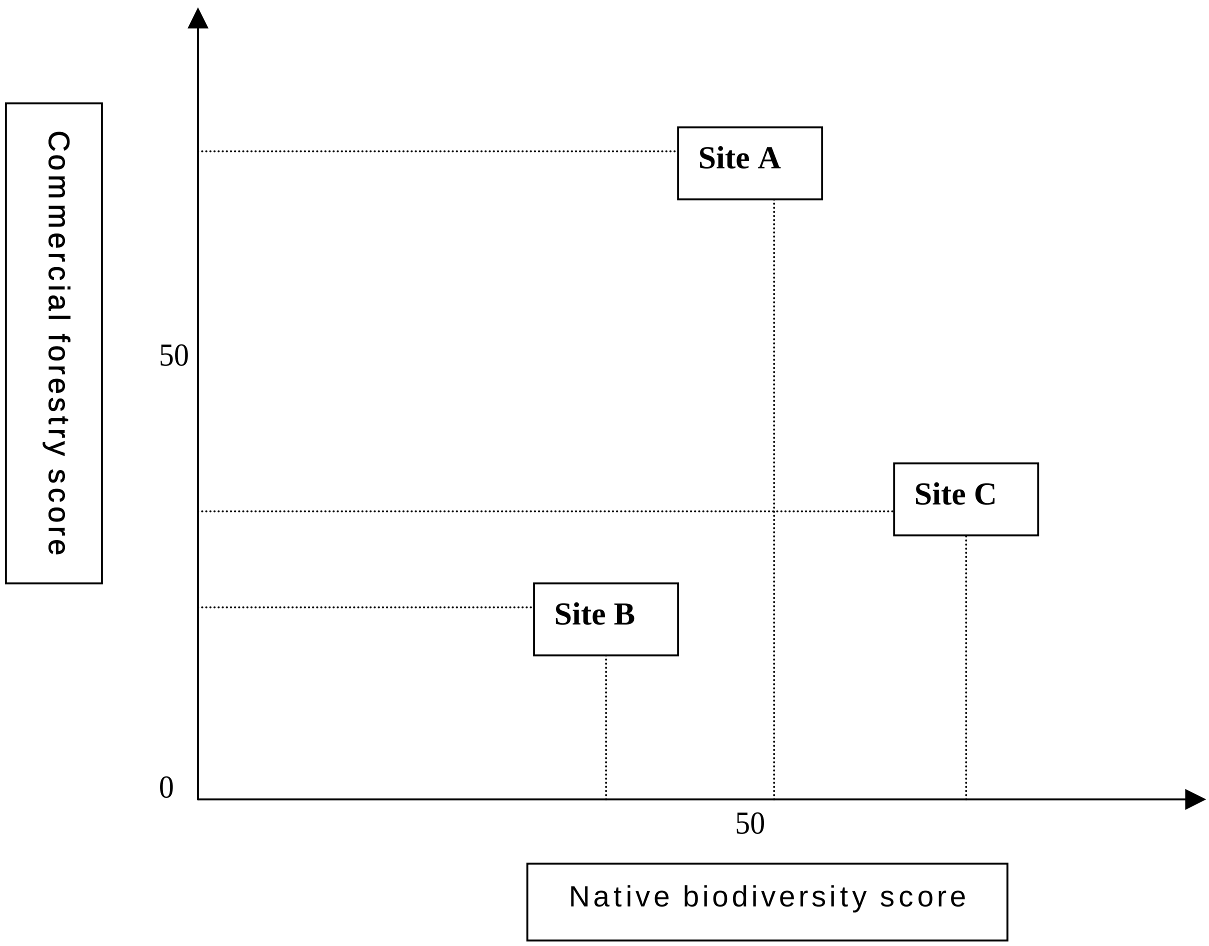
Based on the scoring for a specific site or farm, the tool allows the user to readily identify where the greatest gains can be made. In this situation, discussion could then focus on management options to increase either the commercial forestry or native biodiversity values – or both.

Figure 10: Example of how to apply the farm-scale tool to make an indicative assessment of commercial forestry and native biodiversity

Commercial Forestry Value				Biodiversity Value		
Component	Weighting	Site score		Component	Weighting	Site score
Species selection (extent species match reliable market demand)	25%	20		**Structural complexity of vegetation** (extent vegetation provides diverse habitat opportunities, including presence of understorey plants, leaf litter, old trees, logs & other hollows)	25%	8
Size of planting (efficiency of operations & applying economy of scale)	18%	12		**Species selection** (extent species composition matches endemic vegetation, including absence of pest plant/animals)	20%	15
Silviculture (extent productivity & product quality are optimised)	18%	15		**Connectivity to other vegetation/habitat** (extent plantings link or are near remnant vegetation)	20%	15
Site productivity (rainfall/soil moisture, soil quality influencing growth rate & quality)	14%	12		**Size/scale of vegetation** (extent vegetation adds to the habitat for a range of important species)	20%	10
Markets (within distance of market & reliability of market)	14%	10		**Location/position in landscape** (extent vegetation contributes to habitat of important species or ecosystems)	15%	5
Site access (influencing silviculture & harvesting costs)	11%	5				
Total	100%	74		Total	100%	53

The assessment tool also allows the summative scores to be easily illustrated, such as when comparing the values of different sites (Figure 11, below). The scores applied in the example in Figure 10 (above) have been plotted on a graph together with two other hypothetical sites, to illustrate this point.

Figure 11: Example of how the scores from three sites may be illustrated
(the position of Site A is based on the scores noted in Figure 10, above)



Note: Sites A, B and C noted above are hypothetical and do not relate to any specific sites.

Qualifying this assessment tool

Realistic appraisals

When commercial forestry is developed as uniform plantations (eg. single species, uniform silviculture), the contributions to native biodiversity are likely to be modest. Similarly, factors that improve native biodiversity (eg. diverse vegetation structure) may compromise the economic potential of commercial forestry. However, given the vast scale at which commercial forestry operates (eg. approx. 85,000 ha/year established during 1995-2000), even small gains in favour of native biodiversity at a specific site may accumulate across the country to give an appreciable value. Nonetheless, protection of remnant vegetation remains a critical aspect of enhancing native biodiversity.

Also, we need to acknowledge that forest systems – plantations and native forests – are dynamic. Hence, the tool is designed to help make an assessment of the current value of the farm vegetation – against what the site's current maximum potential may be for commercial forestry and native biodiversity. That is, it is an assessment of forestry or forests at a single point in time, with assessments in subsequent years likely to yield different results as the forest system changes over time.

The assessment tool deliberately aims to be user-friendly, so necessarily simplifies complex topics, such as native biodiversity. For instance, assessing the quality of the existing vegetation is a simple surrogate for assessing native biodiversity – a much more complex system to assess in detail. Inevitably, there are limitations on the extent surrogate variables can give accurate information on more complex systems.

Other purposes of trees on farms

This tool focuses on just two potential values of trees on farms. It is not to say that other aspects of farm vegetation are not important, or indeed more important, such as tree planting for control of dryland salinity, shade and shelter for livestock, carbon sequestration, community development or regional investment. This assessment tool could easily be adapted to take these other values into account. The NSW Department of Land and Water Conservation is developing a definitive assessment tool for vegetation management for salinity control, as the basis for making payments to farmers for particular management practices (Oliver 2002).

Even if given a low score for both commercial forestry and native biodiversity, trees on farms can still provide a range of other benefits – for the farm and wider catchment. Also, it is worth recognising that maximising the scores using this assessment tool may not be the primary purpose of trees on a given farm.

Future work: Towards a management and investment matrix

A logical next step with this assessment tool is to develop a management matrix – that informs people about the likely implications of altering the management of selected components. This type of matrix could also inform people about how best they may invest in farm vegetation to achieve a desired outcome in terms of commercial forestry and/or native biodiversity.

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Appendix 1: List of workshop participants

Farm Forestry: Linking biodiversity to business solutions

National workshop

26th-27th September, 2002
La Trobe – Beechworth Campus, Victoria.

Name	Postal address
Madeleine Baldwin	AFFA, GPO Box 858, Canberra, ACT. 2601.
Ed Baynes	RMB 2021, Barnawartha, Vic. 3688.
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Lyn Coulston	PO Box 21, Koetong, Vic. 3704.
Saul Cunningham	CSIRO Entomology, Canberra, ACT. 2601.
Robert Downie	159 Greens Rd, Orielton, Tas. 7172.
Bernie Evans	5 Sans Souci Drive, Wodonga, Vic. 3690.
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Peter Kanowski	SRES, ANU, ACT. 0200.
Sylvia Leighton	CALM, 120 Albany Hwy, Albany, WA. 6330.
Denis Martin	43 Balaclava Rd, Beechworth, Vic. 3747.
Stephen & Anna McIntosh	RMB 4130, Twist Creek Rd, Yackandandah, Vic. 3749.

Name	Postal address
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Philippa Noble	DNRE, Ford St, Wangaratta, Vic. 3677.
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Jann Williams	Dept. of Geospatial Science, RMIT University, GPO Box 2476V, Melbourne, Vic. 3001.