



Setting priorities for research and development to support the management of Queensland's native vegetation



Mid-term report for the Consortium for Integrated Resource Management (CIRM)

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Executive summary

Priorities for research and development (R&D) are formulated to ensure that limited resources are directed to the most important and pressing issues. However, priority setting is an ongoing process as priorities need to be reviewed frequently to ensure that they respond to changing policy demands and to new scientific findings or experiences. This paper outlines the process of priority setting that has been followed for research on native vegetation in Queensland since 2002, with particular reference to the most recent, a workshop held in April 2007.

The Consortium for Integrated Resource Management (CIRM) (see Appendix 1 for more detail) adopted native vegetation management as a program in 2002 and Dr Jim Tait was contracted to produce a CIRM position paper that was entitled “Prioritising research on native vegetation in Queensland” (Tait, 2004). In May 2004, the first CIRM Native Vegetation Management Workshop brought together key R&D staff involved in native vegetation management. Participants identified 10 collaborative R&D projects and three of them were progressed to two-page project applications. In late 2005, with the support of the CIRM Native Vegetation Management Working Group, three large collaborative projects were submitted to Land and Water Australia (LWA) and the Commonwealth Environmental Research Facilities (CERF) programme for funding and two were successful.

In 2006, the Working Group decided to update the priority themes via another workshop process. The second CIRM vegetation workshop was entitled “Managing Queensland’s native vegetation for multiple benefits” and was held on April 4, 2007 at CSIRO, Queensland Bioscience Precinct. The workshop brought together key researchers and government representatives from CIRM partner organisations as well as other stakeholders in the area of vegetation policy, management and research.

This workshop aimed to identify: the knowledge requirements of managers and policy makers involved in managing native vegetation in Queensland; high priority R&D themes; and possible projects that address these knowledge requirements.

Expected outputs included initial project ideas that would be progressed by the Working Group and the research providers into project proposals for submission to funding bodies.

The workshop identified eight important themes. They are broad themes that include elements of many of the priority issues raised by invited speakers during their presentations or by participants during the general discussion session.

These themes were:

1. 'Crossing the chasm': knowledge brokering in vegetation management
2. Affordable vegetation management practices for landholders
3. Climate change impacts and feedbacks on eco-hydrology, vegetation and species of conservation significance: acceptable thresholds
4. Ecosystem and biodiversity offsets
5. Regrowth as a tool for landscape restoration
6. Integration of western science and Indigenous knowledge applied to vegetation management and extending research into management
7. Peri-urban vegetation: 'Curse or cure'
8. Carbon offsets and storage.

The final task for workshop participants was to subdivide the themes into project topics that could be developed into proposals for funding. Four project briefs were prepared: one for each of the first two themes and two for theme three (Appendix 6).

Shortly after the workshop, the Native Vegetation Management Working Group met to refine, clarify and agree on the R&D themes emerging from the workshop and to review the project ideas. These project ideas will now form the subject of a number of multi-stakeholder discussions to develop and refine project proposals in three areas:

1. Temporal and spatial resilience
2. Gradients and thresholds
3. Socio-economic responses.

Once finalised as R&D proposals, these will be submitted to a number of R&D investors for funding consideration during 2007–08.

This mid-term report will provide the basis of a final report in 2008 of R&D priority setting and investment success by CIRM's Native Vegetation Working Group.

1. Introduction

The sustainable management of Queensland's native vegetation is important for the maintenance of ecosystem health and ecosystem services; biodiversity conservation; socio-economic concerns such as primary industries, tourism and mining; and for rural and urban communities. Policy makers and land managers who are responsible for sustainable management of vegetation depend upon relevant and reliable scientific information being available to guide their decisions and activities. Without appropriate science, there is the risk of potentially costly economic, social and environmental impacts associated with sometimes irreversible natural resource degradation.

Priorities for research and development (R&D) need to be formulated to ensure that limited resources are directed to the most important and pressing issues. However, priority setting is an ongoing process as priorities need to be reviewed frequently to ensure that they respond to changing policy demands and new scientific findings and experiences. This paper outlines the process of priority setting that has been followed in Queensland since 2002, with particular reference to work which occurred in April 2007.

2. Background

In 2002 a workshop entitled "Research needs for the sustainable management of native vegetation in Queensland" was hosted jointly by the Department of Natural Resources and Mines and The University of Queensland (Wright *et al.*, 2002). This prompted two important developments. Firstly, CIRM adopted native vegetation management as a program and secondly, Dr Jim Tait was contracted to produce a CIRM position paper that expanded on the initial workshop and was entitled "Prioritising research on native vegetation in Queensland" (Tait, 2004).

CIRM is a formal linkage network of research providers who share a common interest in natural resource management (NRM) in Queensland and northern Australia. The group's main goals are collaboration, brokerage, communication and a shared approach to common NRM research issues. Since 2002, CIRM has taken responsibility for priority setting and for the development and support of collaborative projects on native vegetation management.

The Tait report (Tait, 2004) was available in draft form in 2003. It provided an overview of R&D needs in native vegetation management in Queensland by developing a structured framework to group issues and to identify needs. In the framework there are 10 summary groupings (Table 1). The report contains a comprehensive discussion of R&D needs for each summary group

and the higher priority issues are summarised under the framework in Appendix 2.

Table 1. Framework of ten summary groupings for R&D priorities (Tait 2004)

	Primary issue areas	Secondary subdivisions
1	Native vegetation inventory and monitoring	
2	Vegetation impact and condition drivers	
3	Defining sustainable native vegetation management	3.1 Conservation of biodiversity 3.2 Ecosystem services and processes 3.3 Landscape health 3.4 Sustainable development
4	Delivering sustainable management outcomes	4.1 Management and planning policy 4.2 Social and economic dimensions 4.3 Information needs and provision 4.4 Active management

In addition to identifying research needs, Tait made seven recommendations to CIRM that he called the “ways forward” for managing R&D for native vegetation in Queensland (Table 2). Most of the recommendations have been acted upon. For example, the CIRM Native Vegetation Management Working Group was formed in August 2003 and the research priorities have been further developed through the Working Group and at workshops. The current composition of the Working Group is given in Appendix 3.

Table 2. Recommendations made to CIRM by Tait (2004)

	Recommendation to CIRM
1	Form a native vegetation R&D working group (in keeping with processes applied with previous CIRM priority R&D areas)
2	Undertake gap analysis and integrated information provision (theme-structured research review on a bioregional or regional ecosystem basis)
3	Conduct R&D partner dialogue and priority setting (building on existing CIRM partnership arrangements and activities)
4	Integrate R&D programs (through, for example, joint funding bids and collaborative, landscape-scale projects)
5	Link with existing vegetation R&D programs and regional natural resource management planning processes (strengthening existing links and actively establishing new ones where opportunities arise)
6	Facilitate long-term monitoring and research programs (investigating and identifying how long-term activities can be supported)
7	Form a native vegetation research scientific reference panel (to inform and support activities of working group and other CIRM representative groups)

During late 2003 and early 2004, the Working Group used the priority research table from the draft Tait report together with an R&D gap analysis conducted via the Regional Vegetation Management Planning (RVMP) process to develop three priority themes:

- Maintenance of ecological values in the management of remnant vegetation systems (specifically the management of vegetation “thickening”)
- Balancing environmental services provided by remnant native vegetation (e.g. biodiversity) with economic outcomes
- Maximising the benefits from land areas that have already been extensively cleared of remnant vegetation for long-term sustainability (specifically the management of vegetation as windbreaks, shelterbelts, erosion control, shade, fodder etc.).

In May 2004 the first CIRM Native Vegetation Management Workshop brought together key R&D staff involved in native vegetation management. Participants identified 10 collaborative R&D projects related to the three identified priority themes. By late 2004, three of the 10 projects identified at the workshop were progressed to two-page applications. In late 2005, with the support of the Working Group, three large collaborative projects were submitted to Land and Water Australia (LWA) and the Commonwealth Environmental Research Facilities (CERF) programme for funding. They were:

- Modelling impacts of vegetation cover change on regional climate (Project Leader C McAlpine, UQ, submitted to LWA)
- Biodiversity values and functional ecology of regrowth vegetation in modified landscapes (Project Leader T Eyre, EPA, submitted to LWA)
- Landscape planning tools for restoring fragmented Brigalow landscapes (Project Leader C McAlpine, UQ, submitted to CERF).

The two projects submitted to LWA were funded and began in 2006.

In 2006, the Working Group decided to update the priority themes via another workshop process. They planned a workshop for April 2007. This paper now reports in detail the content and conclusions of that workshop.

3. Vegetation workshop, April 2007

3.1 Overview and aims

The second CIRM vegetation workshop was entitled “Managing Queensland’s native vegetation for multiple benefits” and was held on April 4, 2007 at CSIRO, Queensland Bioscience Precinct, Brisbane. The workshop brought together key researchers and government representatives from CIRM partner organisations as well as other stakeholders in the area of vegetation policy, management and research.

This workshop aimed to identify:

- the knowledge requirements of managers and policy makers involved in managing native vegetation
- high priority research and development themes
- possible projects that address these knowledge requirements.

Expected outcomes included initial project ideas that would be progressed by the CIRM Native Vegetation Management Working Group and the research providers into project proposals for submission to funding bodies.

3.2. R&D priorities of CIRM partner organisations

Several of the CIRM partner organisations (Environmental Protection Agency, Department of Natural Resources and Water, Department of Primary Industries and Fisheries, CSIRO, Griffith University and University of Queensland) outlined R&D needs to provide information that would guide future management practices and policy decisions.

Specific themes considered are outlined below (Appendix 4 provides more detailed information presented by each speaker; Appendix 5 provides a summary of the ensuing general discussion; Appendix 6 gives project briefs prepared; and Appendix 7 lists the 29 participants at the workshop and their affiliations).

3.2.1. Vegetation management and climate change

Understanding impacts and adapting to climate change and variability by:

- Providing climate change and trends data and projections for Queensland
- Undertaking targeted research on the impacts of climate change and extreme events on Queensland’s species and ecosystems
- Modelling the likely impacts of climate change on ecosystems and develop policies or recommend action to help mitigate or adapt to impacts
- Identifying the interaction between climate change and fragmentation
- Developing assessment tools for calculating emissions from land clearing
- Developing metrics for carbon offsets.

3.2.2. Managing native vegetation in peri-urban landscapes

For example:

- Science to support setting conditions for maximising ecological integrity, despite development (e.g. patch size, lot configuration, density and design placement, thresholds etc.)
- Considerations for allowing material changes of use to maintain functioning ecosystems/ecological processes.

3.2.3. Vegetation condition, biodiversity and functional ecology

For example:

- Developing cost-effective monitoring systems benchmarking biodiversity descriptions for defining condition states
- Enhancing our understanding and knowledge (identification, taxonomy, distribution and ecology) of priority species, lesser known taxonomic groups and ecosystems
- Quantifying the efficacy of regional ecosystems as biodiversity surrogates (taxa/functional groups)
- Controlling and managing environmental invasive species (e.g. prevent, detect and manage early environmental invasive species incursions; advance the understanding of weed ecology in riparian and other vegetation).

3.2.4. Integration of production and biodiversity

For example:

- Achieve an understanding of fire in the landscape and its impacts on biodiversity values
- Woodland thickening/woody weed management
- Analysis of management options and their relative cost/benefit – within Vegetation Management Act
- Sustainable and productive management of fodder
- Science-informed policy
 - Decision-making matrix to assess vegetation offsets for development applications
 - Simple, positive, affordable initiatives to support landholders to manage vegetation condition (e.g. weed methodologies in remnant vegetation, ecosystem maintenance through thinning).

3.2.5. Mapping

For example:

- Improved regional ecosystem mapping to 1:25,000 to 1:50,000 scale in coastal, peri-urban and mining areas and wetlands
- Robust methods to spatially and reliably map vegetation condition states across both remnant and non-remnant parts of the landscape.

3.2.6. Ecosystem services:

For example:

- Understanding the varying extent to which ecosystems supply ecosystem services (e.g. wetlands)
- Assessing the biodiversity values of various vegetation condition states, e.g. regrowth, remnant (and extend mapping into these areas)
- Water flow and condition
- Land stabilisation and condition
- Regional climate
- Atmospheric carbon dynamics.

3.2.7. Cultural considerations:

For example:

- Ecosystem amenity
- Traditional owner issues
 - Indigenous people have been land custodians and land managers for generations and there is concern that their knowledge could be lost. Strong two-way partnerships could be developed in new research as well as in gathering old knowledge.

3.2.8. Information and knowledge sharing:

For example:

- Integration of R&D
 - Simultaneous assessment of effects of vegetation change on multiple attributes (e.g. water, biodiversity, carbon, social values)
- Maintain and develop improved data delivery arrangements and services (e.g. between science, policy and land managers)
- Maintain, support and redevelop natural resource databases
- Provide best practice information management and technology for stakeholder information access.

3.3 R&D constraints

Funding and timing are among the constraints faced by researchers in the NRM sector and while CIRM plays a valuable role in connecting researchers and policy makers, it lacks seed funding that would enable more researchers to be involved. Agencies lack funds for research, although they can provide in-kind support, and researchers are turning to regional bodies that have funds.

At the same time, large-scale, long-term, replicated management experiments are needed. Agencies could fund them but scientists need to demonstrate how the results of such research can translate into useful management information.

3.4 Integrated R&D priority themes

From the information presented by the speakers and from the ensuing group discussion, eight priority R&D themes were identified by workshop participants and are outlined in Table 3. The themes are broad and include elements of many of the priority issues raised by invited speakers or in the general discussion session.

The themes in Table 3 are listed in the order in which the participants ranked them. This ranking was used to select three themes for further development into projects given the limited time allocated for discussion during the workshop. These project outlines are included in Table 4 (with detail in Appendix 6) and are the subject of ongoing investigation and progression via the Working Group.

Table 3. Broad R&D themes identified by workshop participants

Broad theme	Explanation
1. 'Crossing the chasm': knowledge brokering in vegetation management	Knowledge brokering (taking knowledge that exists and applying it at the management and landholder level)
2. Affordable vegetation management practices for landholders	For example: weed management, thinning, functional vegetation and landscapes; active management of functional vegetation (economics and ecology); strategic grazing management for multiple outcomes; role of the matrix in landscape function and conservation
3. Climate change impacts and feedbacks on eco-hydrology, vegetation and species of conservation significance: acceptable thresholds	Impacts of climate change on vegetation communities and the role of vegetation in the impacts of climate change on hydrology and biodiversity
4. Ecosystem and biodiversity offsets	How do you assess ecosystem offsets for development applications that involve the removal of native vegetation and/or ecosystems?
5. Regrowth as a tool for landscape restoration	Managing regrowth vegetation for rehabilitation/cost-effective reforestation Assessing biodiversity values and functional ecology of regrowth vegetation in modified landscapes
6. Integration of western science and Indigenous knowledge applied to vegetation management and extending research into management	Choose pilot areas (e.g. Bunya Mountains: landscape change, important Indigenous area, needs fire management and multiple current stakeholders) Also includes knowledge brokering
7. Peri-urban vegetation: 'Curse or cure'	Spatial configurations; minimising impacts of development and land use on biodiversity; land and ecosystem condition; fragmentation
8. Carbon offsets and storage	How to quantify carbon storage issues and move that to an offset program and how to deal with risks of offset (estimates and measures) Role of vegetation in carbon capture: stage of vegetation cycle and multiple benefits of strategic vegetation management

Table 4. Outlines of projects identified to address an aspect of each of three research themes

Theme No.	Project No.	Project title	Aims and objectives	Predicted outcomes and benefits	Project work outline
1	1.1	Crossing the chasm: knowledge brokering in vegetation management	To make information on vegetation management available and easily accessible to a range of stakeholders	<ul style="list-style-type: none"> - Better informed decisions by a range of end users - Better cooperation between users - Fewer disputes about interpretation - People more comfortable with available knowledge - Regularly updated with new R&D outcomes - Tool for identifying gaps 	<ul style="list-style-type: none"> - Develop a process for identifying end users and types of products (including appropriate database) - Collate information, synthesise, enter into database, develop a range of instruments to make the information available in various “tool kits” - Maintain database/expert system and run workshops/outsource workshops amongst partner organisations as appropriate
2	2.1	Affordable vegetation management practices for landholders	Practical methodologies for affordable land management to enhance productive capacity and maximise environmental outcomes	<ul style="list-style-type: none"> - Practical methodologies for weed management to enhance productive capacity and ensure remnant vegetation status are maintained - Building on theoretical knowledge to develop applied weed management practices - Demonstrated economic benefits of good vegetation management practice - Active management of functioning ecosystems - Strategic grazing management for multiple outcomes 	<ul style="list-style-type: none"> - Design of cost-effective weed management practices for high-risk weed species to achieve improved ecosystem function and retain remnant status - Trial methodologies with landholders to demonstrate economic value of sustainable management of vegetation - Go beyond VMA requirements to stimulate adoption of best practice land management
3	3.1	Climate change impacts and feedback on eco-hydrology	<ul style="list-style-type: none"> - Model role of vegetation in impacts of climate change on the eco-hydrological cycle at multiple scales - Identify and evaluate policy and management responses 	<ul style="list-style-type: none"> - Identify/prioritise where to locate vegetation in the landscape for eco-hydrogeologic outcomes under alternative future climate scenarios - Range of management options including “toolkit”, DSS, guidelines 	<p>Possible sites:</p> <ul style="list-style-type: none"> - South East Queensland; Eastern Darling Downs or Rockhampton/Gladstone area
	3.2	Climate change impacts on vegetation and species of conservation significance	<ul style="list-style-type: none"> - Predict likely shifts in distribution of species and ecosystems under climate change scenarios - Explore a range of possible legislative and policy responses 	<ul style="list-style-type: none"> - Targeted policy responses and tools - Improved conservation management 	<p>Across two scales:</p> <ul style="list-style-type: none"> - State-wide - Selected region, for example SEQ

4. Post-conference activities

Shortly after the workshop, the Native Vegetation Management Working Group met to review the outcomes of the workshop. Their purpose was to refine, clarify and agree on the R&D themes emerging from the workshop and to decide if there were any knowledge gaps not covered by the themes. These project ideas will now form the subject of a number of multi-stakeholder discussions to develop and refine project proposals in three areas:

4. Temporal and spatial resilience
5. Gradients and thresholds
6. Socio-economic responses.

The group also encouraged further work on developing projects in theme 8 (carbon offsets and storage).

The second development since the workshop has been the commitment to develop the research theme on the effects of climate change on biodiversity. This was theme 3 at the workshop. Dr Carla Catterall (GU) organised a meeting in July entitled “Improving the resilience of biodiversity to climate change: the need for a knowledge base”. The focus was on identifying the research priorities for new knowledge that can help adapt vegetation management in a way that minimises the impact of climate change on biodiversity.

5. The way forward

This mid-term report gives an account of CIRM’s Native Vegetation Working Group activities to date and describes a set of collaboratively agreed priority themes to focus future R&D in the management of Queensland’s native vegetation.

While some of these themes will be developed into research proposals to be submitted to a number of external R&D investors for funding consideration during 2007–08, the agreed priority themes should also serve as a broad guide for CIRM partners in making decisions on R&D requirements for managing native vegetation .

This mid-term report will provide the basis of a final report in 2008 of R&D priority setting and investment success by CIRM’s Native Vegetation Working Group.

6. References

- Tait J (2004) *Prioritising research on native vegetation in Queensland*. A report prepared for the Consortium for Integrated Resource Management. CIRM Occasional Papers, (ISSN 1445-9280).
- Wright A, Westrup J, Begbie D, McAlpine C, Possingham H (eds) (2002) *Research needs for the sustainable management of native vegetation in Queensland*. Report on the vegetation management workshop jointly hosted by The University of Queensland and the Department of Natural Resources and Mines, February 2002, Indooroopilly.

Appendix 1. What is CIRM?

The Consortium for Integrated Resource Management (CIRM) is a voluntary collaboration of research providers and government agencies who share an interest in natural resource management in Queensland. CIRM's partners are:

Department of Natural Resources and Water (NRW)
Department of Primary Industries and Fisheries (DPI&F)
Environmental Protection Agency (EPA)
James Cook University (JCU)
University of Queensland (UQ)
Central Queensland University (CQU)
Griffith University (GU)
University of the Sunshine Coast (USC)
Queensland University of Technology (QUT)
Commonwealth Scientific and Industrial Research Organisation (CSIRO).

CIRM's primary objective is to support and facilitate the planning, coordination and collaboration of R&D initiatives through:

- facilitating and enhancing cross-agency collaboration for the implementation of priority natural resource management initiatives
- maximising the opportunities for science to form an effective and timely basis for policy development and natural resource management decision-making
- ensuring holistic, systems-based approaches to natural resource management research.

To date, CIRM has established several working groups, drawing on its partners and other organisations, to progress the identification and implementation of R&D priorities. The focus of CIRM's working groups has included:

Great Barrier Reef catchments
Social and community dimensions of NRM
Dryland salinity risk management
Inland aquatic systems
Native vegetation management
Water renewal in Queensland.

Further information on CIRM's previous contributions to science coordination can be found on the CIRM website at <www.cirm.org.au>.

Appendix 2. High priority sustainable native vegetation management R&D needs (Tait, 2004)

1. Inventory and monitoring	2. Impact and condition drivers	3. Defining sustainable native vegetation management			
		3.1 Conservation of biodiversity	3.2 Ecosystem processes and services	3.3 Maintenance of landscape health	3.4 Sustainable development
<p>Development and adoption of core set of vegetation condition and biodiversity indicators</p> <p>Mapping and monitoring methods for vegetation structural attributes</p> <p>Development of mapping and condition assessment methods for riparian & wetland vegetation</p> <p>Inventory and monitoring of native vegetation — faunal assemblages</p> <p>Development of longer term, landscape scale vegetation monitoring programs</p>	<p>Impacts and interactions of fire and grazing regimes</p> <p>Landscape/ ecosystem processes following clearing</p> <p>Land use intensification, fragmentation and patch size thresholds for ecosystem processes</p> <p>Weeds and exotic vegetation including interaction with fire regime</p> <p>Climate variability and change</p>	<p>Vegetation retention, patch size, connectivity and land use intensification thresholds for biodiversity conservation</p> <p>Assessing the biodiversity conservation surrogacy value of regional ecosystems</p> <p>Definition of areas of high nature conservation value incorporating regional landscape ecology</p> <p>Impacts of grazing and altered fire regimes on floral and faunal biodiversity</p> <p>Biodiversity values of modified vegetation structure, including regrowth and disturbed vegetation classes</p>	<p>Inventory, quantification and evaluation of ecosystem services including:</p> <p>Landscape water balance functions of woody vegetation at various densities (including thickening) and regrowth)</p> <p>Nutrient cycling dynamics in native woodlands and derived grasslands</p> <p>Carbon sequestration or emission of grassland and woodland management regimes</p> <p>Water quality service functions of riparian and wetland vegetation e.g. as nutrient and sediment sinks</p> <p>Impact of vegetation cover change on local, regional and continental climate, especially rainfall</p>	<p>Development and monitoring of vegetation-based indicators of landscape health</p> <p>Impacts of vegetation thickening and management thinning on landscape functional values</p> <p>Interaction of fire and grazing on ecosystem processes maintaining landscape health</p> <p>Ground cover and pasture composition thresholds for soil health</p> <p>Adoption strategies for sustainable grazing and fire regimes per land system type</p>	<p>Land degradation hazard and land capability/ suitability mapping based on Queensland farming systems</p> <p>Development of catchment-based vegetation retention and use intensification thresholds to maintain catchment processes and services</p> <p>Development of sustainability indicators and adaptive management monitoring frameworks for landscape design and intensive-use thresholds</p> <p>Impacts of water resource use on floodplain and riparian vegetation</p> <p>Capture and use of landscape information to develop predictive modelling and management visualisation</p>

Appendix 2 (continued). High priority sustainable native vegetation management R&D needs (Tait, 2004)

4. Delivering sustainable management outcomes			
4.1 Management and planning policy	4.2 Social and economic dimensions	4.3 Information needs and provision	4.4 Active management
Incentives and market-based mechanisms including potential role of environmental management systems for the proactive management of remnant vegetation	Development of longer term benefit–cost analyses that incorporate management and externality costs	<p>Meeting key information needs of Regional Vegetation Management Committees, Vegetation Management Officers and Regional Vegetation Management Plan reviews including:</p> <ul style="list-style-type: none"> – Land resource capability and degradation risks/hazards including land capability and hazard associations of regional ecosystems – Regionally defined areas of high nature conservation value <p>Development of integrated biogeographic/catchment regional information systems capable of incorporating informal and formal knowledge systems and translating relevant vegetation management information between regions</p> <p>Ecologic and economic vegetation management decision support systems/software</p> <p>Resource inventory for land zones and regional ecosystems identified for developmental clearing in Regional Vegetation Management Plans</p> <p>Regionally based information on the proactive management needs of remnant vegetation</p>	<p>Development and implementation of adaptive management frameworks for native vegetation generally, and specifically for the long-term safe utilisation of grazing lands</p> <p>Sustainable management methods for vegetation thickening and regrowth</p> <p>Implementation of sustainable fire regimes</p> <p>Development of integrated, landscape scale methods for environmental weed control</p> <p>Regionally specific approaches for sustainable management and rehabilitation of remnant vegetation specifically addressing</p> <ul style="list-style-type: none"> – Riparian vegetation – The use of natural succession and other broadacre methods for revegetation

Appendix 3. Membership of CIRM Native Vegetation Management Working Group

Donald Begbie (Chairman)	NRW
Jennifer Bailey	NRW
Leslie Shirreffs	RNW
Phil Norman	NRW
Robert Karfs	DPI&F
Teresa Eyre	EPA
John Neldner	EPA
Alan House	CSIRO
Carla Catterall	Griffith University
Bob Miles	University of Central Queensland
Clive McAlpine	University of Queensland
Hugh Possingham	University of Queensland
Alison Moore	CIRM
Amanda Wright	CIRM

Appendix 4. CIRM partner presentation details

1 Environmental Protection Agency (EPA)

EPA's John Neldner spoke about the ecological research priorities for the agency. He explained the need for mapping and benchmarking the condition and biodiversity values of vegetation communities in the landscape; improving our understanding of and information on priority species and ecosystem services; managing invasive species; researching the impacts of climate change; and improving databases and information management. His main points are as follows:

Biodiversity values

- Benchmark descriptions for defining condition states
- Improved regional ecosystem mapping to 1:25,000 to 1:50,000 scale in coastal, peri-urban and mining areas and wetlands
- Quantify the efficacy of regional ecosystems as biodiversity surrogates (taxa/functional groups)
- Enhance understanding and knowledge (identification, taxonomy, distribution and ecology) of priority species, lesser known taxonomic groups and ecosystems
- 'Back on track' species prioritisation framework to identify species that are truly data deficient and where data are deficient

Vegetation condition and assessment

- Robust methods to spatially and reliably map condition states
- Map condition across remnant but also across non-remnant parts of landscape
- Assess the biodiversity values of various condition states, e.g. regrowth and remnant (and extend mapping into these areas)
- Achieve an understanding of fire in the landscape and its impacts on biodiversity values
- Understand the function and management of wetlands
- Understand the varying extent to which ecosystems supply ecosystem services
- Develop cost-effective monitoring systems
- Extend biodiversity planning assessments across the State

Controlling and managing environmental invasive species

- Prevent, detect and manage early environmental invasive species incursions
- Advance the understanding of weed ecology in riparian and other vegetation communities, particularly habitat for species identified as threatened using the 'Back on track' prioritisation framework
- Achieve integrated weed management

Understanding impacts and adapting to climate change and variability

- Provide climate change and trends data and projections for Queensland
- Undertake targeted research on the impacts of climate change and extreme events on Queensland's species and ecosystems
- Model the likely impacts of climate change on ecosystems and develop policies or recommend action to help mitigate or adapt to impacts

Managing natural resource information and knowledge to ensure it is relevant and accessible

- Maintain and develop improved data delivery arrangements and services
- Maintain, support and redevelop natural resource databases
- Provide best practice information management and technology for stakeholder information access.

2 Department of Natural Resources and Water (NRW)

NRW's Leslie Shirreffs outlined the purpose and application of the Vegetation Management Act and its associated codes. From the policy makers' point of view, they require good science to support practical, workable decisions. The challenge for scientists is to advise on conservation priorities and provide information to support evolving policy directions. The following priority science initiatives and potential science initiatives were discussed.

Climate change – greenhouse gas emissions

- Assessment tools for calculating emissions from clearing
- Metrics for carbon offsets

Vegetation offsets

- Setting priorities for offsetting – what are the considerations for strategic target setting?
- Offset performance: Impact of development vs. benefits of offsets
- Recommended conditions to achieve no net loss in the landscape

Changing land use

- Considerations for allowing material changes of use to maintain functioning ecosystems/ecological processes
- Decision-making matrix for achieving Act purposes
- Standardised conditions for development applications and non-contestable grounds for refusal

Building science into policy

- Establish relationships between government and research institutions
- Maximise integration within and between
- Focus on science supporting policy to achieve environmental outcomes

Other science needs for NRW included:

- Simple, positive, affordable initiatives to support landholders to manage vegetation condition (e.g. weed methodologies in remnant vegetation, ecosystem maintenance through thinning)
- Landscape level outcomes using integrated legislative tools
- Science to support setting conditions for maximising ecological integrity, despite development (e.g. patch size, lot configuration, density and design placement, thresholds etc.)
- Simple ecological equivalence metrics (e.g. for offsets)
- Economic benefits of vegetation management.

3 Department of Primary Industries and Fisheries (DPI&F)

First, Bob Karfs from DPI&F spoke of the objective of the Beef Program in the agency and explained that vegetation is the key resource for the grazing industry. He identified six research areas and explained the opportunities and research needs for each.

Carbon accounting and carbon trading opportunities:

- Opportunity: Landholders participating in carbon sequestration and trading
- Research need: Confidence in carbon accounting science and market protocols

Ecosystem services

- Opportunity: Stewardship payments/compensation
- Research need: Measurement and valuation of ecosystem services and establishing agreed duty of care framework for favourable biodiversity outcomes

Woodland thickening woody weed management

- Opportunity: Offsetting losses in productive grazing capacity due to encroachment and thickening of woody species
- Research need: Analysis of management options and their relative cost-benefit – within Vegetation Management Act

Land condition assessment

- Opportunity: Optimal use of pastures
- Research need: Link management actions to condition; analyse management options relevant to cost-benefit; promote integration/coordination of monitoring activities

Sustainable and productive management of fodder

- Opportunity: Use native fodder species during periods of drought
- Research need: Identify ecological thresholds where use of fodder does not lead to degradation

Climate change

- Opportunity: Profitable and sustainable enterprises through periods of variable rainfall
- Research need: Greater understanding of the possible impacts on pasture communities (modelling).

Second, Steven Bray, also from DPI&F, explained in more detail the research area of carbon accounting and trading in grazed woodland. There is scope for carbon accumulation in woodland vegetation but there are important issues for both land managers and policy makers in managing cattle numbers and managing woody vegetation.

Carbon trading and carbon accounting opportunities in grazed woodland

- Project level accounting – Important considerations:
 - Demonstrate benefit (i.e. done something different to increase carbon storage)
 - Minimise risk due to management, climate, and fire
 - Permanence 70–100 years
 - Afforestation, reforestation straight forward (regrowth)
 - Changed management practice (e.g. in remnant woodland) more difficult, but potential
 - System for verification (expensive??)
 - Marketing (regulation/compliance, speculation, marketing)
 - Possibly credit in combination with other environmental benefits
- National emissions trading scheme (under development)
- Collaborative opportunities:
 - Develop tools and systems to ‘cheaply’ assess carbon stock change
 - Modelling to assess risks and likely benefits of scenarios/land systems
 - Assess long-term economic outcomes
 - Contribute to policy for win-win for landholders and global carbon cycle
 - Establish and monitor best-bet options.

4 CSIRO

Alan House spoke about vegetation management research in CSIRO in each State pointing out that the Healthy Terrestrial Ecosystems research theme had close links to the Agricultural Sustainability Initiative. He stated that future research topics are likely to include the following:

- Underpinning science – what lives where and why
- Secondary communities and novel ecosystems
- Restoring ecological processes (fire and grazing; regeneration in woodlands)
- Integration science – social, economic, ecological
- Ecosystem services
- Resilience of Australian ecosystems to change – climate change, biofuels

- Scaling up to landscape scale, difficult to scale up and make relevant at broader scale
- How to manage vegetation in urban environments.

5 Griffith University

Carla Catterall suggested that there were three aspects to the question of the role and function of vegetation in the landscape. She described these aspects as follows:

Functional role of vegetation for the ecosystem

- Biodiversity
- Water flow and condition
- Land stabilisation and condition
- Regional climate
- Atmospheric carbon dynamics
- Human society

Attributes affecting vegetation's role and functions

- Spatial
 - Quantity (% land area in total)
 - Quality (veg. type, veg. condition)
 - Configuration – location, patch sizes, shape, links
 - Context – surrounding land cover
- Temporal
 - Loss (clearing)
 - Turnover (shift in quality)
 - Gain (revegetation, regrowth)
- Effects of differing scales

Effect of external change on vegetation function

- Water extraction or addition; hydrological change
- Sea level change
- Altered salinity
- Pollutants
- Climate change.

Research questions could address various combinations of these three aspects: differing functional roles; attributes affecting them; and effects of external change.

Specifically the following areas for new research were suggested:

Areas for new research

- Interaction between climate change and fragmentation – understanding and enhancing the capacity for regional ecosystems and biota to track changing conditions

- Experimental approaches to management intervention: long-term management experiments plus repeatable monitoring protocols
- Simultaneous assessment of effects of vegetation change on multiple attributes (e.g. water, biodiversity, carbon, social values).

6 The University of Queensland

Clive McAlpine outlined current native vegetation and biodiversity research at UQ St Lucia including:

CERF research hub 2006–2010

- Aim: Develop and test tools to support transparent decision-making for environmental management and provide guidance and support for organisations wishing to use these tools
- Three areas of innovation: new generation decision-making tools, theory and application of optimal monitoring, and spatial analysis for conservation and restoration investment
- Address challenges facing managers: biosecurity, salinisation, habitat fragmentation, water management, invasives and global warming

Vegetation cover change and regional climate – LWA innovation call project 2006–2009

- Major findings of 10 model ensemble of simulations for the period 1949–2003 to quantify the changes in regional climate resulting from anthropogenic land cover change from pre-European to modern day (early 1990s) conditions

Restoring fragmented brigalow landscapes

- Aim: Develop landscape planning and management strategies and spatial decision-support tools for the restoration of Brigalow ecosystems, and their dependent vertebrate fauna

ARC Discovery –Beyond discrete landscape metrics 2006–2009

- Aims: Identify and evaluate suitable continuous, non-discrete landscape metrics/surface measures and analysis techniques for quantifying gradients in landscape structure

Small passerine (perching bird) distribution

Appendix 5. Comments of participants recorded during general discussion and grouped under topics

Topic	Participants' comments and questions
CIRM, agencies and funding issues	<ul style="list-style-type: none"> • CIRM can play a valuable role in maintaining connection between science and management/policy, but the opportunities for projects need to be there, interested researchers need to know policy/management priorities and who to talk to etc. • CIRM lacks its own seed funding for research and this is an issue. If they could find seed project funding researchers would be more committed. • Despite the need, very difficult to work with agencies because they lack the funding, so research is turning to other groups, such as regional bodies. This is not helpful if we're to build better communication and working relationships between research and agencies. • Advantage of agencies is that they can provide in-kind support (people, knowledge, other resources).
Science and policy	<ul style="list-style-type: none"> • The challenge for agencies is having science-backed policy they can "sell". The agencies need to be able to deliver science in landscape (i.e. they need willing participants). • Need for science-savvy policy. What are the State agencies going to provide to research institutions to help ensure the necessary research is completed? • Agencies need science that can be directed to policy, but it is difficult to focus science results on policy needs. Recognised need for better understanding on all sides (science, policy and broader government). • Evidence that some appeals have "stood or fallen" on science (i.e. need to be able to defend the science). • Compared to medical science/knowledge (including acceptance in policy and community) there are serious gaps in science-backed policy for vegetation management. • Problem with capturing the learnings and outcomes from relevant research and determining its relevance to decision makers. From a science perspective this is difficult, partly because of need to present information differently depending on target audience (i.e. landowner, manager or agency). • To connect science with management outcomes, need policy/management people to make clear what they want from science. • Need to recognise the limitations of science researchers being able to answer these questions definitively.
Data sharing and partnerships	<ul style="list-style-type: none"> • Need to link research with external funding sources and agency partners (i.e. purpose of workshop). • Concern with lack of commitment to building databases, allowing for science to drive court decisions. Need for cooperation between state agencies to build information databases over long-term. • Agreement that there is the need to use current data more efficiently and effectively between agencies, need for more and better coordination of data.
Ecosystem services and offsets	<ul style="list-style-type: none"> • Significant knowledge gap with respect to ecosystem services and concern over the issue of stewardship payments. What should the government pay for with regard to ecosystem service conservation and management? • Biodiversity and vegetation offsets for development may be most useful in high pressure coastal zones and energy distribution networks.
Traditional owner issues	<ul style="list-style-type: none"> • Important to recognise that there is knowledge with Indigenous people as land custodians (e.g. traditional owners) and land managers (e.g. in agriculture) for multiple generations. Includes knowledge on changes in species distribution and abundance and fire management. There is a real concern about this knowledge being lost and there is an opportunity to establish strong two-way research partnerships, where it's not just new research being conducted, but also gathering old knowledge.

Topic	Participants' comments and questions
	<ul style="list-style-type: none"> • There is a real need for research directed into partnerships helping Indigenous communities achieve what they need (e.g. natural resource management, education, property planning) and these partnerships could occur through regional bodies and PhD students.
Applied research and management	<ul style="list-style-type: none"> • Need to do good management experiments (i.e. large-scale replicated management experiments); this is beyond the means of most research institutions, but within means of agencies. Important and applied research that is lacking (although there are some projects like this within the EPA). Moreover, important to demonstrate the worth of this research and convey the results into management decisions. • Problem of translating science into useable management information. • Problem of time frames with regard to funding (i.e. 3-yr funding rounds). • One way to ensure products of research is to use PhD or postdoctoral students who must publish their work as part of their position; this is also less costly. • Need to translate research from publications into workable form for managers and policy and then useable form for on-ground managers (i.e. regional bodies etc.).

Appendix 6. Project briefs prepared by workshop participants

Project 1.1 Crossing the chasm: Knowledge brokering in vegetation management

Aims and objectives of project:

To make information on vegetation management available and easily accessible to a range of stakeholders

Predicted outcomes and benefits of project:

- Better informed decisions by a range of end users
- Better cooperation between users
- Fewer disputes about interpretation
- People more comfortable with available knowledge
- Regularly updated with new R&D outcomes
- Tool for gap identification

Project work outline:

The project would have three phases:

1. Develop a process for identifying end users and types of products (including appropriate database):
 - Identify some case studies, document the learning from the case studies and use these to help define the project (e.g. Cochrane Collaboration used to assess merits of medical publications)
 - Identify stakeholders and end users of information
2. Collate information, synthesise, enter into database, develop a range of instruments to make the information available in various “tool kits”:
 - Literature search; précis of outcomes of each R&D
 - Talking to landholders and Aboriginal groups about their data
 - Use a “multiple line of enquiry” style database to manage data
 - Make access to the database information available on line
3. Maintain database/expert system and run workshops/outsource workshops amongst partner organisations as appropriate

Timeframe:

Initially 1 year to set up database and then input ongoing

Budget: \$50 000 (0.5 FTE)

Funding to be targeted:

LWA, NRW, NRM, Agforce, Aboriginal and Torres Strait islander funding groups

Communication:

Information available in a range of forms to suit user: web site, fact sheets, and workshops for specific end users

Researchers and organisations involved: Project leader: CIRM Alison Moore and Amanda Wright (participants identified this as a role for CIRM). Partners/those involved in project development: Col Paton (DPI&F), John Hunter (SEQ Catchments), Phil Norman (NRW) and advisory role: Nadeem Samnakay (LWA).

Project 2.1: Affordable vegetation management practices for landholders

Aims and objectives of project:

Practical methodologies for affordable land management to enhance productive capacity and maximise environmental outcomes

Predicted outcomes and benefits for project:

- Practical methodologies for weed management to enhance productive capacity and ensure remnant vegetation status is maintained
- Building on theoretical knowledge to develop applied weed management practices
- Demonstrated economic benefits of good vegetation management practice
- Active management of functioning ecosystems
- Strategic grazing management for multiple outcomes

Project work outline:

- Design of cost effective, weed management practices for high-risk weed species to achieve improved ecosystem function and retain remnant status
- Trial methodologies with landholders to demonstrate economic value of sustainable management of vegetation
- Go beyond VMA requirements to stimulate adoption of best practice land management

Researchers and organisations involved (potential):

CSIRO; UQ; NRW; AgForward

Timeframe:

To be determined

General outline of work to be completed:

- Collate existing information/research on weed management
- Examine economic drivers for changing behaviour in regards to complementary weed and vegetation management practices
- Examine consequences of improved weed management on ecosystem function
- Examine economics of effective weed management particularly in regard to productive capacity
- Conduct trials on three most invasive weed species, in differing ecosystem types
- Develop guidelines for weed management in native vegetation in collaboration with stakeholders
- Hold series of field days in partnership with AgForward to demonstrate benefits
- Develop landholder guide to effective weed and vegetation management

Estimated budget:

To be determined

Funding possibilities to be targeted:

To be determined

Project contact:

Leslie Shirreffs, Department of Natural Resources and Water

Project 3.1: Climate change impacts and feedback on eco-hydrology

Aims and objectives of project:

- Model role of vegetation in impacts of climate change on the eco-hydrological cycle at multiple scales
- Identify and evaluate policy and management responses

Predicted outcomes and benefits of project:

- Identify/prioritise where to locate vegetation in the landscape for eco-hydrogeologic outcomes under alternative future climate scenarios
- Range of management options including “toolkit”, decision support systems (DSS), guidelines

Location/s of project:

South East Queensland; Eastern Darling Downs or Rockhampton/Gladstone area

Researchers and organisations involved:

University of Queensland; Griffith University; University of Southern Queensland; Natural Resources and Water (Climate Change Centre of Excellence; Water Assessment); EPA (Ecosystem Services, Regional Ecosystems); Regional NRM bodies and industry peak bodies

Timeframe: 3-5 years

General outline of work to be completed):

- Accessing best available climate models - downscaled to region/catchment
- Undertake modelling
- Bring models/expert knowledge together
- Test scenarios and outcomes - simulation
- Identify spatial dimension of change/impacts
- Rules of where to locate vegetation in the landscape most effectively

Estimated budget:

\$150 000 - \$200 000 per annum (postdoc, PhD + operating costs) including industry contribution of roughly \$30 000 cash and in-kind from partners of roughly \$150 000

Funding to be targeted:

ARC Linkage; Land and Water Australia; National Water Commission

How would the results of this project be communicated to vegetation management stakeholders?

Work with regional NRM bodies and industry:

- Partnerships
- Scenario setting and expert knowledge

Project contact /Project champion: Clive McAlpine (UQ); Partners include: Don Begbie (NRW); Carla Catterall (GU); Jennifer Bailey (NRW); Grant Wardell-Johnson (UQ)

Project 3.2: Climate change impacts on vegetation and species of conservation significance

Aims and objectives of project:

- Predict likely shifts in distribution of species and ecosystems under climate change scenarios
- Explore a range of possible legislative and policy responses

Predicted outcomes and benefits of project:

- Targeted policy responses, tools
- Improved conservation management

Project work outline, including:

Location/s of project:

Across two scales:

- State-wide
- Selected region, for example SEQ

Researchers and organisations involved:

Griffith University, University of Queensland, NRW (Climate Change Centre of Excellence, Vegetation Management unit) & EPA (Herbarium)

Timeframe: 3-5 years

General outline of work to be completed:

- At a State-wide regional scale identify target species and ecosystems
- Undertake modelling to identify present climate envelope (conditions under which they occur)
- Use models predicting future climate to predict future distributions under different scenarios of climate change
- Overlay future predicted distributions with existing remnant vegetation and land use and consider (a) implications on species ecosystems and (b) policy response to different scenarios

Estimated budget:

\$150 000 - \$200 000 per annum (postdoc, PhD + operating costs) including \$30 000 cash industry contribution per annum

Funding to be targeted:

ARC Linkage

How would the results of this project be communicated to vegetation management stakeholders?

Through partnerships in the project (government stakeholders) and through NRM bodies and peak industry groups

Project contact /Project champion: Carla Catterall, Griffith University. Partners include: Don Begbie (NRW); Clive McAlpine (UQ); Jennifer Bailey (NRW); Grant Wardell-Johnson (UQ)

Appendix 7. Participants at the 2007 CIRM Vegetation Workshop

Name	Organisation
Facilitator: Michelle Hill	NRW: A/Manager - Business Improvement Unit
Chair: Don Begbie	RNW: Director, Water Sciences and Chair, CIRM Native Vegetation Working Group
Speakers – policy: John Neldner Leslie Shirreffs Robert Karfs and Steven Bray	EPA: Director, Freshwater and Marine Sciences NRW: Director, Vegetation Management DPI&F: Senior Scientist, Sustainable Grazing Systems
Speakers – research and development: Carla Catterall Alan House Clive McAlpine Grant Wardell-Johnson	Griffith University: Associate Professor, School of Environment CSIRO: Senior Research Scientist, Sustainable Ecosystems University of Queensland: Senior Research Fellow, School of Geography University of Queensland: Senior Lecturer, Gatton
Invited participants: Jennifer Bailey Phillip Norman Valerie Debus Bill Schulke Col Paton Christine Williams Rod Fensham Jeremy Thompson Nick Emtage John Tisdell Marc Hero John Hunter Nadeem Samnakay	NRW: Principal Project Officer, Vegetation Management NRW: Principal Scientist, Science Integration and Communication DPI&F: Research Scientist, Forest Technologies DPI&F: Extension Officer, Regional Development DPI&F: Senior Technical Officer, Sustainable Grazing Systems EPA: Executive Director, Environmental Services Division EPA: Chief Scientist, Biodiversity Sciences Unit EPA: Manager, Ecosystem Services UQ: School of Natural and Rural Systems Management Griffith University; Assoc. Professor, Australian Rivers Institute Griffith University: Assoc. Professor, Vertebrate Ecology DEH: Indigenous Land Management Facilitator LWA: Knowledge and Adoptions Officer, Landscapes
CIRM: Amanda Wright Sam Lloyd Alison Moore	CIRM: Project Officer CIRM: Project Officer CIRM: Executive Officer