

National R&D Program on Rehabilitation, Management and Conservation of Remnant Vegetation

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Cover photo: Before the suburbs: patterns of native vegetation – original forest in mountainous Namadgi National Park, mostly cleared yellow box woodland in the valleys and farm tree plantations, northern Gungahlin, ACT.
Photo courtesy of Rodney Falconer.

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Preface

Large areas of the Australian landscape, including much of our most productive land, have been substantially cleared of their natural vegetation. For some regions, up to 95% of natural vegetation has been removed. Many of the remnants which are left are small and isolated, and are subject to many stresses, including rising water tables and salting; the impact of grazing, fire or fertiliser; invasion by exotic weeds; and increasingly intense insect attack. There is growing evidence that many parts of our rural landscape, particularly in southern Australia, will be devoid of native bush if we do not learn how to manage these remnants better.

In 1994 the Australian Nature Conservation Agency, now known as the Biodiversity Group of Environment Australia, and the Land and Water Resources Research and Development Corporation (LWRRDC) agreed to join forces to establish and fund a national program of research and development to devise improved methods of managing bushland. The aim of this national R&D program is to assist government agencies, community groups and landholders to better manage and protect remnant native vegetation through the application of improved knowledge and understanding gained from research. The program has a strong emphasis on practical outcomes in managing remnant native vegetation; it also seeks to form better links between vegetation managers and researchers.

The program is targeted specifically at funding R&D; support for on-ground management of remnant vegetation is made available nationally through the Save The Bush component of the National Landcare Program, as well as by many other grants or incentive schemes established within the States and Territories. Funding for the R&D program amounts to \$4.5 million over the five years 1994–1999.

Following a national call for research proposals in 1994, the program funded eight projects examining different aspects of the ecology of native vegetation, with a particular focus on identifying the key processes by which different types of disturbance influence the long-term maintenance and conservation value of remnant native vegetation. Several of these projects are based on the woodland ecosystems that have been extensively cleared to make way for cropping and pastures in southern Australia, and which are perhaps under the most intense pressure as a result. A ninth project funded from the call is developing a novel approach to promoting the better management of remnant native vegetation by individual landholders.

In addition to developing a broadly-based ecological understanding which can be transferred and applied generally, Environment Australia and LWRRDC also have a particular interest in socio-economic and policy research. There is clear evidence of a large and continuing gap between the knowledge and understanding gained by researchers and its application by private and public managers of remnant native vegetation. There are large differences in the way that native vegetation is viewed and managed between the States and Territories, between regions, between government agencies, and between individual landholders. These may reflect actual differences in the value or significance of remnant vegetation in different locations, or differences in awareness or in willingness or ability to carry out sustainable management of native

vegetation, even when it is recognised as a desirable goal. Whatever the reasons, it is clear that these impediments to ecologically sustainable management of remnant native vegetation must be addressed if current knowledge is to be used effectively in managing our rural landscapes.

Following a workshop held in 1995 to examine 'Socio-economic Aspects of Maintaining Native Vegetation on Agricultural Land', a further 14 projects were funded to examine a range of socio-economic issues. Some projects aim to measure the market and non-market values of remnant vegetation, while others are aimed at developing improved legislation and incentives at national, local and individual property scales.

Annual program meeting

An important aim of the R&D program structure is to make sure that effective links are made between the individual projects within it, and particularly across the boundary between the ecological and socio-economic projects. Not only are there obvious common threads between the projects in each group (e.g. in assessing the impacts of disturbances such as fire or grazing on woodland communities across southern Australia), but there are also important linkages between the two sets (e.g. knowledge of ecological 'status' has an important bearing on market and non-market values). For this reason, researchers within the program are brought together once each year and are required to make a presentation on the purpose, methods and results to date of their individual projects. The main objectives of this meeting are:

- to make sure that each research group is fully aware of other projects within the program
- to provide an opportunity to develop formal and informal links between the projects within the program
- to expose each research project to the scrutiny and review of peers
- to provide an interactive review of project progress for the two funding agencies (this is in addition to a formal process of milestone reporting)
- to enable people working within the program to draw out general principles from research results that can be used to develop improved and cost-effective, practical methods for managing remnant native vegetation.

Program compendium

Another important aim of the R&D program is to promote links between the research projects under way and other research and management projects undertaken through other funding sources. At the first meeting of researchers from all the program projects, held in Bendigo in September 1996, it was agreed that a compendium of the projects would be produced in order to provide an easy reference to the research under way. Within this document, you will find the title and objectives of each R&D project within the program, together with a brief description of progress and results to date. The main comments or questions raised about each project, during discussion at the meeting, are also recorded. There are contact numbers for each principal investigator or research team. You are encouraged to contact the researchers if you are interested in these projects and require further information on results or how they could be brought into practical use, or on the work proposed for the future. The R&D projects are spread across a large number of regions, and we anticipate they may be of special interest to people in the same locality involved in bushland management.

Any comments or suggestions from readers on ways of improving the value of this compendium, or of improving the publication and adoption of research results, would be most welcome.

Phil Price, LWRRDC

Project summaries

Ecosystem resilience and the restoration of damaged plant communities

Project reference	USH3
Organisation	University of Western Sydney, Hawkesbury
Location of work	Richmond, NSW
Project supervisor	Dr J Conroy Bourke Street University of Western Sydney, Hawkesbury RICHMOND NSW 2753 ph: (045) 970 1311 fax: (045) 970 1314
Commencement date	1 October 1994
Completion date	31 August 1996

OBJECTIVES

1. Review the use of the resilience concept in relation to a wide range of both overseas and Australian restoration cases.
2. Monitor and analyse the initial recovery response of a range of highly degraded Australian sclerophyll and rainforest remnants to restoration treatments.
3. Synthesise, in theoretical terms, patterns of relative resilience of four major Australian ecosystem types (sclerophyll, rainforest, wetland, grassland) to a broad range of degradation type, intensity and duration.
4. Develop the case for the use of ecosystem resilience as an organising principle for rehabilitation/reconstruction site analysis and treatment prescription.
5. Formulate useful resilience analysis guidelines for restoration projects.
6. Evaluate the effectiveness of restoration approaches (in the light of ecosystem resilience issues) used by the various branches of the restoration industry/community to identify potential for improved practice and information dissemination.

SUMMARY

Principal investigator: Tein McDonald

An examination was undertaken of the literature and restoration cases for four major Australian vegetation types (sclerophyll, rainforest, grassland and wetland) to explore the proposition that ecological resilience may govern recovery after anthropogenic damage, and may provide a fundamental guide and measure of success for ecological restoration. Also, primary data were collected from highly degraded sites (five

sclerophyll, three rainforest, and four grassy sites) to assess recovery after restoration treatment. These were supplemented with questionnaire data from practitioners working at a wider range of rainforest and sclerophyll sites, and reports from practitioners working on grassland and wetland sites.

Despite high levels of degradation on the study sites before treatment, recovery occurred after treatment for a range of species, except where propagule sources were depleted or too distant. The degree of recovery was generally inverse to the degree of impact, with the number of species that recovered on sites decreased with increased anthropogenic impact. Some species and species groups showed an incapacity to recover from some impacts. Where different 'disturbance treatments' were compared, those which more closely resembled natural recovery triggers (appropriate to the particular vegetation type) resulted in higher regeneration results.

In all four vegetation types, species generally fell into two main groups: longer lived 'resprouters' and shorter lived 'obligate seeders'. But different resilience models were identified for the four vegetation types. The sclerophyll type exhibited higher in situ resilience but lower migratory resilience than the rainforest type, which was facilitated by flying frugivore dispersal to perch trees. Self-perpetuation was more tightly coupled with disturbance in the sclerophyll, grassland and wetland types than in rainforest. Therefore, 'designed disturbance' played a more obvious role in enhancing recovery within these types than in rainforest.

A degree of prediction of resilience potential of particular degraded sites within a landscape (and the prediction of the degree and type of restoration subsidy needed) can be based on knowledge of individual species' recovery mechanisms; resilience models for individual vegetation types; and the site's colonisation potential and impact history.

This predictive capacity allows the more accurate determination of whether an area within a restoration site is a 'natural regeneration area' (best treated using interventions designed to 'kick-start' natural recovery) or a 'reconstruction area' (where wholesale reintroductions and/or major substrate constructions are required).

In conclusion, the concept of resilience can be used as an organising principle for the practice of ecological restoration. This suggests that resilience theory needs to be included in restoration ecology curricula at the levels of practitioner, technician and ecologist. To this end, background material for teachers is being developed for these three levels.

DISCUSSION COMMENTS

- Differences in sclerophyll and rainforest communities with regard to the weed species present and response to treatment were noted. Is there ongoing weed control in the sclerophyll sites? Lantana is not so much a problem in sclerophyll sites, but at most sites weed seedlings are continuing to be removed.
- Is there any evidence that fauna will transfer to regenerated sites in rainforest? Are insects, birds and other animals returning with tree regeneration? The project has shown that

birds and mammals are returning, while the status of insect fauna is unknown.

- Intensive intervention in the form of regeneration and re-planting, and possibly site restoration, should occur only when natural regeneration is considered not to be a viable option.
- Project results have been prepared in the form of practical guides on regeneration aimed at community groups and education institutions.

Practical solutions for the rehabilitation of degraded remnant woodland

Project reference	CWE10
Organisation	CSIRO Division of Wildlife and Ecology
Location of work	Kellerberrin, WA
Project supervisor	Dr R Hobbs Principal Research Scientist CSIRO Division of Wildlife and Ecology LMB 4 PO MIDLAND WA 6056 ph: (09) 290 8122 fax: (09) 290 8134
Commencement date	1 May 1995
Completion date	31 August 1998

OBJECTIVES

1. Review existing research results and other literature on woodland regeneration and rehabilitation across Australia, and identify general principles, broad differences related to environmental or plant community characteristics and major gaps in knowledge that limit managers' ability to undertake practical restoration.
2. Assess the potential for development of a protocol for remnant rehabilitation that could be applied to woodlands nationally.
3. Test this protocol in degraded woodland remnants in the central wheat-belt of Western Australia, and compare results with those of similar projects in the eastern States.
4. Develop effective methods to provide and disseminate the protocol and information on woodland rehabilitation, and to promote their uptake and use, to landholders, landcare and other community groups and government agencies involved with land management.

SUMMARY

Principal investigators: Colin Yates and Richard Hobbs

Review of existing knowledge of Australian woodlands

A review has recently been completed and is in revision for publication in the *Australian Journal of Botany*. The review highlighted a generally low level of information available on woodlands nationally. There is general agreement on the factors leading to woodland degradation, but little information on the effects of ameliorating these influences and few guidelines for woodland management or restoration. Considerable anecdotal material exists, but the generality and robustness of this has yet to be assessed.

Workshop on woodland management and conservation

As a result of the review, it became clear that there was a need to synthesise existing knowledge and expertise further, and a workshop is therefore to be held in December 1996, with the aim of developing and testing management guidelines, and determining the optimal methods of delivering these outcomes to managers. The participants at the workshop will also contribute to a synthesis publication on Australian woodlands.

Development of decision rules for woodland management

In order to develop management protocols for Australian woodlands, draft decision rules are being developed which examine the biological requirements for woodland regeneration in terms of potential management actions. These draft guidelines will be circulated before the December workshop, tested for a number of woodland systems across the country, and refined thereafter.

Field experimentation in Western Australia

As part of the field testing of management protocols, a field experiment has been set up in remnant salmon gum woodland (*Eucalyptus salmonophloia*) in the Western Australian wheat-belt. Many of these remnants are severely degraded by live-stock grazing, weed invasion and soil compaction, and do not regenerate following removal of livestock. Regeneration in unfragmented woodlands apparently follows disturbance events such as fire, flood or windstorm. The field experiment, set up this year, has the following treatments: grazing (+/- rabbit grazing) x canopy disturbance (+/- competition from adult trees) x soil amelioration (+/- deep ripping). These treatments were carried out at four sites, and all sites were fenced from livestock and received weed control treatments. The canopy disturbance treatment consisted of ringbarking an adult tree, to mimic the effects of natural disturbance in causing adult mortality. A series of plots with these combinations of treatments were planted, with seedlings of tree and understorey species, and survival and growth are being monitored.

DISCUSSION COMMENTS

- There has been some spontaneous revegetation in the experimental plots, with understorey species moving into them.
- In practical terms, it is not possible to remove all disturbances from remnants; the answer is to adopt appropriate management methods.
- Is there evidence that windblown soil, containing higher levels of phosphate, is having a negative effect on plant regeneration or the health of remnants?
- There is scope to develop links between this project and KPB1, including to assess the persistence of species following smoke stimulation.
- What will be the end products of this project, and how will results be provided in a form that encourages rapid uptake and adoption?
- There is much interest in Western Australia in native plants and how to propagate them, and also in re-establishment techniques and management protocols.

Guidelines for the maintenance and improvement of remnant bush in Tasmania

Project reference	UTA4
Organisation	University of Tasmania
Location of work	Campbell Town, Tas
Project supervisor	Professor Jamie Kirkpatrick Head of Department Geography and Environmental Studies University of Tasmania PO Box 252-78 HOBART TAS 7001 ph: (03) 6220 2460 fax: (03) 6220 2989
Commencement date	1 July 1995
Completion date	30 June 2000

OBJECTIVES

1. Produce maps of distribution of land clearance in Tasmania between 1989 and 1994, and between 1994 and 1999, and identify the areas and vegetation types most affected by clearing.
2. Determine the relationships between the size, age, environment and management of Tasmanian humid basalt bush remnants and their condition.
3. Test the hypotheses that: small remnants can maintain good condition in a matrix of exotic pasture; rare and threatened plant species can survive in a weedy matrix if appropriate disturbance regimes are maintained; a decreased intensity and/or duration of stock grazing improves remnant condition; an increased frequency of fire reduces remnant condition; the interaction between increased fire frequency and increased stock grazing pressure results in greater deterioration than either factor in isolation; and macronutrient inputs reduce the condition of remnants.
4. Determine whether dieback in remnants is associated with any particular combinations of environment and management regime, and test the efficacy of possum-proofing, watering and protection of the root zone from stock and fertilisation in relieving symptoms of dieback.
5. Involve landowners in the research process and make them aware of the importance of their remnant bush.
6. Develop and disseminate personalised extension material that provides the best available specific advice for individual landowners on the maintenance of significant vegetation and trees on their properties.

SUMMARY

Principal investigator: Jamie Kirkpatrick

This project extends previous studies by my research group on remnant bush in Tasmania that have established that management is the major correlate of condition of remnants, not size, shape or environment; that the remnants with rare and threatened vascular plant species are not generally those in best condition; that the owners/managers of remnants are almost all aware of their values, but awareness of values does not necessarily translate into willingness to maintain remnants; and that remnant owners want extension, not education.

The research component of the project will monitor land clearance, monitor the condition of previously surveyed remnants, determine the correlates of good condition in lowland basalt remnants in areas of high rainfall, determine the interactive effects of fire and grazing on different remnant vegetation types, and determine the interactive effects of various practical means of reversing tree dieback. All of these subprojects have been initiated, with data collected for the first time period. In addition, associated projects have been commenced by postgraduate research students on birds, reptiles and invertebrates in remnants previously surveyed for vascular plants, and on the nature and significance of edge effects in heathy remnants.

The extension part of the project involves communicating information on management and the significance of conservation. The major approach is to communicate property-specific information to individual landowners/managers. This has commenced for the property owners/managers whose remnants were surveyed previous to this grant. A second approach is to communicate research results and their implications to the extension community. A seminar will be held in November for this purpose.

The only completed component of the work is the survey of land clearance for the period 1988–1994. This survey was done from 1:250 000 satellite images for the two periods. The rate of vegetation loss as a whole has increased from the 6000 ha per annum calculated for the period 1982–1988, being 10 429 ha per annum, with 62 575 ha being lost in total.

A large proportion of the clearance relates to eucalypt and pine plantation establishment (28 775 ha, 4796 ha per annum), in contrast to the situation in 1972–1988. The rate of agricultural land clearance has not markedly slowed, with 5045 ha of natural vegetation per annum being lost between 1988 and 1994 (total 30 275 ha). Losses to inundation were also greater between 1988 and 1994 than between 1980 and 1988, with 3525 ha being lost in the latter period.

A high rate of clearance took place in inland *Eucalyptus tenuiramis* dry forest. This type suffered a slightly lower rate of clearance in the earlier period. This acceleration of clearance is

of particular concern given the depletion of this type and its low level of reservation. In contrast, the rate of clearance of the severely depleted and extremely poorly reserved grassy woodland has slowed. A low percentage clearance figure for the grossly depleted and poorly reserved grassland masks a rate of 1.27% for the nationally endangered lowland grassland, because of its inclusion with the highland grassland (0.13%). The extremely poorly reserved inland grassy forests are also still suffering a high rate of loss, although the rate has declined.

Clearance is still concentrated in the most depleted and least reserved vegetation types. However, the total pattern of native vegetation loss has changed, with massive rates of plantation establishment in State Forest and on private forest land, and the flooding of impoundments in western Tasmania. The north-west and west of the State have had a very high level of clearance, partly because of plantation establishment and impoundments, but also because of much clearing for agriculture on private land. The north-east is another area of substantial clearance.

Clearance seems to have declined a little in the driest parts of the State, but obviously continues at a level of considerable concern, especially in relation to the future of lowland grassland, inland grassy forest and inland *Eucalyptus tenuiramis* dry forest.

DISCUSSION COMMENTS

- One problem with assessing agricultural extension efforts through this methodology is that surveys will only be able to show that people are aware or intend to take up management programs; the assessment will not result in an evaluation of the outcomes of the extension or of the improved management.
- Some studies have shown that visits by extension officers are not effective in changing attitudes and behaviours in managing remnant vegetation.
- Cooperation across government agencies and other groups is achieved in this project through representation on its steering committee.
- Continued clearing in Tasmania is driven mainly by corporations rather than private individuals.
- There is still a culture of clearing in Tasmania, and there are no proposals to introduce clearing controls in the State in the near future. This issue may come up for further debate through the Comprehensive Regional Assessments and the Regional Forest Agreement processes.

Native plant regeneration processes in remnant woodland vegetation

Project reference	UNE21
Organisation	University of New England
Location of work	Armidale, NSW
Project supervisor	Dr P Clarke Lecturer in Plant Ecology Department of Botany University of New England ARMIDALE NSW 2351 ph: (067) 73 3712 fax: (067) 73 3283
Commencement date	1 January 1995
Completion date	31 December 1998

OBJECTIVES

1. Identify and define the mechanisms that mediate regeneration in remnant woodland vegetation by:
 - measuring demographic processes of dispersal, establishment, seedling survival, time to reproduction and fecundity in a range of species that are representative of plant life forms found in northern tableland woodlands
 - examine at experimental sites on public and private land the influence of resources (light, nutrients and water), conditions (soil disturbance, predators, temperature, grazing, fire) and interactions at the same trophic level (tolerance, facilitation, competition) on demographic processes crucial to regeneration.
2. Develop generalisations about plant functional groups or 'lifestyles' for species in northern tableland woodlands, and make predictions about community composition through time in relation to changes in condition, including management practices.
3. Provide information to managers on methods to enhance regeneration of woodland plant species, with emphasis on trial and monitoring so that the management process is adaptive rather than prescriptive.

SUMMARY

Principal investigators: Peter Clarke and Elizabeth Davison

At the first Environment Australia/LWRRDC workshop on 'Socio-economic aspects of managing native vegetation on agricultural land' in 1995, we outlined the rationale and approach we have taken in our project on 'Rural bush regeneration'. The details of this rationale are being published in the conference proceedings of 'Conservation outside nature reserves'. At this workshop we present some preliminary find-

ings of our experimental work on the northern tablelands of New South Wales.

Inventory and experiments

Maps of the major vegetation remnants on the New England Tableland have been provided by the New South Wales National Parks and Wildlife Service at a scale of 1:100 000. Sites for study have been selected based on these maps, LANDSAT images, topographic maps and unpublished geological maps. A pilot study was also undertaken to assess the resources necessary for a comprehensive vegetation survey of the region (see research report). Site characteristics for 55 sites have been collected and analysed using multivariate methods. In all, 17 vegetation types were described from the numeric classification. From this study and feedback from a workshop, three areas were selected for study.

Three sites on farm properties were selected for experimental studies (see Table 1). Each site is located in an area of degraded woodland that currently has low levels of grazing and some native species component in the understorey.

Table 1: Location of field experimental sites

Property name	Geology	Vegetation type
Ban Wyong (private)	Basalt	<i>Eucalyptus viminalis</i>
Newholme (UNE)	Granite	<i>Eucalyptus melliodora</i> , <i>E. blakelyi</i>
Eastlake (private)	Metasediments	<i>Eucalyptus caliginosa</i>

Two hundred and twenty seed collections, together with specimen vouchers, have been collected from areas in the vicinity of the above sites. Of these, 30 species have been used in laboratory germination trials to determine their germinability response to smoke and light. From these species, 20 were selected for a field experiment (see Table 2) that examined the effects of grazing, cover, soil disturbance and fire on seedling emergence and survival. Separate experiments have examined the effects of ants on seed theft. In all, over 100 000 seeds have been sown.

Table 2: Species selected to be used in field experiments

Common to all locations	Newholme	Eastlake	Ban Wyong
<i>Eucalyptus blakelyi</i>	<i>Acacia dealbata</i>	<i>Xanthorrea johnsonii</i>	<i>Eucalyptus viminalis</i>
<i>Eucalyptus melliodora</i>	<i>Lomatia fraseri</i>	<i>Indigofera australis</i>	<i>Mentha dimenica</i>
<i>Leptospermum polygalifolium</i>	<i>Eucalyptus youmanii</i>	<i>Vittadinia cuneata</i>	<i>Psoralea tenax</i>
<i>Danthonia racemosa</i>	<i>Cassinia quinquefaria</i>	<i>Stipa rudis</i>	<i>Ammobium alatum</i>
<i>Bracteantha bracteata</i>	<i>Aristida ramosa</i>	<i>Lomandra longifolia</i>	<i>Carex inversa</i>

Involvement by stakeholders

A workshop involving landholders and other interested parties was held to canvass ideas about what information is required to manage rural bushland. Following this meeting, species were selected for field experiments and guidelines were prepared for monitoring rural bushland. It was clear, however, from the number of private landholders that the local landcare coordinator was able to 'enlist' that conservation and management of bushland remnants is a low priority for the vast majority of landholders.

Ongoing research

- Long-term monitoring of the effect of field soil storage on seed viability.
- Effect of grazing on established seedlings exposed to different grazing regimes.
- Effect of interspecific competition on recruited seedlings.
- Laboratory germination trials of a large range of tableland native plant species.

DISCUSSION COMMENTS

- The project has used extensive trials in paddocks based on management manipulations to stimulate natural regeneration.
- Initial results have shown that ant theft of seed is a significant factor in the length of time seed is available for germination.
- It was not clear whether burning treatments have a large effect over a greater area, although the project has found that small fires tend not to break up the pasture sward.
- The project could look at linkages to formal vegetation management agreements, that is, a contract for outcomes on the ground; such agreements might in fact stop people from experimenting with methods of stimulating natural regeneration and militate against the adaptive management approach being adopted in the project.
- The project and management guidelines could give attention to the option of trialling different regeneration methods in patches.
- The approach to supporting natural regeneration depends upon the availability of soil seedbank or other sources of seed, and the relative proportion of re-sprouters; have these been assessed for the experimental areas?
- There is a need to be careful about the location of plots in relation to existing cover, as canopy cover and root competition will have a major effect on plant recruitment.
- There is a need to look further at bird and mammal theft of seed, as well as that by ants, and tracking as far as possible the fate of the stolen seeds.

Extinction processes and fauna conservation in remnant box-ironbark woodlands

Project reference	DUV2
Organisation	School of Aquatic Sciences and Natural Resources Management Deakin University (Rusden Campus)
Location of work	Heidelberg, Vic
Project supervisor	Dr Andrew Bennett Lecturer Wildlife Ecology Deakin University 662 Blackburn Rd CLAYTON VIC 3168 ph: (03) 9244 7511 fax: (03) 9244 7403
Commencement date	1 July 1994
Completion date	31 December 1998

OBJECTIVES

1. Document the occurrence and conservation status of the vertebrate fauna and selected invertebrates, (e.g. ants, beetles, spiders) in the woodlands of the box-ironbark region in Victoria.
2. Quantify patterns in the distribution and abundance of species and species groups in relation to measured attributes of the natural environment (e.g. vegetation floristics and structure, climate, geology, topography).
3. Measure the type and size of the response of selected species groups to major disturbance processes in these remnant woodlands (i.e. loss of large old trees, changes to ground layer habitats, and fragmentation of woodlands) resulting from timber harvesting, firewood collection, grazing by domestic stock, and clearing.
4. Examine ecological attributes (e.g. habitat specialisation, population density, mobility) of those species that are sensitive to extinction processes to identify species groups that are potential bio-indicators of remnant quality.
5. Examine changes in abundance and diversity of invertebrate fauna before and after major shifts in bird fauna induced by experimental removal of noisy miners, compare them with natural changes over time on associated control areas, and relate them to documented variation in leaf damage and tree health.
6. Provide information and results from the study to public and private land managers and the wider community to facilitate effective conservation and management of the

woodlands and their fauna, as part of a broader recovery program for the box-ironbark region.

SUMMARY

Principal investigator: Andrew Bennett

Progress to date in this collaborative research project has seen the completion of field work for a major fauna survey and the implementation of studies of a range of disturbance processes.

Baseline survey of the vertebrate and invertebrate fauna

A total of 80 sites were selected for faunal surveys, carefully located to sample the range of ecological vegetation classes across the box-ironbark region. At each site, a 2.0 ha plot was marked and used as the basis for standardised surveys of the fauna. All records of vertebrates have been entered in the databases of the Atlas of Victorian Wildlife (>6000 records), and summaries of the relative abundance of species groups in relation to vegetation classes have been prepared.

Arboreal mammals and owls were surveyed by spotlight searches at night on two occasions in spring 1995 (September–December) and again in autumn 1996 when playback tapes of owl calls were used to detect forest owls. Bats were surveyed during summer months by using bat traps and ultrasonic bat detectors at each site, and resulted in the capture of 1256 bats of 10 species. Other mammals, such as kangaroos, wallabies and echidnas, have been recorded by incidental observations during field work. Hair-sampling tubes were employed in an effort to detect some rarer mammals, and revealed the occurrence of brush-tailed phascogales, eastern pygmy-possum and common dunnart, all difficult to detect.

Birds were censused at each site in spring 1995 and again in winter 1996 during the non-breeding season (and when heavy flowering of eucalypts occurs in this area). Reptiles were detected during the warmer months by standard censuses and searches at each site and also by intensive pitfall trapping at a subset of 40 sites. Although a species list of some 21 species has been obtained for the region, the number of individuals and species at each site was low. Invertebrates were surveyed by using pitfall traps at each site, and sorting of samples to orders is under way. Two groups, ants and spiders, will be sorted to finer levels. Ants will be assigned to functional groups to help interpret the effects of disturbance.

Studies of disturbance processes

Impacts of woodland fragmentation and isolation

A series of study sites have been carefully chosen and include 38 woodland fragments, mostly on private land. These include 18 fragments of approximately 10 ha, 10 of 20 ha, five of 40 ha and five of 80 ha. Comparable 'pseudofragments' (i.e. plots of similar size but located within three large regional blocks) have also been established – 12 of 10 ha, six of 20 ha, six of 40 ha and six of 80 ha. Bird censuses have been carried out at each site on three occasions to date and 103 species have been recorded. Reptile censuses (active searches and transects) commenced during spring/summer and intensive

pitfall trapping was carried out on two occasions. Research projects by several BSc (Hons) students will further extend and complement this study.

Impacts of noisy miners

This study is examining changes in the abundance and diversity of invertebrates (particularly defoliating insects) before and after major shifts in the composition of the avifauna induced by the experimental removal of noisy miners. Three pairs of sites have *Eucalyptus sideroxylon* as the dominant tree species and four pairs of sites are dominated by *E. microcarpa*. Noisy miners were removed from the experimental *E. sideroxylon* sites in June 1994 and from experimental *E. microcarpa* sites in June 1995. Diversity and abundance of birds has been censused at all sites each month, and will continue until mid-1997. Quarterly sampling of invertebrates, leaf damage and overall tree health will also continue at all sites until mid-1997.

Studies of the effects of two other processes – disturbance to ground layer habitats and the loss of large old trees – are currently being planned and will commence in spring 1996.

The research is being carried out in close collaboration with field staff of the Department of Natural Resources and Environment, and a newsletter with flora and fauna news is being distributed to >350 interested people (landholders, groups, naturalists and so on). Several planning processes are under way in the region, including a review of the use of all public lands, and these are providing opportunities to integrate research outcomes with future management plans for the region.

DISCUSSION COMMENTS

- Size and condition of box-ironbark remnants are both important variables, as is the size and age of trees, particularly in relation to providing reliable food and habitat.
- Well-maintained remnants usually show a close relationship to size.
- There is often little or no understorey in some remnants, particularly those open to grazing.
- The study is looking at the effects of vegetation fragmentation on *classes* of animals, rather than on particular or individual species.
- Trees in this region generally need to be around 150 years or older to contain significant tree hollows, and this does not match into the timescale required for economically profitable wood production.
- Within the project, work on the effects of fragmentation and noisy miner removal are under way, while work to assess the effects of loss of large trees or loss of groundcover is about to commence.

The role of corridors and retained vegetation in biodiversity conservation

Project reference	ANU6
Organisation	Australian National University
Location of work	Tumut, NSW
Project supervisor	Dr D Lindenmayer Research Fellow Centre for Resource and Environmental Studies Australian National University CANBERRA ACT 0200 ph: (06) 249 0654 fax: (06) 249 0757
Commencement date	1 July 1995
Completion date	30 June 2000

OBJECTIVES

1. Provide valuable new information on the contribution of vegetation remnants for biodiversity conservation by integrating techniques and information from landscape ecology, metapopulation dynamics and conservation genetics.
2. Apply various molecular genetics techniques to examine the role of animal dispersal and movement in contributing to the persistence and genetic status of subpopulations of metapopulations of wildlife in fragmented landscapes.
3. Examine the role of computer simulation packages in the estimation of extinction risks of biodiversity in fragmented systems of remnant habitat.
4. Provide a formal test of the accuracy of predictions that are generated from the application of computer simulation approaches by comparing the results of field surveys with those from computer models.
5. Provide an overarching synthesis of information to land managers and government/non-government organisations that will assist them to maintain and design networks of retained habitat which will be effective for the conservation of biodiversity in fragmented landscapes; this will include general design principles for corridor planting or selection and the relative effectiveness of artificial and natural corridors.
6. Widely disseminate the key outcomes of the project to promote the adoption of important generic design principles for retained systems of vegetation in multi-use landscapes.

SUMMARY

Principal investigators: David Lindenmayer; Hugh Possingham and Robert Lacy

The Tumut fragmentation experiment commenced in July 1995 and a series of logically linked steps have been completed as part of the study since that time. The sequence of stages completed to date, and some of the key outcomes of each phase, are briefly outlined below.

Step 1: Selection of the study region

The Tumut region was selected for study as a two-year (unfunded) reconnaissance phase during which a wide array of areas were examined and assessed for their suitability. Tumut was selected because the range of conditions which characterises the region allowed a carefully designed, statistically based, landscape-scale experiment to be undertaken. The experiment contains three broad types of sites:

1. remnant patches of native forest embedded within a 50 000 ha softwood plantation
2. 'control' sites matched to the remnants on the basis of forest types, climatic and geological conditions
3. pine 'matrix' sites with similar geological and bioclimatic conditions to those which characterise both the remnant and control sites.

A major component of the project is to measure the presence and abundance of wildlife in these three types of study sites.

Step 2: Patch enumeration

A total of 192 patches of varying size, shape, vegetation (forest and woodland) type were identified from spatial analysis of a geographic information system database generated for the region by State Forests of New South Wales. Field surveys were then completed in which every patch was carefully examined and key attributes were gathered (e.g. forest type, slope features, connected versus unconnected). Cross-tabulation procedures were employed to examine the attributes of the 'population' of remnant patches in the study area.

Step 3: Regional environmental characterisation

Databases on climate, geology, terrain and vegetation held (or generated by) State Forests of New South Wales, New South Wales National Parks and Wildlife Service, and the Centre for Resource and Environmental Studies were interrogated to identify regional environmental regimes that characterise the Tumut region.

Step 4: Pilot study

A pilot study was undertaken in part of the study area to:

- identify the sampling regime required for the study
- determine those parameters worthy of detailed study as part of the experimental treatment structure in the larger (and subsequent) main study.

Arboreal marsupials and small mammals were the target taxa for this phase of the project. The results of the pilot study indicated that a 600-metre-long transect set out in 100-metre

sections was the required standardised sampling regime across the three broad types of sites examined in the study. In addition, the pilot study indicated that features such as forest type, patch size and shape and the time since patch isolation were key parameters that needed to be included in the treatment structure of the design of the main fragmentation experiment.

Step 5: Final study design

Based on the results of the pilot study, a randomised and replicated experimental design was completed in which 86 patches and strips were selected for detailed field survey. A total of 40 control sites and 40 sites in the landscape matrix (i.e. within the pine plantation) were also targeted for survey. The regional environmental analyses were used to identify control and matrix sites suitable for matching with the array of 86 remnant survey sites.

Step 6: Field surveys

Field surveys of all 166 survey sites have been completed for small mammals (using hair-tubing techniques) and arboreal marsupials (spotlighting methods). Surveys of birds have been partially completed (as of September 1996) and further work will be undertaken during October and November 1996. Detailed vegetation data have also been gathered for all sites.

Step 7: Preliminary analyses

Data generated from the field surveys are highly skewed and new statistical techniques have been developed to overcome these problems (e.g. zero inflated poisson regression methods). Field survey results have shown that very few animals occur in the pine forest sites. However, initial statistical analyses have indicated that, when the data are averaged across all sites, there are no significant differences ($P < 0.05$) between the abundance of arboreal marsupials in control and remnant sites. Indeed, in the case of one species (the common ringtail possum) significantly more individuals ($P < 0.01$) were detected in the remnant than the control areas. Further analyses are presently under way that will examine the relationships between animal distribution and abundance and measured attributes of sites at finer levels of resolution with the data sets that have been gathered (e.g. patch size, shape).

Step 8: Further work

Considerable further work remains to be undertaken as part of the Tumut fragmentation experiment. Some of the planned research activities include:

- further analysis of data (including covariates) collected on arboreal marsupials and survey sites
- call box recording of bird populations during spring and summer 1996
- bird population surveys using transects (spring/summer 1996)
- trapping of small mammals and possums in remnant patches to collect samples for subsequent genetic analyses
- comparisons of genetic variability among existing field populations of greater gliders and ancient DNA samples from animals collected by Professor Tyndale-Biscoe in the mid-1960s in the same area where trapping will take place
- simulation modelling of arboreal marsupials in the pilot study area; this will enable comparisons of the actual abundance of animals and the predicted numbers from population viability analysis
- coordination of field days for staff from State Forests of New South Wales and the New South Wales National Parks and Wildlife Service to highlight the value of remnant vegetation for biodiversity conservation, particularly as part of planning the design of new plantation forests on degraded agricultural lands.

DISCUSSION COMMENTS

- Results to date have shown that introduced vertebrates are not being detected through hair tubes; scat analysis has not been undertaken as yet.
- Results show that black rats have been located in areas of pine but not in remnant eucalypt patches.
- It was suggested the project should include an economist at an early stage so that data on remnant size, number, location, and so on can be fed into an economic model to show the potential costs to plantation forestry of retaining and managing an adequate remnant estate.
- There is a high level of continued development occurring in the experimental area, with rapid expansion of plantations.
- The project has achieved good involvement of forestry industry and workers.
- There is a need to understand what the fire regimes have been for both the remnants and the pine plantations, as this may affect the ecological assessment of controls for the experiment. Anecdotal evidence suggests that remnants have been subject to prescribed burns as often as every two years.
- Assessment transects of 600 metres may be difficult to obtain, as remnant vegetation is unlikely to retain homogeneity over this distance. To address this, the transects have been broken down into 100-metre units as the basis for detailed data collection.
- There were clear common linkages between this project and CTC9.

Guidelines and methods for the practical use of smoke-induced germination for bushland restoration

Project reference	KPBI
Organisation	Kings Park and Botanic Garden
Location of work	Perth, WA
Project supervisor	Dr K Dixon Assistant Director Science and Education Kings Park and Botanic Garden WEST PERTH WA 6005 ph: (09) 321 7332 fax: (09) 322 5064
Commencement date	1 January 1995
Completion date	31 December 1997

OBJECTIVES

1. Develop seed viability testing procedures for individual plant species, taxonomic groups and natural communities important for bushland restoration. Test double cueing and other requirements for germination of species that are unresponsive or poorly responsive to conventional smoke treatments. Measure smoke effectiveness in relation to total germinability for both *ex situ* and *in situ* seed. Develop methods for direct priming of seed.
2. Identify species that are rapid indicators of germination enhancement by smoke and use them in studies of:
 - effective concentrations of pure and derived smoke products
 - receptor or permeation sites on or in seeds
 - seed/embryo morphological and anatomical changes in response to smoke treatment
 - optimal germination/incubation conditions and minimum exposure times for exposure of seeds to smoke or its products.
3. Establish a series of field sites, in collaboration with community groups and landholders, to test and demonstrate the practical use of smoke-induced germination in bushland restoration.
4. Use the field sites to determine:
 - total seed recruitment potential and smoke effects
 - effective application methods, rate/concentration and timing
 - relationships between recruitment success, season of treatment and post-treatment management
 - relationship between germination effects and time since last disturbance (fire) and abundance of parent plants
 - residual soil seed banks in newly burnt areas

- growth, vigour, survival and micro-symbionts of smoke versus fire-induced germinants
 - genetic consequences of smoke induction.
5. Use the results to prepare guidelines for the practical application of smoke-induced germination to bushland restoration, and publicise widely.

SUMMARY

Principal investigators: Patrick Courtney and Kingsley Dixon

After 18 months this research program is on the verge of developing smoke technologies for broadscale restoration of remnant bushland. An integrated approach to managing remnants using smoke-stimulated germination in conjunction with selective herbicide application for weed control is being developed. Where remnant seed banks exist, smoke technologies offer a unique approach without the vagaries and associated hazards of burning. Smoke products can be delivered in a uniform and scientific fashion, allowing the user to apply a known amount of germination-promoting factors for a desired result. Given the extensive testing to this point, the requirement for smoke appears to be a widespread phenomenon applicable to the majority of native species with soil seed banks for broadcasting. The use of smoke for the treatment of seed for broadcasting offers economical and effective use of native seed for revegetation.

Testing for remnant seed banks

Smoke is a valuable tool for evaluating remnant soil seed banks, particularly for determining the status of the seed bank in new untested sites. Present research is determining the relationship of smoke-stimulated germinants to total soil seed bank in nature. Present indications are that smoke provides a good estimate (approximately 65–85%) of actual soil seed bank in bushland sites.

Broadscale applications

In terms of broadscale applications, smoke in its gaseous form has limited applications for remnant bushland restoration, except as a testing tool for remnant seed banks. Liquid forms of smoke offer ease of delivery on a practical scale. Current required rates of application are 1 l/m² or 10 000 l/ha. As indicated by laboratory trials, food smokes are highly concentrated and the success of the 1996 field trials may indicate a more effective means for generating and applying smoke. Concentrated food smokes, possibly in conjunction with agricultural binding agents, will allow for low volume applications using agricultural spray technologies. Even at the maximum projected rates, food smokes will offer a substantial cost benefit when compared to smoke water made by the current method.

Time of application

The best time to apply smoke products for maximum benefit is before seasonal rainfall. In Western Australia and temperate southern Australia, summer and autumn smoke applications before winter rains give the best germination.

The effectiveness of smoke application diminishes with time after initial 'breaking' rains. Present studies indicate that winter and spring applications of smoke lead to substantially reduced germination and depressed survival of germinants in the first summer.

Herbicide treatments

The use of selective herbicides is now being integrated into management programs using smoke-stimulated germination technology. The ability to stimulate remnant seed banks offers substantial opportunities for bushland restoration; however, weed competition can be a major problem at many sites. Spraying non-selective herbicides in open sites before native germinants emerge is a possibility due to the early emergence of most invasive weed species. Where existing native flora and germinants are already present, new selective herbicides, currently being tested, offer the exciting possibility of simultaneous removal of both grass and broadleaf weeds from such habitats. In association with the germination promotive benefits of smoke treatments, the ability to remove invasive foreign species will be a powerful tool for remnant bushland restoration. Trials are currently being assessed for effectiveness of a range of herbicides in combination with smoke for selective recruitment of native species and diminution of weedy species. The herbicides and rates currently being used are:

- Lontrel 500 ml/ha
- Fusilade 2 l/ha
- Pulse (binding agent) 2 ml/l of carrier liquid.

Fusilade and Lontrel can be applied together. The volume of water used to deliver the chemical depends on the spray application method. Fusilade has been registered for use on bushland in Western Australia. Lontrel has not been registered at this point. It is unlikely that either chemical has been registered for such use in other States and all current trials are on an experimental basis. Lontrel is known to harm acacias but at rates higher than we are currently testing.

Seed priming and treatments

Where remnant seed banks are not present or are extremely depleted, direct seeding provides the most economical and effective method for recovery of mixed species of native vegetation. Direct priming of seeds with smoke chemicals is effective for a range of smoke-responsive species. Seeds can be treated as follows.

- Direct smoking of seeds using aerosol smoke and a fumigation tent for up to 1 hour.
- Imbibing of seed using smoked water (produced following the Kings Park method) diluted at a rate of 1 in 10 for a period ranging from 6–24 hours.

Rates and exposure times to smoke provide a positive response for most species, with some research required to optimise germination response for individual species. As a rule, large seeds (e.g. *Hibbertia*, *Grevillea*) appear to require (or tolerate) more intensive smoke treatment, while small seeded species (e.g. Asteraceae, Epacridaceae) respond to lower applications of smoke.

Seed ageing has also proven to be a requirement for some species. Until current rapid seed ageing trials are assessed, soil

storage of seed with natural wetting and drying patterns may be a beneficial treatment for many species which do not initially respond to smoke treatments. Broad-scale application of smoke to direct seeding sites in the year after broadcasting may also be a highly effective method for recruiting native species. This is currently being assessed.

Osmoconditioning, pre-germination and the use of organic solvents may also prove to have benefits for direct seeding programs through improved germination, ease of application of smoke and the ability to sow seeds when the seasonal conditions are at their optimum for germination.

More information

A CD-ROM on smoke technologies and their uses is available from Kings Park at a cost of \$10.00. For specific advice and further information, contact:

Kingsley Dixon, Kings Park and Botanic Garden,
West Perth, 6005, ph: (09) 480 3637 fax: (09) 480 3641
email: kdixon@cyllene.uwa.edu.au

DISCUSSION COMMENTS

- Managers cannot dismiss the role of fire altogether; fire is a good tool and if used at different intensities can create a patchwork or mosaic of different vegetation types. Smoke-stimulated germination technology may not be effective for species where seed storage is primarily on the plant (e.g. some *Banksia* and *Hakea* spp).
- The technology provides a new opportunity, particularly for degraded sites, to achieve germination at a time of year most favourable to successful establishment. It can also be combined with herbicide treatment where weed control is necessary to achieve re-establishment of natives.
- There are possible applications for pasture establishment, as well as for pre-cueing seed for direct seeding.
- There is a need to look at the issue of using local providence when marketing smoke-stimulated seeds; there appear to be two markets for this technology, one for the smoke-treated seeds and one for the chemicals which will induce germination of soil seedbanks in the field.
- Because the technology is relatively simple, it may be difficult to get companies interested as it will be easy (if not the most effective) for individuals to smoke their own seed or make their own smoke water.
- The focus of this project is on germination; has any study been done on growth rates and survival following treatment?

Further development of a socio-ecology extension program as an Australian model

Project reference	CSU6
Organisation	Charles Sturt University
Location of work	Bathurst, NSW
Project supervisor	Associate Professor D Goldney Associate Director Environmental Study Unit Charles Sturt University BATHURST NSW 2795 ph: (063) 384 386 fax: (063) 384 649
Commencement date	1 July 1995
Completion date	31 December 1998

OBJECTIVES

1. As part of a deliberate marketing strategy for improved management of remnant bushland, develop a set of remnant bushland management kits, and parallel traditional extension material, for use by landholders in the central west region of New South Wales (and elsewhere as appropriate), based on identified economic and ecological values of bushland within agricultural production systems.
2. Achieve use of key kits in the field by landholders, including at least 30% of landcare groups in the region, and 10% of landholders that are not landcare members.
3. Develop, test and apply appropriate and objective methods to assess the response of both user groups to the kits, focusing on changes in awareness, attitudes and behaviour. Apply these results to revise and upgrade the kits for further and wider use. Compare the user response to the kits (plus marketing strategy) with response to, and effectiveness of, traditional extension materials.
4. As further components of the marketing strategy: develop and apply a variety of multimedia methods to raise awareness and provide information within the region; facilitate the development and use of policies, strategies and activities for integrating the management of remnant bushland within agricultural systems by public agencies, coordinating groups and catchment management communities; and facilitate the development of a network of public and private groups to further enhance such integration.
5. Establish with landholder groups and agencies a series of bushland restoration demonstration sites within the region, assist in providing extension and interpretation materials (including rapid assessment methods), and use the sites to evaluate both practical methods for bushland rehabilitation and the usefulness of the sites in changing attitudes and behaviour.

6. Prepare a literature review assessing the economic values of bushland for farmers and graziers, and use this material as the basis for developing one kit and other extension material.
7. Disseminate project results as they come to hand, and facilitate the adoption and adaptation of the marketing approach and kits for use elsewhere. Assess the feasibility of conducting a major conference in 1995–96 in integrated approaches to conserving remnant bushland in agricultural regions within the Murray–Darling Basin. Maintain links with other R&D projects funded by Environment Australia/LWRRDC within the Remnant Vegetation Program.

SUMMARY

Principal investigator: David Goldney

A range of extension materials are being developed which will enable landholders to carry out their own research into key environmental issues on their properties, including remnant woodland and scattered tree sustainability assessment, biodiversity baseline studies and assessment of river and stream health. The materials will also enable them to develop rehabilitation strategies within the context of whole farm planning. The primary instrument to facilitate these outcomes is the development of 10 key self-assessment kits. Six of these are now developed nearly to the colour print stage, but require further peer review from landholders and relevant scientists. A further four kits are in the concept development stage. A well-defined development strategy will ensure a product that works for most landholders and delivers research know-how in an easily digested form. A critical step in the development phase of each kit is their trialling by landholders from landcare and non-landcare backgrounds using focus groups. Twelve potential focus groups have been identified, and a focus strategy has been developed with the help of Ian Reeves (University of New England) and Allan Curtis from Charles Sturt University (Albury).

We expect six kits to be in the focus groups trial phase before Christmas 1996 and the remainder by March 1997. Trial kits will be modified as necessary and final print runs carried out for the release of this material in June–July 1997. To help facilitate this program, Sue Wakefield was appointed in late 1995 as educator–facilitator. At the same time we have also:

- developed a list of supplementary extension materials which will be produced in brochure format; 10 are in production development, the remainder (35) will be written by either December 1996 or March 1997
- developed a mass media marketing strategy which will be used to launch the self-assessment products
- run a one-day regional conference on the current state of remnant woodland research and extension in the region (100 people attended)
- identified the feasibility of hosting a conference on the theme 'Integrating sustainable agriculture and nature conservation – a land use imperative' in the Murray–Darling Basin in July 1998

- set up, in association with a parallel Natural Resource Management Strategy funded project, 72 fenced plots, each 0.25 ha in area, half in grassy yellow box woodlands and half in white box woodlands, as a long-term experiment to optimise conditions for regeneration
- gathered significant amounts of material on the economic values of remnant woodland in agricultural land, as a prelude to preparing a paper and the tenth kit
- addressed and participated in numerous landcare groups and workshops.

DISCUSSION COMMENTS

- Thought needs to be given to the pricing structures and marketing of the kits; it is important that the kits are seen to have a value and nominal fees at a minimum will do this.
- The project could look at the potential to link the collected information into state-of-the-environment reporting.
- The project could use local businesses (e.g. Hazelton Airlines) to help advertise the project and the remnant vegetation 'product' to the local community.
- It will be important to have strategies in place after exposure of the kits at field days in order to cope with likely high demand for information.

Economics of remnant native vegetation conservation on private property

Project reference	CSU10
Organisation	Charles Sturt University
Location of work	Albury, NSW
Project supervisor	Mr Michael Lockwood Associate Director Johnstone Centre Charles Sturt University PO Box 789 ALBURY NSW 2640 ph: (060) 419 884 fax: (060) 418 897
Commencement date	1 June 1996
Completion date	31 August 1999

OBJECTIVES

1. Identify and characterise the remnant native vegetation on private land in the study areas.
2. Estimate the non-market economic values associated with these remnants.
3. Estimate the market economic values of these remnants.
4. Recommend mechanisms by which the values identified in objectives 2 and 3 (both on-site and off-site) can be translated into policies and incentives for remnant vegetation conservation.
5. Assess the likely success of the policy alternatives developed under objective 4 based on the views of landholder focus groups.
6. Effectively communicate information about the project and its results to stakeholders.

SUMMARY

Principal investigators: Michael Lockwood, Sandra Walpole, Kreg Lindberg, Allan Curtis, David Goldney, Evelyn Buckley

This project is a multidisciplinary venture which encompasses economics, social science, ecology and land management. The project has four main phases: resource inventory, economic analysis, policy assessment and communication.

Resource inventory

The project focuses on the North East Catchment Management Region in Victoria and the Murray Catchment Management Region in New South Wales. Remnant vegetation on private property will be identified, using remote sensing in conjunction with field surveys. Remnants will be categorised

into quality classes using a methodology developed by David Goldney.

Economic analysis

The economic values associated with the remnants identified in the resource inventory will be measured. These values include both market and non-market economic benefits and costs. Market-related values include timber, prevention of on-farm land degradation, stock shelter and effects on property value. There are also off-farm market benefits associated with the prevention of land degradation. Non-market benefits include conservation of native plant and animal communities (both on- and off-farm) and provision of scenic amenity. This project will conduct an integrated assessment of these values, and incorporate them into a cost-benefit framework. The basis for the economic assessment will be a change in the management regime for the remnants, from the current situation to circumstances where nature conservation values are maximised. Market values will be assessed via landholder surveys and hedonic pricing. The costs of conserving remnant native vegetation will be estimated, including opportunity costs and direct costs associated with protection measures such as fencing. Non-market values will be measured using stated preference techniques, including the contingent valuation method. To enhance transferability to other study areas, values will be disaggregated according to biogeographic region, vegetation type, remnant quality class and local agricultural practices.

Policy assessment

Policies designed to conserve remnant native vegetation on private property should be consistent with the underlying values affected by such conservation. The results of the cost-benefit analysis will be used to recommend and test economic policy instruments for remnant vegetation conservation. Testing will concentrate on the likely acceptability of various policy options to landholders. Tests will be conducted using focus groups composed of landholders from the two catchment regions under study.

Communication

The project will be guided by a steering committee consisting of both technical experts and stakeholder representatives. Mechanisms such as dissemination of reports and community workshops will be used to communicate the results of the project to stakeholders. Major outcomes will be the following.

- Documentation of location and quality of remnant vegetation on private land in the study areas.
- Estimation of market and non-market values for these remnants.
- Identification of the key determinants of value, which will enable some (limited) transferability of the value estimates to other study areas.
- Review of the degree of congruence between the estimated values and policies for remnant vegetation conservation.
- Development and testing of value-based incentive schemes for the conservation of remnants.

- Recommendations to the government and stakeholders concerning preferred policy alternatives.

DISCUSSION COMMENTS

- The project is looking at alternative policy options; benefit-cost analyses can only look at alternative vegetation states.
- Farm income modelling work can also only examine alternative vegetation states.
- There is a need to be clear about what the project will be measuring; for example, consumer surplus or producer surplus.
- Measurement of off-site benefits of management of native vegetation will be very difficult (a problem shared by many projects); is it likely that off-site benefits will change landholder attitudes?
- It was suggested that programs 5 and 6 of the project could be merged, and that data from project CWE13 could assist in suggesting possible scenarios and policies as well as models for cost-benefit analyses.
- The project might be able to use Western Australian data sets that suggest a range of 'values' for remnant native vegetation in terms of off-site or indirect benefits; some indirect benefits may need to be expressed in terms of probabilities (e.g. the likelihood of survival, or higher numbers, of regent honeyeaters).

Using choice modelling to estimate non-market values

Project reference	UNSI9
Organisation	University of New South Wales
Location of work	Brisbane, Qld
Project supervisor	Professor Jeff Bennett Environmental and Resource Economics University College The University of NSW Australian Defence Force Academy Canberra ACT 2600 ph: (06) 268 8833 fax: (06) 268 8450
Commencement date	1 January 1996
Completion date	28 February 1999

OBJECTIVES

1. To develop an accurate, reliable and practical technique of estimating non-market environmental values in order to gain a better understanding of how the public values environmental goods. This will involve identification of the key attributes driving environmental values, the processes by which individuals bring these attributes together in formulating overall preferences, and how these attributes, processes and preferences vary across different institutional contexts.
2. Demonstrate the application of the technique in the case of stands of remnant vegetation in Queensland to give:
 - estimates of the conservation values of remnant vegetation stands
 - an analysis of the incidence of these benefits as an aid to the development of cost-sharing arrangements
 - a model to extrapolate the value estimates across other remnant vegetation stands
 - user-friendly software to demonstrate the value trade-offs inherent in resource use decisions involving remnant vegetation.
3. Demonstrate the application of the technique in the case of New South Wales wetlands, as a parallel to the remnant vegetation case study.
4. Work with a catchment management committee and explore divergences between private and social perceptions of value, and the potential for incorporating information regarding social values into private decision-making, in addition to the more common public use.
5. Describe how choice modelling could be incorporated into decision processes for the allocation and use of natural resources.

SUMMARY

Principal investigator: Jeff Bennett

Coming to grips with the complexities of the choice modelling process from a theoretical perspective has been the primary task of the research team during the initial months of the project. The culmination of this effort will be the release of the project's first research report in late 1996 and its presentation at the conference of the Australian Agricultural and Resource Economics Society in January 1997. The report will provide a comprehensive, comparative analysis of all the stated preference techniques for estimating non-market values.

Preparatory work has also been undertaken on the second and third research reports. These reports will provide details of the project's two case study areas: the desert uplands of central Queensland, and wetlands in the north-west of New South Wales. This work has involved field trips to the sites and extensive liaison with agencies cooperating in the project, notably the Queensland Department of Primary Industries, Natural Resources and the Environment and the New South Wales National Parks and Wildlife Service. Piecing together a picture of the desert uplands has proven particularly difficult, largely because the biogeographic data on the area are so limited. The project team is therefore involved in a process that will bring together for the first time, in a geographic information system framework, what data are available.

The next step in the choice modelling process will be to gain an appreciation of the attributes that make up people's perceptions of the conservation values of remnant vegetation. This will be achieved in the coming months through focus group meetings with residents of Sydney, Brisbane, Emerald and Moree.

To facilitate the extension of the findings of the project, a mailing list of people wishing to be kept informed has been drawn up. This was achieved through the publication and distribution of a pamphlet that summarises the goals of the project along with some background information on choice modelling. The level of interest in the project has been very strong, with over 400 responses to the pamphlet being received to date.

DISCUSSION COMMENTS

- The contingent valuation method implies that there is some 'true' value; does choice modelling also make this assumption?
- The existence of a 'true' value is dependent on the correct way of describing it as a good. As there is no single or correct description of environmental goods (because they depend on individual attitudes and perspectives), it may be necessary to describe environmental characteristics in different ways to different respondents. This is a problem for marketers as well as those involved in non-market valuation.
- The type and method of provision of information is also extremely important when modelling choice.
- The survey is using a methodology that involves drop-off and pick-up rather than mail, and this usually elicits a better response.
- In this project there is an implicit assumption that people understand the issues. It may be useful to set up a group of ecological experts as a control and compare their results with those from the primary survey.
- Because of the lack of information on environmental goods, it is important to make choices as close to market transactions as possible.
- There are trends towards co-management of natural resources, that is, groups of stakeholders making decisions. How strong is this relationship? Would there be differences between individual and group responses in choice modelling?
- In a comparison of contingent valuation and choice modelling, the inefficiencies are that it is more expensive to administer choice modelling primarily because sample sizes need to be bigger and more complex to achieve a statistically-defensible result.
- Data is being collected about the ecological issues for the two experimental areas, and this will be incorporated into the choice modelling questionnaires.

Factors influencing the market value of remnant native vegetation in South Australia, 1982-1994

Project reference	USA2
Organisation	University of South Australia
Location of work	Pooraka, SA
Project supervisor	Mr Wayne AJ Marano Lecturer School Economics, Finance and Property University of South Australia North Terrace ADELAIDE SA 5000 ph: (08) 8302 2523
Commencement date	19 August 1996
Completion date	30 April 1998

OBJECTIVES

1. Establish a model of market value for rural properties in South Australia which comprise a component of remnant vegetation.
2. Determine the changes in the market value attributable to remnant vegetation in South Australia from 1982 to 1994, and the factors which influence the market value attributable to remnant native vegetation.
3. Determine the ratio of the market value of remnant native vegetation to its potential cleared land market value, and how this varies according to land use, location and time.
4. Determine the impact heritage agreements (protective covenants) have on the market value of a rural property.
5. Establish the equity of the financial assistance payments made by the Native Vegetation Management Branch (South Australian Department of the Environment and Natural Resources) under the *Native Vegetation Management Act 1985*.
6. Determine the total financial assistance payment if the scheme was introduced as at 1994.
7. Comment on the general implications of the results for the increased use of protective covenants to conserve remnant native vegetation.

SUMMARY

Principal investigator: Wayne Marano

There is debate on how market values for remnant vegetation in a land clearance regulated environment are determined by the land market. Furthermore, there is debate on the impact that protective covenants have on the market value of rural property.

The project aims to provide additional knowledge on these matters through the investigation of market sales of properties from 1982 to 1994. The properties are restricted to those that are greater than 2 ha in size and located outside urban residential developments. The investigations aim to establish what amount of a purchase price (if any) is attributed to the remnant native vegetation and the factors which influence that amount. In addition, the study will determine the impact a heritage agreement registered on a land title has on the resale value of the property.

The findings will be important for landowners, bank managers, potential purchasers, real estate agents, farm advisers, farmer organisations, landcare groups and conservation authorities.

Research method

- Literature review and liaison with other researchers in the field of study.
- Problem definition and formation of research questions.
- Data collection. This involves six sources.
 - (i) real estate sales data from the Valuer General of South Australia for the period 1982–1994
 - (ii) property characteristic data from the Valuer General of South Australia
 - (iii) interviews with participants active in the market, key local farmers, local community groups, real estate agents and valuers
 - (iv) socio-economic characteristics and attitudinal and perception responses of the purchasers
 - (v) data from Native Vegetation Management Branch, Department of Environment and Natural Resources
 - (vi) exogenous variables that could influence the values of rural property across time and locations
- Quantitative and qualitative analysis of the data will be used to provide a basis for answers to the research questions. Analysis will be exhaustive, and numerous approaches explored. Essentially, an approach will be used which follows how price is determined in the market-place. The market data collected will be used to specify a hedonic price function and least squares linear multiple regression used to calibrate the implicit prices that are paid for the various characteristics that comprise a rural property. The possibility of both multicollinearity and interactive effects is highly likely, so specification and method will need to deal with these issues.

Outcomes

There are many natural resource issues addressed by the project, the major outcome determining the impact a land clearance regulated environment has had on the market values of remnant vegetation. The research will provide outcomes by way of a market value model of remnant vegetation, a model of ratios of market value of remnant vegetation in a land clearance regulated environment to its market value as if cleared, and an examination of the equity of the financial assistance payments made in South Australia. These outcomes are critical to answering questions such as the following.

- Are the impacts spread equally across locations and across land uses?
- How do the impacts change over time?
- Do properties that have certain characteristics suffer greater impacts?
- What impact do heritage agreements (protective covenants) have on the market value of rural property and are they spread equally?
- To what extent are future management costs being built into land value?
- Are the land value outcomes putting at risk the management of remnant vegetation?

The research will provide stakeholders with important information for developing policy on the retention and management of remnant native vegetation. Stakeholders will have improved knowledge of the factors influencing the market values of remnant vegetation in a regulated land clearance environment. They will therefore be in a better position to evaluate the impact that instruments and policy used in the management and conservation of remnant vegetation have on landowners, and the likelihood of conservation objectives being achieved.

The research will also help evaluate the likely costs that would be incurred in revolving funds and their likelihood of success.

In addition, bankers, agricultural advisers, real estate agents and new purchasers will be in a position to make more informed decisions and to give more informed advice on rural property matters.

DISCUSSION COMMENTS

- There is a need to incorporate key dates into the model, such as when compensation was paid under the South Australian *Native Vegetation Management Act 1985*.
- The project could look at a subset of hobby farms, if possible, as preferences and willingness to pay may be different for hobby farms (smaller area and cost) and for people with substantial non-farming income. This might show up as a geographic preference related to properties close to urban centres.
- Will the hedonic pricing function be modelled at one time or across time? There could be difficulties if time is included as a variable in the model.
- A time-series approach could be used to look at all samples and all site characteristics. There is a need to include properties with little or no vegetation in the model to obtain statistical reliability.
- The model should test the assumption that sellers are indifferent to the presence of native vegetation on properties, whereas buyers are not; this could be modelled in a staged approach to provide both demand and supply curves.
- The reasons for purchasing a farming property are notoriously variable, and it may be difficult for purchasers to remember the primary motivation for their purchase and willingness to pay.
- Early results suggest that 15% of the sample properties have been the subject of more than one purchase transaction.
- There is a need to do a time-series analysis on data, as since 1982 fluctuations in the real estate market will influence price as well as the presence/absence of remnant native vegetation.
- It might be useful to develop the model in a specific region and to then expand it to cover the entire State; a regional variable could be included in the model.
- The project needs to take into account that revegetation works may perhaps have also increased the value of properties, so there is a need to differentiate between remnant vegetation, regrowth, and revegetation in the analysis, if at all possible.

Landholder perceptions of remnant vegetation in the box-ironbark region of northern Victoria

Project reference	VCAI
Organisation	Victorian College of Agriculture and Horticulture
Location of work	Wodonga, Vic
Project supervisor	Dr S Hamilton Victorian College of Agriculture and Horticulture Dookie College MELBOURNE VIC 3647 ph: (03) 5828 6371
Commencement date	1 February 1996
Completion date	30 June 1997

OBJECTIVES

1. To improve the conservation and management of remnant vegetation on private land in the box-ironbark region of northern Victoria by gathering information from rural landholders about:
 - their perceptions of the extent, diversity, value and significance of remnant vegetation on their property, or on adjacent shire and Crown land
 - their actions as individuals to manage remnant vegetation
 - their actions as part of a community group to manage their remnants, and the influence that community groups have had on these management strategies
 - the extent to which agency programs and personal initiatives, such as exotic species establishment or farm forestry, may have impacted or will impact on remnant vegetation
 - the efficacy of agency and community-based extension programs in influencing remnant management.
2. Present the research findings to a forum of policy-makers, extension staff, community groups and key landholders, and identify potential market and non-market incentives to overcome current impediments to effective management and conservation of box-ironbark remnants.
3. Present the findings to a follow-up workshop of participating landholders, and identify improved management practices that could be implemented readily and the most effective ways of initiating action by individuals and communities.
4. Report the findings of the projects to all stakeholders in the management and conservation of box-ironbark vegetation.

SUMMARY

Principal investigator: Paul Dittman

The box-ironbark region consists of more than 1 million ha of woodland and forest vegetation in northern Victoria. More than 75% of this area has been substantially cleared, and only 2.5% is reserved. Many quality old growth and regeneration remnants remain on private landholdings; however, little is known about the perceptions, actions and needs of landholders who manage such remnants.

This project seeks to gain an understanding of the landholders' perceptions through a mail survey and a series of interviews. Eight subcatchments have been selected as representative of the major influences on the region since European settlement. Seventy landholders within each subcatchment have been identified to receive the mail survey. Firstly, each landholder was sent a letter advising them of the survey, and a questionnaire was mailed one week later. The following week, a reminder note was sent. Recently, non-respondents were mailed a further letter requesting their assistance, and another copy of the survey. To date, there has been a 54% response to the initial survey mail-out. A response rate of 65–70% is desired at the conclusion of the survey.

The survey covers the areas of:

- management of native vegetation in the local area
 - value of native vegetation
 - use of available funds
- private and government funds
 - contact with programs and community groups
- concerns about remnant vegetation
- level of knowledge of remnant vegetation
- managing remnant vegetation on the property
- information about the landholder, property and remnant vegetation.

A random phone survey of non-respondents will be conducted to ascertain the views of the 25–35% who declined to fill in the mail survey.

A series of 30 interviews will also be conducted based on a range of responses from the mail-out survey. These will be flexible, and will attempt to explore various aspects in more detail.

Following compilation of survey and interview results, a series of focus group workshops will be conducted throughout the box-ironbark region. These will present the results of the project to industry representatives, agency groups, policy-makers and the landholders.

DISCUSSION COMMENTS

- There is a need to do follow-up interviews from the mail surveys.
- There is also a need to develop a conceptual framework in order to identify the remnants of special priority. This may require developing hypotheses from the survey data and then going into key management issues in more detail via face-to-face interviews.
- The project could also consider using focus groups.
- It might be useful to look at the differences in perception of landholders with Crown or reserve land adjoining their properties and those without. The project could look at the issues of pest plants and animals in this context.
- Maintaining confidentiality in the surveys is a high priority, as landholders may become angry if confidentiality is not ensured.
- The project could focus on differences in commercial and non-commercial uses of the box-ironbark woodlands.
- The project could also look at whether landholders' views are different depending upon whether they are in landcare groups.
- Management by hobby farmers as against those who depend on the land for their livelihood might be another important issue.

Perceptual attributes contributing to maintaining native vegetation: a marketing study

Project reference	UME28
Organisation	University of Melbourne
Location of work	Parkville, Vic
Project supervisor	Dr J Cary Associate Professor School of Agriculture and Forestry University of Melbourne PARKVILLE VIC 3052 ph: (03) 9344 5016 fax: (03) 9344 5570
Commencement date	1 November 1996
Completion date	30 September 1998

OBJECTIVES

1. Identify attitudes towards native vegetation held by land users in specified agro-ecological zones, comprising grasslands, grassy woodlands, and areas where cropping is practised.
2. Identify the components of intrinsic values held by land users with respect to native vegetation in farming systems.
3. Determine relative preferences for landscapes incorporating native vegetation vis à vis more commonplace rural landscapes where native vegetation has not been maintained or has been eliminated.
4. Determine if attitudes to native vegetation, and landscape preferences, act as a barrier against maintaining native vegetation.
5. Identify more general attitudes towards native vegetation held by stakeholders in the urban community.
6. Develop guidelines for marketing the rehabilitation and maintenance of native vegetation to identified and differentiated land user groups and also to urban stakeholders.
7. Actively communicate results and guidelines to rural industries, government agencies, agricultural advisers and community organisations during the project and at its completion.

SUMMARY

Principal investigator: John Cary

Methods

- Site identification: Three study areas will be located: in the Wimmera in Victoria, in the Midlands in Tasmania, and in the south-east of South Australia. Landholders in these areas will be participants, as will an urban sample in Melbourne. The sites in the three rural regions will have a representative diversity of native remnant vegetation.
- Identifying and establishing images: The vegetation systems at these sites will provide a basis for providing a catalogue of pictorial (photographic) images of typical remnant vegetation, in various states of ecological health, and of different levels of maintenance quality. A range of remnant vegetation, particularly grassy woodlands, and grassy woodlands in association with cropping land, will be included in the images. Images may be computer-enhanced to highlight different associations and remnant characteristics.
- Preferences for different associations and identification of underlying patterns of association will be elicited from landholder and urban samples.
- Inherent and utilitarian values held for remnant vegetation will be identified.
- Patterns of meaning and descriptors related to management and value of remnant vegetation will be identified using an artificial neural network technique.

Outcomes

- The identification, for different target groups of land users, of positive and negative attributes associated with native vegetation; the identification of barriers to the maintenance of remnant vegetation by landholders.
- Meanings associated with different remnant vegetation associations.
- The establishment of marketing strategies to develop effective marketing and extension programs promoting native vegetation to rural landholders and also amongst urban stakeholders will improve the management of rural land, rural landscape amenity, and the effectiveness of programs encouraging national vegetation initiatives.
- Identification of landholder attitudes to native vegetation in grasslands, grassy woodlands and where cropping is practised.
- Identification of intrinsic values held by land users regarding native vegetation.
- Identification of relative preferences for landscapes incorporating native vegetation.
- Identification of attitudes towards native vegetation in the urban community.
- Development of marketing guidelines for remnant vegetation rehabilitation and maintenance for land user groups and urban stakeholders.
- Communication of results and guidelines.

DISCUSSION COMMENTS

- Evidence that human preferences for vegetation favour types that offer prospect and refuge, that is, the viewer can see without being seen.
- What range of ecological landscapes will be included within the project and where are they located?
- How will the project identify individual landholders with the sites that represent archetypal vegetation?
- It would be useful to include a question in the interviews about landholders' perceptions about fallen logs and other ecologically important litter.
- The project is examining information processing by individuals and is therefore context-dependent; this will be an important issue in the analysis of results. Interesting comparison of preferences in regions where clearing has ceased (or is being reversed) with those where clearing is the norm.
- There is a need to introduce controls on aspects of the photographic representations, for example on lighting, as preference may be expressed for associated effects (e.g. sunsets) rather than the vegetation type. There are also problems that need to be addressed because of the scale, that is, the photographs may need a close-up view for the details of grasslands, whereas a wide-angled view would be needed to convey the special character of woodlands. Also, the project will need to be careful in choice of time of year and preferences; for example, green grassland versus brown grassland.
- The project may need to differentiate between preferences for spending money as against broader preferences for particular types of landscape, and preferences for expenditure of society's money rather than the individual's.
- It might be useful to look at differences in preference values in South Australia for remnants with and without heritage agreements.
- Local context may have a big effect on existence values and hence preferences. Urban groups may have a high value for existence of the few bushland remnants remaining. The project will have to be specific about the interviewee being in the landscape rather than just knowing it is there.
- Ethnic background could be an important influence on preference values for different types of landscape.

Opportunities for the use of incentive payments to conserve remnant vegetation

Project reference	CWEI3
Organisation	CSIRO Division of Wildlife and Ecology
Location of work	Canberra, ACT
Project supervisor	Dr Mike Young CSIRO Division of Wildlife and Ecology PO Box 84 Lyneham ACT 2602 ph: (06) 242 1600 fax: (06) 241 3343
Commencement date	1 July 1996
Completion date	30 June 1999

OBJECTIVES

1. To produce and communicate five specific proposals for policy changes that will encourage the conservation of remnant vegetation throughout Australia. These will focus on opportunities to:
 - make payments associated with the introduction of management agreements and associated conservation covenants more cost-effective (Direct Payment Guidelines)
 - make the costs of conserving remnant vegetation more tax deductible, especially on land not used for the production of assessable income (Taxation Incentives)
 - use local government grant formula and associated state of the environment reporting mechanisms to encourage local government authorities to become more actively involved in the protection of remnant vegetation (Incentives for Local Government)
 - remove the perverse signals that many land tax and local government rating systems give landholders (Perverse Rating Incentives)
 - encourage non-government organisations to raise money needed to conserve remnant vegetation (Incentives for Non-government Organisations).
2. To involve in the R&D project the key organisations and groups whose support will be essential to have the policy changes implemented, and to recommend to Environment Australia/LWRRDC and others any additional action required to achieve implementation.

SUMMARY

Principal investigators: Mike Young and Carl Binning

Throughout all of these studies, the emphasis will be on the provision of incentives necessary to ensure that remnant vegetation, whose use is restricted by clearing regulations, is maintained in good condition.

Approach

Each of the studies to be undertaken is based on the assumption that, if biodiversity is to be conserved outside nature reserves, then it will be necessary for the people who use these lands to want to do so. The suite of mechanisms available to build such an attitude is vast and includes a range of institutional, motivational, financial, property-right and regulatory arrangements. Research to date suggests that these mechanisms are most effective when used in concert with one another. Against the backdrop of a government commitment to a 'national vegetation initiative' and using a series of case studies and simple models, this project will aim to develop pragmatic proposals for the use of financial incentives as part of a wider effort to encourage off-reserve biodiversity conservation. Each study will assess the feasibility of different program options and ways to implement them cost-effectively. Attention will be given to the types of legislative changes, if any, necessary to maximise the effectiveness of each financial instrument. All options will be evaluated against an assessment of their implications for government budgets and the extent of any changes they might make to the quantity of biodiversity conserved outside nature reserves.

The team is presently looking for suitable locations to complete the necessary case studies and for State government departments keen to work with us on each of the proposed studies. The first report is expected in February 1997 and, subject to guidance from the project's steering committee, will be on the use of direct payment mechanisms such as conservation covenants and management agreements.

DISCUSSION COMMENTS

- The order of dealing with the project objectives is very important. Is the project looking at the revenue side as well as the expenditure side of, in particular, the options for non-government organisations (e.g. waiver of stamp duties or other fees)?
- Incentive structures should perhaps be linked with regulatory instruments.
- There is a need for more scrutiny of tax expenditures, and the project could examine overseas incentives and models.
- The project may need to carefully distinguish incentives to conserve remnant native vegetation and those to foster general revegetation for other (non-ecological) purposes.
- The project will clearly have the phases completed at different times, but this risks losing the potential links between the objectives.
- Incentives such as tax concessions and rebates may be resisted or of less impact when considered over the long term. With respect to revolving fund mechanisms, are there possibilities of conservation organisations taking on management of remnants?
- Will the project examine the scope of environmental levies, which may spread ownership of land degradation problems to city as well as rural people?
- The project will need to include equity issues in consideration of incentive packages, and address who exactly will pay and how much under what conditions.
- Is the project related primarily to private land or will it deal with incentives for management of remnant vegetation on public land as well?
- Incentives need to be targeted to ongoing management, not just a once-off exercise.

Model native vegetation legislation and policies

Project reference	FASI
Organisation	NSW Farmers' Association
Location of work	NSW/SA/VIC
Project supervisor	Mr Fred Gulson Executive Officer NSW Farmers' Association GPO Box 1068 SYDNEY NSW 2001 ph: (02) 9251 1700 fax: (02) 9221 6913
Commencement date	19 August 1996
Completion date	31 March 1997

OBJECTIVES

1. Develop an improved legislative framework and policies to promote sustainable management and conservation of remnant native vegetation on farms, based on a clear identification of stakeholders and their roles and the development of an appropriate policy mix.
2. Publicise the results of the study, and recommend to Environment Australia/LWRRDC and other groups the actions required to implement project results.

SUMMARY

Principal investigator: Mr Fred Gulson

The project is a joint research effort by three farmer organisations: the New South Wales Farmers' Association, who are co-ordinating the project on behalf of the three organisations; the Victorian Farmers' Federation; and the South Australian Farmers' Federation.

Methods

1. Review of existing native vegetation legislation in New South Wales, Victoria and South Australia and elsewhere where appropriate. The aim of this section is to provide an overview of how existing legislation is used to protect and manage native vegetation.
2. Evaluation of existing legislation against a number of objectives generated by stakeholders, based on a survey of stakeholder attitudes, and other work including projects within the Environment Australia/LWRRDC program.
3. Development of model legislation based on sources including information drawn from stages 1 and 2 and experiences with other remnant native vegetation policy instruments in Australia or overseas.

Expected benefits

Research results will include input from various stakeholders and this will lead to a greater acceptance of recommendations and their adoption by both land managers and government agencies.

Outcomes

- Improved understanding of the roles, problems and issues faced by various stakeholders in remnant native vegetation protection and management.
- Cooperation and improved channels of communication among stakeholders.
- Community-based policy instruments.

Communication of results

The three organisations have extensive membership structure and media units. This will facilitate the involvement of land-owners and dissemination of research results.

Adoption of outcomes

A follow-up survey of stakeholders is proposed to provide feedback on communication of results and recommendations of actions needed to have project results implemented.

DISCUSSION COMMENTS

- Will the project examine voluntary controls as well as specific legislation?
- Communication needs to be constructive, and working from within farmer organisations is likely to be an effective method of understanding and changing attitudes and behaviours.
- The project needs to go beyond members of farming organisations to other rural landholders as well. A strategy might be to start with organisational members and then move on to the landcare movement, and then to other rural landholders.
- The research will require ecological information to assist objectivity, but clearly has an important political aspect as well.
- The steering committee for the project needs to have environmental expertise available to it.

Identifying alternatives to using remnant eucalypt vegetation for firewood in the Australian Capital Territory region through consultation with residents and farmers

Project reference	UOC7
Organisation	University of Canberra
Location of work	Canberra, ACT
Project supervisor	Allison Treweek Applied Ecology Research Group University of Canberra PO Box 1 BELCONNEN ACT 2616 ph: (06) 201 2937 fax: (06) 201 5999
Commencement date	1 September 1995
Completion date	31 December 1996

OBJECTIVES

1. Determine the species of eucalypts and the biomass of wood being used by residents of the Australian Capital Territory, and the spatial extent of the firewood catchment supplying these consumers.
2. Determine the socio-economic forces behind the Australian Capital Territory firewood industry and the market forces which dictate what the consumer of firewood buys.
3. Consult with farmers in the Australian Capital Territory about the possibilities of commercially growing hardwood timber on their properties to supply local firewood users.
4. Determine the extent of knowledge and understanding of the 'firewood issue' by residents of the Australian Capital Territory, and explore through consultation the alternatives available to them.

SUMMARY

Principal investigator: Ms Allison Treweek

Each winter an estimated 80 000 tonnes of firewood is consumed in the Canberra region. This is 20% of Canberra's annual domestic energy consumption for heating. In the last decade the firewood catchment area for Canberra has extended from within the region to include areas in central western New South Wales on private agricultural land. The dilemma is that these areas have conservation value as stands of remnant vegetation. This study encompasses four major stakeholders in the firewood industry: merchants, retailers, farmers and consumers.

Merchants

There are eight major wood merchants in the area. Four participated in the survey. A major merchant is one who advertises in the Yellow Pages™ and holds permanent yards. From these interviews it was determined that the firewood catchment for the Canberra region had expanded to include areas approximately 500 km north-west, towards Condobolin in the New South Wales wheat-belt. This is due to consumer demand for the popular species of box and ironbark. The merchants who were interviewed only sold these species and some river red gum (*Eucalyptus camaldulensis*). They had tried other species but had found them unmarketable. The participant merchants currently transport approximately 22 000 tonnes of firewood into Canberra per annum. This discounts the smaller merchants without permanent yards and the larger merchants not interviewed. The estimate for all larger merchant enterprises is 35 000–40 000 tonnes per year.

The delivery of firewood can be divided into two socio-economic factors: labour and transport.

- Labour: The cost varies greatly. The two merchants who use contractors pay \$35–\$50/tonne depending on the time of year. The remainder, who use suppliers, pay on average \$80–\$90/tonne which includes transport and labour.
- Transport: The costs of transport vary between \$35–\$50/tonne for the two who use contracted labour. The capital of one of these merchants includes a truck, lowering transport costs to \$35/tonne.

Retailers

The six fireplace retailers in the Australian Capital Territory were surveyed for recommended timber species. Their perception of the industry's economic condition was also recorded. All but one retailer stock slow-combustion products. They all commented that the industry is in a growth period, with figures up since the start of the 1990s.

The retailers all recommended hardwood timbers and no softwood. Fifty per cent specified red box (*Eucalyptus polyanthemos*) or yellow box (*Eucalyptus melliodora*) for combustion purposes. This includes the largest two retailers. The other three recommend 'good Australian hardwood', only naming species when prompted. However, the merchants recommended as suppliers of firewood only stock box species. In the words of one retailer, it is a 'catch 22' situation.

Farmers

Twelve farmers were sampled: 10 from the New South Wales region and two from the Australian Capital Territory. The farmers were interviewed to assess their interest in supplying the Canberra region with plantation hardwood. Out of the 12 who were interviewed, all but two are interested in planting firewood species on their property. The Australian Capital Territory farmers do not see a viable possibility because the lease-hold system in place restricts their long-term planning capacity.

The farmers are already planting for a variety of reasons including creating shelter belts and to combat land degradation. Most would prefer to have an economic benefit directly associated with this activity. The current model for viable plantation timber is to cultivate *Pinus radiata*. Hardwood plantations for firewood present a potential alternative.

Consumers

The consumer survey process is still under way. Consequently there are no results to report.

CONCLUSIONS

Canberra's firewood industry is driven by consumers. As a result, the merchants are unwilling to change the timber species they stock, at the risk of losing business. This is a concern supported by the fireplace retailers, who also recommend only the box species. The problem is that these are the slowest growing trees. Without extensive cultivation, the market will exhaust itself. The interest in the farming community to plant appropriate tree species should be capitalised on if the industry is to sustain itself. To that end, the growth rates of those species need to be established and distributed to the industry. The survey of the consumer group, the Canberra wood-burning community, will indicate whether the community only burns box species. It will also gauge whether they are willing to burn other species that are grown from a plantation resource rather than remnant vegetation.

DISCUSSION COMMENTS

- There are already several fuelwood plantations in Australia, including some managed by Australian Capital Territory Forests. Some of these include non-eucalypt species such as *Acacia mearnsii*, which are quick-growing and provide wood with good burning characteristics.
- Problems of source timber are built into the fuelwood industry; for example, fuel heaters are sold with warranties stating that they are covered only for the use of hardwood timbers.
- There are some pressures within the fuel-heating industry to control development of the market.
- The Sydney firewood market is bigger than Canberra, and this may offer additional opportunities or additional problems.
- There are also problems with manufacturers of fuel stoves having to design them to meet emission standards set by environmental protection authorities. Because of the time needed to cure softwood timbers, hardwoods are the most likely source used to meet these standards.
- The Australian market for firewood is estimated to be 6.1 million tonnes per annum, and this is likely to be having a significant effect on remnant vegetation in firewood source areas.
- It may not be possible to readily achieve a market-driven solution, and there may be a need for regulations. The industry is not necessarily against some forms of control, as this would help to regulate fly-by-nighters operating outside the standards of the industry.
- There is evidence that the search for firewood is having a significant impact on habitat in the central-west of New South Wales, for example trees on travelling stock routes are being ringbarked for later felling as a source of firewood.

Building conservation strategies from stakeholders' intrinsic and social values

Project reference	UNE26
Organisation	University of New England
Location of work	Armidale, NSW
Project supervisor	Mr Geoffrey Kaine University of New England ARMIDALE NSW 2351 ph: (067) 73 2220 fax: (067) 73 3245
Commencement date	1 January 1997
Completion date	30 June 1999

OBJECTIVES

1. Identify and describe the intrinsic and economic values that stakeholders place on native vegetation in agricultural landscapes.
2. Measure the relative importance of these vegetation-specific values in stakeholders' judgements about the desirability of retaining and managing native remnant vegetation.
3. Examine the relationships among each of the following:
 - the intrinsic and economic values that stakeholders place on remnant native vegetation
 - the relative importance of these vegetation-specific values in different stakeholders' judgements about the desirability of retaining and managing remnant native vegetation
 - the broader social values and contexts in which vegetation-specific values have evolved and are evolving; these will be important determinants of the management options that will be acceptable to different stakeholder groups.
4. Assess the extent to which conflicts between stakeholder groups over remnant vegetation in Australia could be resolved by raising awareness of the values at the root of conflicts, or by clarification of rights and responsibilities of stakeholder groups.
5. Identify the implications of this assessment for the formulation of strategies aimed at establishing collaboration between stakeholder groups (e.g. government, conservationists, landholders, research and extension professionals) to retain and manage remnant native vegetation on agricultural land.
6. Canvass the views of a wide range of stakeholders on these implications and consolidate these in a document that will assist government agencies to develop regional programs for managing remnant native vegetation on agricultural land with the support of other stakeholders. Publicise project results widely.

SUMMARY

Principal investigators: Geoff Kaine and Jean Sandall

This project is being undertaken at the Rural Development Centre at the University of New England. Additional expertise will be provided to the project by Ray Cooksey and Ian Reeve of the Department of Marketing and Management and the Department of Sociology.

The problem of conserving remnant native vegetation on agricultural land is a complex one and involves the attitudes and behaviour of a range of stakeholders. On the one hand, there are long-term public benefits to be gained from conserving Australia's unique vegetation. On the other, the costs of conserving remnant vegetation on agricultural land, both in terms of potential losses in production and direct management costs, are borne largely by individual landholders. From the perspective of landholders, the costs may well exceed any personal rewards. Progress in ensuring an equitable distribution of the benefits and costs of conserving native vegetation in agricultural landscapes has been impeded by conflicts of values and interests among stakeholder groups.

The aim of this research is to improve the understanding among stakeholder groups of the value bases that underlie their perceptions of remnant native vegetation issues. By this means, the project aims to assist stakeholders to identify: (1) areas of shared values to support conservation initiatives, and (2) the types of institutional change that might be acceptable where such change is needed. By focusing on stakeholders' values, the project is directed at altering the nature of the debate among stakeholders over remnant native vegetation. This research will encourage stakeholders to reconceptualise remnant native vegetation issues, contemplate new options for change and view existing options in a different light. This will, in turn, provide a starting point from which negotiation and progress to new policies and programs can take place.

The project will use two case study regions that are different in terms of the nature (e.g. historical context) and degree of contention involved. Focus groups will be held in each of the case study regions with representatives of stakeholder groups, including landholders, research and extension professionals, conservationists and policy-makers. The knowledge gained from these focus groups will be used to assist in the design of face-to-face interviews that will be conducted with about 250 members of these stakeholder groups. The interview data will be analysed to enable social values that are shared by stakeholders to be identified, and the relationships between those values and the values they hold regarding remnant native vegetation to be evaluated. A representative sample of stakeholders who participated in the focus groups will then be invited to attend a workshop in each case study region.

The aim in these workshops will be to present the findings of the project and encourage reflection among the participants on the value conflicts underlying remnant native vegetation issues. The research outcomes, together with the workshop outcomes, will be consolidated into a document which will be circulated to a wide range of stakeholders for comment. After receiving stakeholder comment and revising the document, the

final report will be presented to Environment Australia, LWRRDC and other stakeholders at a seminar in Canberra.

DISCUSSION COMMENTS

- Most States that have clearing controls have gone through a process of reaching a level of landscape change which had an adverse effect on productivity before there was sufficient support for clearing controls to be introduced. It would be useful to compare a region that has not yet reached that point to see whether people are prepared to move to good land management practices and reduce clearing *before* environmental indicators make this an imperative.
- It might be better, for comparative reasons, to locate the case studies in one State. For example, States in clearing or replanting cycles are likely to also differ in demographic structure, business approach to land management, and organisational and political structures.
- It might be preferable to undertake the research in Victoria or South Australia where clearing controls have already been introduced, rather than other States where controls are not fully implemented, as the use of a region where vegetation management is controversial may make it difficult to unpack the variables influencing landholder values and attitudes.
- Changes in attitude of the focus groups may occur during the course of the project, for example, following the introduction of clearing control legislation, such as State Environmental Planning Policy 46 in New South Wales.
- The project will need to be clear and careful about the information that people are using as a base for their values; if the information base changes the attitudes may follow.

Effectiveness of incentives in changing landholder attitudes towards remnant vegetation

Project reference	CCM3
Organisation	Department of Conservation and Land Management, WA
Location of work	Como, WA
Project supervisor	Ms Penny Hussey Rural Nature Conservation Officer Department of Conservation and Land Management, WA PO Box 104, Bentley Delivery Centre COMO WA 6953 ph: (09) 334 0530 fax: (09) 334 0278
Commencement date	1 January 1996
Completion date	30 June 1996

OBJECTIVE

To assess attitudes towards remnant vegetation in four shires in the Western Australian wheat-belt.

SUMMARY

Principal investigators: Greg Beeston and Penny Hussey

Concern for the retention of native vegetation on private land in agricultural areas led to a collaborative project in 1986 to determine the needs and attitudes of farmers to conserving remnant vegetation. Four shires were surveyed and the results published (Coates 1987).

At that time, landcare and Greening Australia had barely commenced. Huge inputs of dollars and time and 'awareness-raising' have since been aimed at the agricultural community. How effective have they been? It was decided to repeat the survey 10 years on to determine what changes in attitude and action have taken place, and, if possible, to see what prompted these changes.

Method

Repeat, as far as possible, the 1986 data for comparison purposes. Therefore, same shires (Dumbleyung, Lake Grace, Pingelly and Tammin) with Kellerberrin added for CSIRO's needs, same proportion of landholders, same interview method, same questions plus others. Work undertaken from January to May 1996, data put into ORACLE, accessed via SITES at Agriculture, Western Australia. The initial comparison of 1986-96 has been done, and will soon be published as an Agriculture, Western Australia Technical Bulletin. Further

analysis will be done (thanks to Environment Australia for some extra funding for data access).

Results

If you would like a copy of the report to be sent to you, please contact Penny Hussey, CALM, Locked Bag 104, Bentley Delivery Centre, WA 6983.

DISCUSSION COMMENTS

- Bias related to the interviewer could be a factor in the results; that is, the respondents may have been trying to please the interviewer by providing the 'right' answer.
- Care is needed in extrapolating data about the value of financial incentives from one jurisdiction to another as the dynamics and context are often very different.
- Care is also needed in uncovering the causes and effects of changed attitudes; assumptions about these cannot be made from the data presented to date.
- Attitudes can be cyclic and dependent upon a particular issue; for example in Western Australia there are massive salinity problems.
- Environment Australia and LWRRDC should discuss further analysis with the principal investigator; some workshop participants asked to see copies of the questionnaire and raw data and would provide suggestions on how best to analyse and publish the results.

REFERENCE

Coates, A. 1987, *Management of Native Vegetation on Farmland in the Wheatbelt of Western Australia*, Resource Management Technical Report 145, Department of Agriculture, WA.

Applying management principles in variegated landscapes; identifying production-conservation trade-offs

Project reference	CTC9
Organisation	CSIRO Division of Tropical Crops and Pastures
Location of work	Mandubbera, Qld
Project supervisor	Mr N MacLeod Senior Experimental Scientist Cunningham Laboratories CSIRO Division of Tropical Crops and Pastures 306 Carmody Road ST LUCIA QLD 4067 ph: (07) 3377 0770 fax: (07) 3377 0266
Commencement date	1 July 1996
Completion date	30 June 2000

OBJECTIVES

1. Explore the scope for translating variegated habitat management principles to practical property management strategies for the protection of remnant pasture vegetation (herbage plus trees) that meet both resource conservation and economic production goals.
2. Use four beef cattle producing enterprises located in two subregions within the subtropical woodlands of south-eastern Queensland to examine and quantify the potential trade-offs between production and conservation objectives.
3. Develop for each of the four case study properties a comparison between the physical and economic performance of present management strategies, and that projected for alternative strategies that seek specifically to optimise production and conservation performance at the whole enterprise scale.
4. Identify the nature and extent of barriers to, and opportunities for, the definition and implementation of such strategies.
5. Assess the implications of potential vegetation conservation policies at the individual case level.
6. Generate guidelines and strategies for extending this information widely to beef cattle producers (including the development of property management planning modules) to public land managers and policy-makers, and to provide qualitative and quantitative data for regional land use planning projects.

SUMMARY

Principal investigator: Neil MacLeod

The project is centred on the subtropical woodlands of southern subcoastal Queensland. These woodlands are largely managed as pastures to support extensive livestock grazing or, to a lesser extent, are being cultivated for cropping. Extensive areas of these woodland pastures are either degraded or degrading from *both* a production and a conservation perspective.

Attributed causes, from a pasture plant and treescape perspective, include severe grazing, excessive tree clearing, soil disturbance, fertilisation and the introduction of exotic plant species (either in conjunction with pasture 'improvement' activities or as weeds) and, more generally, pasture management decision-making based on production versus conservation values. The concept of habitat variegation (cf. fragmentation) is the most applicable model for these grassy woodlands, as the remnant vegetation to be conserved is modified to varying degrees, but essentially forms the production system (natural herbage, shrubs and trees) itself. *Principles* to integrate management and conservation of the variegated remnants within commercial grazing production systems have been advanced, but their translation to *practical management strategies* has been limited to date. Both beef producers and land managers and the professionals servicing their interests (extension, agribusiness and so on) are actively seeking this information with strong emphasis on practicality and demonstrations of success.

The project uses a case-study approach, involving four beef cattle producing enterprises located in two subregions within the subtropical woodlands, to examine the nature and scope of potential trade-offs between production and conservation objectives. Comparisons will be drawn for each case property between the physical and economic performance of present management strategies and that projected for alternative strategies that seek specifically to optimise production and conservation performance at the whole enterprise scale. Conservation strategies will centre on conserving the remnant vegetation and promoting biodiversity within the context of a *variegated habitat* management system. The alternative strategies for each case will be determined by a panel of technical specialists (e.g. conservation biology, pasture ecology, grazing systems, property resource planning, soil hydrology, agricultural extension) in conjunction with the case property managers and other selected landholders. Barriers to, and opportunities for, adoption of the alternative management strategies will be identified and the cases will act as focal points for an innovative extension campaign in the target region.

The project is being conducted by a multidisciplinary research, development and extension team working closely and interactively with local land managers, including the case property managers. It has grown from earlier CSIRO-Queensland Department of Primary Industries-Queensland Department of Natural Resources collaborative initiatives (e.g. MRC Project CS 195, LWRRDC Project CTC2) which were also multidisciplinary and which recognised the need for a 'platform' or series of focal points to both highlight the need for integration of experimental approaches and results, and to direct its practical form into information of direct value for land

managers. The case-study format and upfront objective to develop practical management strategies (including property management planning modules) are specifically proposed to meet this ideal, as is the whole enterprise scale of approach.

DISCUSSION COMMENTS

- There is a need to build in issues of spatial and temporal scales for both the economic and ecological components of this project.
- The project needs to ensure experimental areas are carefully selected, and it may need to include areas of intensive development.
- A technical panel will be established to provide specific advice on aspects of the project as it develops.
- The concept of break points in both ecological state and transitions and economic circumstances could be adopted into the proposal.

Grassy white box woodlands: incentives and barriers to rural conservation

Project reference	CSO2
Organisation	Community Solutions
Location of work	NSW
Project supervisors	Ms J Elix and Dr J Lambert Community Solutions 179 Sydney Road FAIRLIGHT NSW 2094 ph: (02) 9948 7862 fax: (02) 9948 7862
Commencement date	1 April 1996
Completion date	30 September 1997

OBJECTIVES

1. Building on existing information on the locations and conservation status of grassy white box woodland remnants in New South Wales, identify through stakeholder consultation:
 - incentives likely to lead to conservation of these remnants
 - general costs to government of such initiatives
 - barriers to such conservation.
2. Bring together academic research, a major conservation non-government organisation and a peak farmer organisation to work closely with rural landholders in a collaborative project to expand community understanding of the issues involved.
3. Examine the place of on-farm conservation agreements in remnant vegetation retention and management.
4. Provide an initial assessment of costs to government(s) of implementing incentives necessary to increase conservation of grassy white box woodland remnants.
5. Develop a model for on-farm conservation of remnant vegetation, using grassy box woodlands as a case study.

SUMMARY

Principal investigators: Judy Lambert and Jane Elix

An essential element of this project is that it is a collaborative effort in which Community Solutions is working with the New South Wales Farmers' Association, the World Wide Fund for Nature, and the Environmental Studies Unit at Charles Sturt University, Bathurst.

Work completed includes:

- literature review and interviews on location, tenure and conservation status of grassy white box woodlands

- identification of key stakeholder/managers of grassy white box areas in the Wagga Wagga, Bathurst–Orange and Tamworth regions
- provision of background information to stakeholders
- individual interviews and completion of short questionnaires on issues relating to conservation management, barriers to such management and possible incentives.

Interviews are nearing completion and data analysis will begin in the next two weeks.

Participants

Twenty-nine site visits completed have included cemeteries, farms, local parks and reserves, roadside reserves, town commons and travelling stock routes and reserves. To date, 39 questionnaires have been returned, the respondents being as follows.

	Wagga Wagga	Bathurst–Orange*	Tamworth
Farmers/graziers	6	3	7
Government officers	3	2	2
Local government staff	2	1	2
Academics	1	–	1
Conservation non-government organisations	–	1	2
Other	2	1	3
Total	14	8	17

* Interviews just completed, awaiting some questionnaires

Issues

Although no data analysis has yet been done, preliminary consideration of the interview material indicates that key issues include the following.

White box identification

While scientists may have some difficulty in distinguishing white box from other related species, the need for ordinary landholder/managers is to recognise the ecological community and the importance of the understorey.

'Locking up' versus managing for conservation and production

The possibility of reserving the small remaining near-pristine areas on public land and managing them for conservation while managing productive land in ways which will aid conservation while still allowing intermittent use for stock feed and shelter.

Costs are a barrier

The observation that costs are a real barrier to conservation management and that these can in part be addressed through cooperative schemes such as the Land and Environment Education Program.

Conservation agreements

Even committed conservation farmers are not enthusiastic about conservation agreements entered into with the New South Wales National Parks and Wildlife Service, their concerns being for the possible level of government intervention in the management of private land.

DISCUSSION COMMENTS

- Conservation agreements could be with non-government organisations as well as, or rather than, with government agencies.
- The project could include cemetery trusts in the surveys, as cemeteries often contain significant remnants of native species.
- Within the white box region, there will be different responses from different groups of people as a result of the amount of previous work undertaken and information provided locally, and in the number of trees remaining in the area.
- Community groups may be willing to take on the management of specific areas of high conservation status or need.
- There may be some difficulties for landholders in identifying the grassy white box vegetation community.
- The project needs to be clear on whether it is dealing with management of existing remnants and/or with revegetation issues.
- Incentives or benefit transfer mechanisms are likely to differ widely between government and private managers.

Improving market outcomes: the case of native grasslands

Project reference	UME25
Organisation	University of Melbourne
Location of work	Vic, SA and NSW
Project supervisor	Mr Bill Malcolm Senior Lecturer School of Agriculture and Forestry University of Melbourne PARKVILLE VIC 3052 ph: (03) 9344 5015 fax: (03) 9344 5570
Commencement date	1 July 1996
Completion date	30 June 1998

OBJECTIVES

1. Produce two reports (one for natural grassland plains, one for secondary grasslands on slopes and hills), in cooperation with relevant programs and agencies, which:
 - identify the key economic, environmental and social factors taken into account by landholders when making decisions which affect native grasslands
 - quantify the economic role of native grassland and native grasses and forbs across south-eastern Australia, in different property management systems under different economic conditions; this will include both direct economic uses such as livestock production and, as far as possible, indirect and off-site effects such as control of waterlogging and salinity
 - produce region-specific economic and financial information about the management of remnant grasslands and native grasses and native forbs within whole farm systems
 - develop methods for decision-making by land managers about native pasture in situations where there is limited information about pasture characteristics, about response to management and about future benefits
 - identify feasible financial and non-financial incentives for sustainable management and conservation of native grasslands and management and establishment of native pastures, based on the likely private and public benefits already identified.
2. Assist rural industries, government agencies and community groups to incorporate project findings into their policies and programs, including the use of effective incentives.
3. Develop and promote a farm management decision support package to assist landholders with native grassland to analyse the management options available to them, and to evaluate the financial consequence of those alternatives.

SUMMARY

Principal investigators: Jim Crosthwaite and Bill Malcolm

This project will examine the economics of managing native grasslands on farms, in particular how changes to the management of predominantly native grass paddocks affect whole farm economic returns. The issue will be addressed in two contexts: where native grasslands on farms may require particular management if they are to retain their conservation values, and where native grasses and forbs may help prevent and overcome land degradation.

Two case study farms are being chosen for the natural grassland areas in each State, and two for the slopes and hills in each State. The case studies will be accompanied by interviews with up to 10 farmers in each region and preparation of background information about farming systems in the region. Maintaining links with regional groups that have an interest in native grassland management is an important component of the project.

The approach for each case study involves estimating the economic contribution of native pasture within a whole farm system, and how this contribution could vary in response to changes in external factors (e.g. drought, price change) or to changes to farm management (including management of individual paddocks). A simple, transparent and robust model is required for users, who will be mainly farmers and extension officers. A spreadsheet budgeting approach will be used which can be adapted to the lack of pasture data, and to estimating actual and potential stocking rates.

The model will be used to address how changes on one part of the farm affect another, because native pasture is often found only on a part of the farm rather than the whole farm. As far as possible, estimates will be made of production and use of feed from each paddock; this will require tracking stock movement from one part of the farm to another. Results from each paddock are combined to give monthly feed supply/demand for the whole farm; this can be presented graphically to show the relative contribution of each paddock at different times. Stock numbers, costs and income will be linked to generate annual economic/financial measures for the whole farm. The model will be useful for analysing choices about managing existing pastures, incorporating a risk element as for drought, and estimating (at the whole farm level) opportunity costs of managing native grassland of high conservation value. Pasture development or cropping options will also be evaluated.

Estimation of indirect and off-site effects of different management systems will be largely derived from other studies. Results from the on-farm study, and estimates of indirect and off-site effects, will be used to identify feasible incentives.

DISCUSSION COMMENTS

- The project appears to emphasise within-farm issues rather than comparison across farms.
- Is it possible to use economic analysis to identify the *potential* livestock capability of a particular paddock, or does this need unambiguous field data?
- Wool harvesting costs are significant and could be a primary influence on farm productivity and hence decisions.
- A useful extension of the project, which currently concentrates on European stocking systems, would be to look at stocking of kangaroos.
- The challenge for the project is to develop a whole-systems approach, incorporating both direct and indirect costs and benefits.
- The project could compare data with equivalent information published by the Farm 500 Group, reflecting different enterprises and lifestyle choices.
- A major challenge for this project is to examine in sufficient detail the whole-farm system, and direct and indirect economic and environmental benefits. There are a number of data sets and models available, but these have largely focused on economic issues (e.g. Farm 500 data, Formula in Western Australia, pasture and grazing programs).
- Another layer of complexity could be added to the model by including gross family margins.
- GRASSPLAN (CSIRO) and the University of Melbourne Veterinary Science Sheep Graziers Network models could be considered.

Managing remnant vegetation in dry agricultural areas of southern Australia

Project reference	UMU9
Organisation	Murdoch University
Location of work	Murdoch, WA
Project supervisor	Dr Susan Moore Lecturer Environmental Science Murdoch University MURDOCH WA 6150 ph: (09) 360 6484 fax: (09) 310 4997
Commencement date	24 February 1997
Completion date	24 February 2000

OBJECTIVE

To undertake case studies of management of small government reserves and privately owned remnants in dry farming areas of southern Australia in order to:

- investigate options for non-government heritage agreements
- evaluate the costs of these management options, including the economic value of grants and value of voluntary contributions; compare these costs with the costs of government management of equivalent reserves
- evaluate the social values: the participants' reasons for contributing to management, including their perceptions of the private and public benefits, intrinsic values, sense of ownership, sense of place
- evaluate the effectiveness of government support mechanisms in motivating and assisting community participation
- recommend strategies for successful community involvement in management of government and privately owned remnant vegetation.

SUMMARY

Principal investigator: Rod Safstrom

This is a study to investigate the economic and social value of community involvement in the management of both government and private remnant vegetation. It aims to determine, by examining actual cases, why and how the community is involved, to compare this involvement with government management, and to explore ways in which effective involvement can be nurtured and encouraged.

The study is based on the premises that we cannot rely on the government to provide and manage a fully representative

reserve system, and that private sector involvement in managing remnant vegetation on private land and in government reserves is required if the remaining biodiversity is to be retained.

The study will focus on remnant vegetation in dry agricultural areas (rainfall less than 600 mm) of Western Australia, South Australia and Victoria. This vegetation is characterised by small patches of inadequately reserved vegetation managed by government and private owners. The majority of remnants on private land and many on public land are not actively managed for private or public benefits and nature conservation values are often deteriorating. Fortunately, some remnants and reserves are being actively managed by individuals and community groups, often on a voluntary basis, and it is some of these groups which will be the basis for the case studies.

The economic aspects of management of remnant vegetation will be explored. The project will determine costs and effectiveness of government management of its small reserves and compare these costs with those of joint government and community management and community management options. Community management will involve looking at its effectiveness and economic value and the costs and effectiveness of any government support for that management.

Community management models to be investigated include wardens, custodians, local and remote committees of management, covenants and heritage agreements. Models for community purchase of threatened private land such as co-operatives and fund-raising by non-profit organisations will also be explored.

An important part of the project will be discovering reasons for community contribution to management; for example, what are the perceptions of private and public benefits, intrinsic values, sense of ownership and sense of place towards particular areas of remnant vegetation.

It is hoped that the study will determine the most effective ways of managing land to retain and improve its conservation values. The impact of private and community management is currently small, but, if such management is socially and economically valuable and can be optimised, then improved habitat management of national significance could occur.

DISCUSSION COMMENTS

- Communication is an essential aspect of this project.
- The project could look at John Wamsley's *Earth Sanctuaries* concept, also Wetlands for Wildlife, another non-government organisation.
- The project may also look at the reasons why conservation and landcare groups form, and the size and life-cycle of these groups.
- Another aspect that could be included in the project is relating landholders' use of local knowledge and interest in adaptive management and research to the quality of their management.

- The project could also look at 'friends' groups, such as the Friends of the Helmeted Honeyeater. If there are no scientists involved in these groups, there are usually some field naturalists. These groups might provide a useful contrast to other community organisations, such as landcare groups, for the purposes of the project.
- There is a need to look at institutional models to help form an understanding of how groups develop, and work could also look at organisational and control relationships in relation to efficiencies of management.
- A case-study approach would be useful for this project.
- The project should involve close links with a sociologist as well as an economist.

Policy instruments for the conservation of remnant vegetation: a UK perspective

John Bowers

Vegetation remnants are survivors from populations which have largely disappeared. They show three important characteristics: they are of small size; comprise a small fraction of what existed in the past; and require active management for long-term survival.

The lowland sites of the UK whose survival is deemed by the statutory conservation body to be necessary to conserve UK biodiversity are 'remnants' by these criteria.

These sites are semi-natural and survival depends on the continuation of uneconomic land use practices. Many are sensitive to minor variations in technical parameters such as stocking rates and fodder cutting dates.

Many are located on small and economically marginal agricultural holdings; in other words, where restrictions on land use practices significantly affect viability.

Remnants have survived for various reasons:

- socio-economic factors – the owners lack capital; are old; lack successors
- legal factors – title is unclear or divided
- physical factors – topography.

In many cases there can be no expectation of survival without active policy.

These remnants cannot be protected by sanctions or controls but instead require incentives. Incentives are needed for a number of reasons: to protect against first mover exploitation and moral hazard; because management entails the commitment of resources by the landholder; and to create equity because the owners of remnants are those who have conserved their vegetation.

In the UK, incentives take the form of management agreements whereby the landholder accepts a series of restrictions on husbandry in return for an annual payment based on the profit foregone. Management agreements may be site-specific for valuable sites; with less valuable sites a standard package may be adequate.