Multi-Year Research Plan

Landscapes and Policy Hub

July 2011 – December 2014
Version 1.0

National Environmental Research Program
(NERP)

Australian Government
Department of Sustainability, Environment,
Water, Population and Communities

Multi-Year Research Plan National Environmental Research Program (NERP) Landscapes & Policy Hub VERSION CONTROL REVISION HISTORY			
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Multi-Year Research Plan NERP ACCEPTANCE AND RELEASE NOTICE			
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Role	**Name and Position title**	**Signature**	**Date**
Hub Leader	Ted Lefroy		6/7/11
DSEWPaC	Geoff Richardson, ERIB		

Introduction

The National Environmental Research Program (NERP) is an Australian Government program that provides funding for applied public good research. It builds on the Commonwealth Environment Research Facilities (CERF) program with a specific focus on biodiversity.

The program's objective is: *To improve our capacity to understand, manage and conserve Australia's unique biodiversity and ecosystems through the generation of world-class research and its delivery to Australian environmental decision makers and other stakeholders.*

NERP focuses on biodiversity research and delivering information that the Australian Government and other stakeholders need to better inform environmental management, policy and decision making, both in the short-term and into the future. This includes understanding how ecosystems function, monitoring their health, maintaining and building their resilience, using them sustainably and exploring how to better use markets to protect biodiversity.

The NERP seeks to achieve its objectives by supporting applied research that:

- Has a strong public-good focus and public-good outcome
- Is end-user focused and addresses the needs of the Australian Government and other stakeholders in developing evidence-based policy to improve management of the Australian environment
- Is highly innovative and aims to achieve world-class research
- Enhances Australia's environmental research capacity
- Is collaborative and builds critical mass by drawing on multiple disciplines from multiple research institutions to address challenging research questions
- Provides results accessible to government, industry and the community, and
- Includes a focus on synthesis and analysis of existing knowledge.

Five large multi-institutional research hubs have been established to examine biodiversity issues in terrestrial, freshwater and marine ecosystems across Australia. For further details see www.environment.gov.au/nerp

This Multi Year Research Plan (MYRP)
This research plan has been developed for the Landscapes and Policy Hub. To check you have the most recent version of this document, please see the NERP website www.environment.gov.au/nerp.

The purpose of the MYRP is to:

- Provide contextual information and a breakdown of research activities in the Hub
- Describe the research that the Hub will be undertaking under the NERP between 2011 and 2014
- Identify research priorities and links to Australian Government Environment Portfolio policies and programs
- Outline the relationship of the research to the Australian Government Environment Portfolio and other key end users, and
- Provide a framework for monitoring and evaluating the Hub activities, as part of the NERP.

The primary audience for the MYRP is the Minister for Sustainability, Environment, Water, Population and Communities, environment portfolio agencies, particularly the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) and the Hub with its researchers. Other interested stakeholders include non-hub researchers, government and non-government organisations and the general public.

This research plan was prepared in consultation with the Hub partners (UTAS, ANU, Murdoch), relevant branches within DSEWPaC (Strategic Assessment, Biodiversity Conservation, National Reserve System, Parks and Biodiversity Science and Aquatic Ecosystems and Health), collaborating agencies and institutions (DPIPWE, Parks Victoria, ABARES) and individuals from state, regional, local and non-government organisations involved in biodiversity conservation (Tasmanian Land Conservancy, Greening Australia, Bush Heritage, NRM North and DECCW NSW).

This Multi-Year Research Plan broadly describes the scope of the Hub's research work program over the period 2011 to 2014. It will be accompanied by several Annual Work Plans (AWPs), which will define details of the scheduled activities on an annual basis.

1.0 The Research Hub

1.1 Introduction/Background

Hub leader and organisation

Name:	Prof. Ted Lefroy
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Context

The 2009 Hawke review of the Environmental Protection and Biodiversity Conservation Act (1999) recommended that we need to lift the scale at which we consider and manage Australia's biological diversity from that of species and communities to whole landscapes and ecosystems. This project will take an integrated social, economic and ecological perspective of the review's recommendation for "…*greater reliance on strategic assessments and bioregional planning*".

Outline

The hub will ***develop tools, techniques and policy pathways to support regional biodiversity planning*** by taking an integrated social, economic and ecological perspective of large scale biodiversity conservation. Techniques will be developed to analyse existing regional scale environmental, economic and social datasets and combine this with fine scale regional climate modelling (~10 km grid cells) to examine the likely prospects for areas of high natural values and the social and economic implications of a range of biodiversity planning and policy responses. It will do this by examining the likely implications of different scenarios of climate change, land use change, land management, demographic change, infrastructure development and other human and natural influences on habitat suitability for selected mammal, reptile, bird, amphibian and plant taxa with a particular focus on species and communities listed as MNES (Matters of National Environmental Significance) under the EPBC Act. The implications of different biodiversity planning processes, policies and institutional arrangements on fire risk, water yield, carbon sequestration and social and economic well being will then be assessed using ecological analysis and modelling, experimental economics and social and institutional research in two contrasting landscapes, the greater Tasmanian Midlands and the Australian Alps.

1.2 Hub Mission

To bring consideration of biodiversity into mainstream planning processes by fostering an interdisciplinary approach that (i) incorporates integrated assessment of social, institutional, economic and biophysical attributes (ii) is capable of examining the likely consequences of alternative biodiversity policies, planning instruments and institutional arrangements.

1.3 Hub Strategic Goals

To provide proof-of-concept for tools, techniques and policy pathways that support regional biodiversity planning.

1.4 Expected Outcomes

1. Approaches to examining the social and economic implications of managing areas of high natural value under a range of likely human and natural threats and opportunities that are systematic, empirically grounded and widely applicable.

2. Demonstration of how ecological data, social research and community engagement can be applied to biodiversity planning in two regional scale case studies.

3. Understanding of the effectiveness of incentive mechanisms aimed at encouraging biodiversity conservation on private land and designs for future mechanisms and planning instruments.

4. Evaluation of the concepts of resilience and connectivity and their operational use in regional scale conservation planning and management.

1.5 Expected Outputs

Outputs Tables 2011-2014
The Hub's outputs are listed in Tables 2-5 at the project level for 2011/12 and 2012/13, as integrated theme outputs for 2013/14 and as integrated Hub outputs for the third and fourth quarters of 2014 (see Figure 1).

Table 1. Hub Theme and Project structure

Theme	Project	Leader
Communication	1. Communication & Knowledge Broking	Ted Lefroy
Social and Economic Futures	2. Social & Institutional Futures	Michael Lockwood & Sue Moore
	3. Economic Futures	John Tisdell
Ecological Futures	4. Bioregional Futures	Brendan Mackey
	5. Climate Futures	Nathan Bindoff
	6. Wildlife	Chris Johnson
	7. Vegetation & Fire	David Bowman
	8. Freshwater Systems	Peter Davies

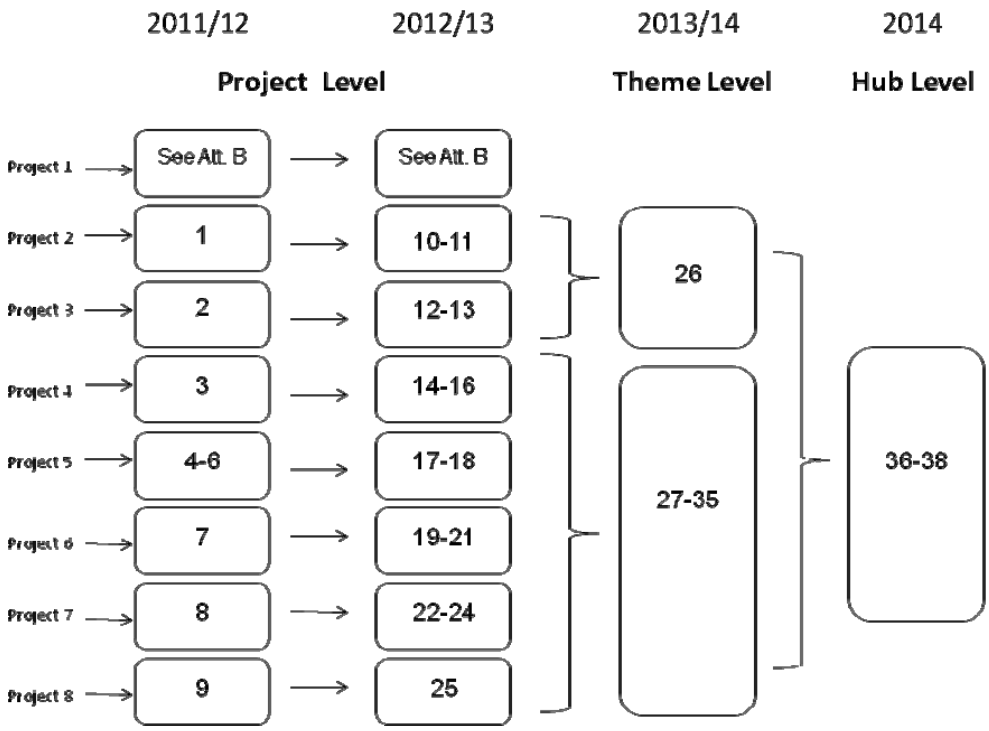

Figure 1. Outputs (numbered in boxes) at project, theme and Hub level showing inter-relationships**.**

Table 2. Project level outputs for 2011/12

Project (Project Leader)	**Outputs**
2. Social and Institutional Futures (Michael Lockwood & Sue Moore)	1. Evaluation of current institutional, social and economic policies and instruments applied to biodiversity conservation in the two case study regions based on available Australian Bureau of Statistics (ABS) of data and targeted surveys.
3. Economic Futures (John Tisdell)	2. Development of a conceptual landscape bio-economic model and associated experimental economics platform to evaluate the likely effectiveness of policy options with a focus on market based instruments (MBIs).
4. Bioregional Futures (Brendan Mackey)	3. Spatial and temporal representation of land systems in contrasting study regions, including (i) stocks and flows of energy, water and nutrients; (ii) habitat resources; (iii) patterns of diversity, distribution and abundance of species and communities; (iv) patterns of tenure, land use and land management. (v) effective environmental conditions.

	(i.e. representation of the fundamental characteristics of biodiversity in time and space).
5. Climate Futures (Nathan Bindoff)	4. Fine scale climate projections (10 km grid cells) from the Climate Futures Tasmania project applied to conservation planning in the public and non-government organisation (NGO) sectors in the Tasmanian Midlands bioregion case study, with specific ecosystem indices and simulations determined according to the needs of the other Hub projects and partners. 5. Workshops completed on the application of existing fine scale climate simulations to conservation planning. 6. Regional scale climate projections initiated for the Greater Alps case study region including design of experiments, feasibility of simulations, and potential for collaborative modelling over a larger area of SE Australia
6. Wildlife (Chris Johnson)	7. Distribution models for vertebrates, with complete coverage for terrestrial groups (selected spp. of reptiles, amphibian, birds, mammals) plus selected freshwater species, using meta-analysis to map patterns of vertebrate richness, local endemism and assemblage structure in the 2 case study regions, plus correlative distribution models & mechanistic niche models for selected species
7. Vegetation and Fire (David Bowman)	8. Interactive web-based maps of Tasmania's fire history developed from interpretation of historical air photos and satellite imagery
8. Freshwater Systems (Peter Davies)	9. Design of natural experiments to test key biophysical assumptions and management interventions underpinning large scale multi-species conservation efforts for rivers and wetlands in the Tasmanian Midlands and the Greater Alps case study region.

Table 3. Project level outputs for 2012/13

Project (Project Leader)	**Outputs**
2. Social and Institutional Futures (Michael Lockwood & Sue Moore)	10. Design of promising institutional, policy and planning reforms that address hypothesised trajectories for biodiversity values and threats emerging from the 5 biophysical projects. 11. Evaluation of potential uptake, issues, barriers and opportunities for promising institutional, policy and planning reforms.
3. Economic Futures (John Tisdell)	12. Tests of the landscape bio-economic model using characteristics of the two case study regions. 13. Design of MBIs associated with hypothesised trajectories for biodiversity emerging from the 5 biophysical projects for both case study regions.
4. Bioregional Futures (Brendan Mackey)	14. Modelled and field tested techniques for identifying refugia (against drought, fire and climate change) for selected species, communities and MNES, determined in collaboration with the Climate Futures, Wildlife, Vegetation and Fire and Freshwater Systems projects and partner organisations. 15. Mapped current connectivity gaps for focal species, determined in collaboration with Project 4. 16. The conservation status of landscapes, ecosystems and focal species and associated degrading and threatening processes identified for contrasting study regions.
5. Climate Futures (Nathan Bindoff)	17. Regional scale climate projections for SE Australia with a focus on the greater Alps case study area using the A2 emissions scenario and a range of GCM models (up to 6 to be selected). 18. Develop ecosystem indices based on those generated in collaboration with the other 4 biophysical projects, determined according to the needs of the other Hub projects and partners.
6. Wildlife (Chris Johnson)	19. Refined species distribution models that include the effects of weather-induced local scale variability. 20. Fine-scale mapping of stable refugia based on historical weather variability. 21. Projection of locations of refugia under future climate and weather scenarios.

7. Vegetation and Fire (David Bowman)	22. Analysis of the likely implications of fine scaled climate projections on fire frequency and intensity for the whole of Tasmania. 23. Analysis of 'at risk' plant communities in the Tasmanian Midlands case study area. 24. A summary map product for fire management prioritisation based on outputs 22 and 23 and web delivery tool.
8. Freshwater Systems (Peter Davies)	25. a) Preliminary analysis of relationships between past interventions, ecosystems process and the distribution and abundance of selected species and b) relationships established between past interventions, ecosystems process and the distribution and abundance of selected species based on modelling recent historical changes to water and land management in the Tasmanian Midlands and Greater Alps case study areas.

Table 4. Theme level outputs for 2013/14

Theme (Theme leader)	**Outputs**
Social and Economic Futures (Michael Lockwood)	26. Evaluation of different scenario of institutional, policy and planning reform in terms of (i) likely efficacy of achieving desired conservation trajectories (ii) institutional and social acceptability (iii) economic costs and benefits associated with achieving conservation trajectories and (iv) pilot testing MBI interventions in subsets of the two study regions.
Ecological Futures (Brendan Mackey)	27. Conservation management options identified for landscapes, ecosystems and focal species with respect to refugia, connectivity and degrading and threatening processes. 28. Evaluation of the potential impacts of projected climate change on the conservation management options identified in output 26. 29. Evaluation of climate change impacts on (i) *W* (climatic water balance index); (ii) Net Ecosystem Exchange (GPP, respiration). 30. Modelled potential impacts of climate change on fire regimes in Tasmania and the Greater Alps and consequences for vegetation, habitat resources and focal species. 31. Comparative analysis of fire activity in mainland temperate forests to understand the climate, topographic vegetation and land management factors that cause mega fires and relate this knowledge to Tasmania and the Alps to generate plausible fire risk scenarios. 32. Comparative analysis of projected threats to persistence of vertebrates in the 2 case study regions under future spatial patterns of climate change and climate variability, including likely changes in land use and invasive exotic species. 33. The likely impacts of climate change on freshwater ecosystems in the 2 case study regions based on fine scale regional projections applied to the results of natural experiments from output 21. 34. A systematic approach for identifying refugia likely to be effective against multiple threats for multiple species developed from the synthesis of outputs 27 to 33. 35. Systematic processes for identifying priority locations for protection, enhancement, connection, acquisition and remediation developed from the synthesis of outputs 27 to 33.

Table 5. Hub level outputs for 2014 (Third and Fourth Quarter)

Hub	
Integrated Ecological, Social and Economic Futures	36. The likely effectiveness of alternative institutional, policy and planning reforms in achieving societal preferences for biodiversity under likely scenarios of environmental and social change based on (i) ecosystem dynamics and the conservation status of selected species and communities, (ii) human well being and the sustainability of regional communities. 37. Descriptions of the tools and methods used to achieve output 36. 38. Indicators for monitoring the effectiveness of institutional, policy and planning reforms.

1.6 Research relevance

Relevance to NERP National Policy Questions for Research

The outputs of the Hub will address issues under the 5 policy questions for research as follows.

Question 1. Values: understanding the major drivers for maintaining biodiversity

The *Social and Economic Futures* theme will assess the economic and social benefits and costs of different policy instruments using experimental techniques and social research in each of the study regions which will address two questions about the major drivers of biodiversity conservation.

***1.3** What is the fairest and most cost-effective mix of policy tools to conserve recognised biodiversity values (e.g. land acquisition, covenants, stewardship payments, regulation, education) at both national and regional scales?*

The review of current practices (Output 1) will explore land acquisition, covenants, stewardship payments and regulatory policy options for conserving biodiversity values. Those that have shown promise will be explored further through modelling (Output 10 and 11) and associated experimental economic analyses involving participants from inside and outside the study area (Outputs 12 and 13). The experimental designs will be a mix of policy tools, market structures and biodiversity indices relevant to each region. The relative performance of the policy instruments will be objectively judged against fairness and cost-effectiveness criteria (Output 26).

***1.4** What are the best mechanisms for sharing the costs of management between the various beneficiaries?*

The review (Output 1) will examine the literature on cost sharing options between the various beneficiaries including landholders, downstream users and society in general. We will also elicit expert panel advice and incorporate national, state and regional NRM opinion. The result will be a synthesis of opinion and a series of policy recommendations.

Question 2. Ecosystems: understanding ecosystem function and monitoring ecosystem health

***2.1** How can we improve our capacity to understand, monitor and evaluate ecosystem function/health?*

Current approaches to biodiversity conservation at large scale such as the CAR criteria (Comprehensive, adequate and representative) and systematic conservation planning (Margules and Pressey 2000) rely on assumptions that there are direct functional connections between surrogates (such as woody vegetation cover, connectivity, plant community diversity, resource availability) and the condition of ecosystem processes that sustain biodiversity over the long term. Some of these assumptions such as the species-area relationship have stronger empirical support than others. For most however we rely on assumptions that deeper relationships do exist, and base our management and investment decisions on these indicators. Outputs 33 and 34 will test some of these assumptions in contrasting regions using natural experiments that compare geomorphically similar landscapes that have been subject to different 'treatments' over long time periods such as land use intensity, patterns of fragmentation and fire frequency.

***2.2** What are practical models for incorporating complex ecosystem science into management? What are the minimum data needed to determine the healthy functioning of an ecosystem?*

Outputs 34, 35 and 36 will address this question by developing explicit numerical and Bayesian models which will a) link multiple key drivers to biological measures of sustainability, b) link management interventions and measures of condition to socio-economic consequences, c) produce spatially explicit, GIS-linked scenarios of socioeconomic change and response under a range of climate futures and d) be used to test the effectiveness of a range of management interventions and policy instruments operating at different spatial and temporal scales on desired conservation outcomes (both integrated measures of ecosystem sustainability and specific conservation targets such as the status of threatened species and communities).

These models will be developed around multiple case histories in each contrasting regional study to examine different combinations of threats (drivers) and conservation objectives (threatened species and communities etc.). This approach was successfully used in the CERF Hub Landscape Logic to indentify the primary drivers of river ecological health in Tasmanian rivers and appropriate management interventions (Davies *et al.* in press). In this project, for example, a case study in the Murray Darling Basin might focus on fish assemblages and red gum forests in relation to multiple drivers such as flow, river ecosystem condition and sustainability in relation to changes in land and water use in rural landscapes generally. In other regions, the focus might be maintenance of bird assemblages under different scenarios of fire, or fragmentation and connectivity, or changes in mammal assemblages in response to shifts in predation and competition as populations of introduced animals respond to land use and climate change. Models will be run for each case

history using existing and new data, and a series of scenarios developed with stakeholders. Scenarios will include climate change and key management interventions at multiple scales and be evaluated against conservation outcomes and risks (measures of conservation status and sustainability, matched against a range of targets, measures of socioeconomic consequence and risk, and investment required). Through sensitivity analysis, the dominant controlling variables will be identified at each scale as a focus of intervention and monitoring and a means of identifying the factors that underpin the resilience of these systems.

Outputs 26 and 36 will produce a) a process for evaluating drivers (threats) and responses (conservation outcomes) in regional planning, b) a process for prioritizing conservation management and policy interventions at regional scale (includes socioeconomic drivers and responses) under a range of climate futures, and c) a process for identifying key drivers and management interventions under different socioeconomic contexts and responses.

2.3 *How can emerging genetic technologies and analysis of past management practices assist our understanding of ecosystems?*
Genetic techniques will be selectively employed in the *Vegetation and Fire* and *Wildlife* projects to reveal information about natural connectivity and natural barriers within and among conservation 'islands'. This will provide information on ecosystem functioning directly relevant to a number of strategies for improving resilience and facilitating adaptation to climate change, such as identification and protection of refugia, restoration of functional connectivity through corridors and community linkages, and identification of the need for and the potential risks of assisted migration within and between islands. Identification of refugia and establishment of connectivity will contribute to applied use of the concept of resilience and ensure that our natural environments retain their biodiversity values (genetic diversity and adaptive potential) and critical ecological functions such as connectivity in the face of growing pressure, especially those related to climate change.

Question 3. Threats: maintaining/building resilience for future changing threats
3.1 *How do we [govern, plan] manage ecosystems and regions for ecological resilience?*
3.2 *How do we best manage important ecological features, such as climatic refugia, that could prevent decline in ecosystem function or improve species management?*
3.3 *How can we assess the effectiveness of habitat connectivity as an adaptation mechanism for future climatic changes?*
3.9 *How can different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?*
Outputs 34 and 35 will enable exploration of these questions in different case study situations by developing regionally relevant models which relate key conservation outcomes (measures of status and sustainability of ecosystems, communities and populations) to key anthropogenic and biophysical drivers, as well as socioeconomic responses. The models and regional case studies will each explicitly explore a range of key ecological features such as connectivity, habitat diversity, climatic refugia building on past work in the private and public domains, and will attempt to evaluate the interactive impact of threats and the likely influence of combinations of management interventions and policy settings.

Question 4. Sustainable use of biodiversity and ecosystems
4.1 *What information, incentives and other support do land managers in the intensive use agricultural regions need to allow them to improve their management of biodiversity within the framework of a commercially productive landscape?*
4.2 *What contribution are land managers voluntarily making to biodiversity conservation beyond that recognised through formal programs such as covenants or stewardship payments? How can this contribution be measured? How can it be recognised and encouraged?*
The regional case studies will encompass all land tenures and land uses, and it is likely that one of the case study regions will be in an intensive agricultural zone. Through field work and modelling the Hub will capture the essential dynamics of these landscapes and the ability of a range of policy, governance and planning options including instruments such as incentives to address threats to biodiversity to produce region-specific analyses of the likely socio-economic consequences of different policy regimes. The governance component of the Hub will examine informal and formal decision making structures, including those of individual land managers with and without supporting mechanisms such as stewardship payments. Measurement of unaided contributions will be built into the regional socio-economic surveys and delivered in Output 1. Analysis of future options will consider how such unilateral action can be recognised and encouraged.

Question 5. Biodiversity markets
5.1 *When building biodiversity markets, how are benefits to individuals, the community, and ecosystems evaluated and quantified?*

Outputs 12 and 13 will be built on secondary valuation data on ecosystem services. Seminal works, such as the values developed by Costanza *et al*. (1997) along with data from physical national accounts and regional input-output models will be used to develop a database of values for the Australian landscape. Splitting the values between individuals, communities and ecosystems (represented by society as a whole) will be determined by expert panels made up of physical and social scientists from national, state and regional NRM bodies, and experts working on regional projects. The integrity of this data will then be tested at regional level.

5.2 *What are the comparative costs and benefits for different market models?*
The review (Output 1) will canvass literature on cost sharing options between the various beneficiaries including landholders, downstream users and society in general and the reflective success of markets, like bush tender, in Australia. A significant point of comparison of the experimental data will be the costs and benefits of the different market models – including the use of combinatorial markets, smart markets and composite indices.

5.3 *How can biodiversity markets best operate at a landscape scale?*
The experimental markets (Outputs 2 and 12) will be first based on linking individual landholders. This will be followed by a series of experiments were interest groups, such as regional NRM and associated Landcare groups coordinate packages of land management and develop social contracts for coordinated actions at the landscape and bioregion level. This could occur at a state level, for example when bargaining environmental flow regimes in the Murray Darling basin. These larger scale markets are likely to be highly concentrated with key players having significant power, in which case these environments will be modelled using game theory to capture the significance of the players and their interdependence.

5.6 *How can biodiversity markets integrate with markets for other ecosystem services, such as water provision and carbon capture and storage?*
Output 12 and 13 will explore two of the main methods used to integrate markets with multiple benefits; trade in a composite index of attributes and combinatorial markets. Composite indices have the potential to capture the multiplicity of benefits, such as water quality, carbon capture, wildlife protection and soil conservation. Work by CSIRO and others have demonstrated promise in this approach, though it often leads to market inefficiencies due to asymmetric information problems. The second method is to use combinatorial markets. In combinatorial markets, packages rather than individual attributes are traded. Both approaches will be explored in this study.

Relevance to DSEWPaC policy and programs
The outputs of this Hub (Tables 2-5, pp 5-8) will be relevant to three of DSEWPaC's policy priority areas; i) the recommendation in the Hawke review of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to undertake bioregional planning, ii) development of national environmental accounts through the National Plan for Environmental Information, and iii) State of Environment Reporting. Relevance of the Hub outputs has also been mapped below to *Australia's Biodiversity Conservation Strategy: 2010-2020*, *Australia's Biodiversity and Climate Change: Summary for Policy Makers 2009*, and the NERP National Policy Questions for Research.

Hawke Review
The outputs of the Landscapes and Policy Hub will contribute to the design, development and evaluation of approaches to regional biodiversity planning as a means of moving towards more proactive, preventative and cost effective conservation. They will test the effectiveness of different planning approaches and policy instruments under scenarios of change in land use, climate and other major drivers of biodiversity values in contrasting regions using modelling and experiments (both experimental economics and natural ecological experiments). Outputs 27-35 have been designed to enable partners and stakeholders to review the research at critical decision points and provide advice on its future direction based on their needs and interests.

National Plan for Environmental Information
All of the outputs from the Ecological Futures Theme will be relevant to the NPEI's task of 'prioritising the information needs required to deliver comprehensive national environmental accounts'. Outputs 27-35 will specifically contribute to 'improved understanding of ecosystem function' at regional scale and the identification of the particular attributes of ecosystems that can currently be measured and modelled and those that could most usefully be measured in the future.

State of Environment Reporting

Output that represent ecological, social and economic determinants of environment condition will be relevant to Stage 4 of the SoE development process (data and information review and identification of gaps). Output 35 will also contribute to Stage 6 of the next cycle of SoE reporting (Synthesising and value adding to data and information), and to link SoE data collection and reporting to the development of national environmental accounts.

Australia's Biodiversity Conservation Strategy: 2010-2020—Consultation Draft

The Draft Biodiversity Conservation Strategy identifies 'building ecosystem resilience', 'understanding and maintaining ecological processes' and 'more holistic management approaches at the landscape level' as priorities. Output 34 is directly relevant to these priorities as it will establish plausible directions and degrees of change in key ecosystem processes at regional level through regional case studies, explore means of assessing resilience using natural experiments and social research. The strategy also recommends basing management of Australia's biodiversity on 'conservation planning at all levels from local to continental' which is a major focus of the Hub and will be addressed by Outputs 22-25 and Output 35.

Australia's Biodiversity and Climate Change: Summary for Policy Makers 2009

Output 34 will directly address knowledge gaps in the area of future climate projections. The *Summary for Policy Makers* also noted that our current governance arrangements for conserving biodiversity are not designed to deal with the challenges of climate change, which demand more flexible, innovative structures and larger scale approaches. The Summary highlighted a need to reorient policy and legislative frameworks and reform institutions and governance. Designing systems of complementary rules and principles across jurisdictions and institutions so that governance arrangements are more likely to achieve a coordinated national conservation effort at landscape scale is a focus of the Social and Institutional Futures project to be delivered through Output 26.

1.7 Partner/collaborative organisations

Table 6. NERP funding and partner contributions

Hub Activity (exc GST)		2010-11	2011-12	2012-13	2013-14	2014-15	Total program budget
Research Projects	NERP	**541**,017	1,119,113	1,190,598	1,261,181	648,679	4,760,588
	CASH/IN-KIND	763,**552**	1,573,323	1,663,949	1,712,887	858,709	6,572,420
	TOTAL	**1,304,569**	**2,692,436**	**2,854,547**	**2,974,068**	**1,507,388**	11,333,008
Knowledge Brokering and Communication	NERP	142,489	294,111	309,189	325,595	168,028	1,239,412
	CASH/IN-KIND	244,095	498,072	516,364	537,566	275,179	2,071,276
	TOTAL	**386,584**	**792,183**	**825,553**	**863,161**	**443,207**	**3,310,688**
Administration	NERP	-	-	-	-	-	-
	CASH/IN-KIND	68,485	141,458	149,979	158,678	81,671	600,271
	TOTAL	**68,485**	**141,458**	**149,979**	**158,678**	**81,671**	**600,271**
Total Funding (excl. GST)	NERP	683,506	1,413,224*	1,499,787	1,586,776	816,707	6,000,000
	CASH/IN-KIND	1,076,132	2,212,853	2,330,292	2,409,131	1,215,559	9,243,967
	TOTAL	**1,759,638**	**3,626,077**	**3,830,079**	**3,995,907**	**2,032,266**	**15,243,967**

**The total NERP expenditure for 2011-12 ($1,413,224 includes $316,494 carried forward from 2010-11)*

Research Partners

Australian National University
Murdoch University

Collaborators

Tasmanian Department of Primary Industries, Parks, Water and Environment (Alistair Scott, Manager Resource Management and Conservation)
Parks Victoria (Ian Walker, Deputy General Manager Parks)
Department of Environment, Climate Change and Water NSW (Dr Ian Pulsford, Manager Landscape Connectivity)
NRM North, Tasmania (James McKee, CEO)
Tasmanian Land Conservancy (Nathan Males, CEO)
Bush Heritage (Doug Human, CEO)
The Australian Alps Liaison Committee (Anthony Evans, Executive Officer)
Greening Australia (Dr David Freudenberger, Director Science and Major Projects)
Others to be determined as necessary and appropriate, including the ACT Government, Catchment Management Organisations in Victoria and NSW and, Local Government Authorities in Tasmania and Victoria, community groups and others involved in regional planning.

1.8 Links to other research programs

Lefroy was Principal Researcher of the CERF Hub Landscape Logic 2006-2010, collaboration between 13 institutional partners with 40 researchers, 10 postdoctoral fellows and 8 PhD students. That Hub involved links with the AEDA Hub led by Hugh Possingham through a jointly funded post doctoral fellowship and co-hosting the 2008 Fenner Conference on the Environment. He also led the biodiversity component of the Grain and Graze project, a national survey of the biodiversity value of agricultural landscapes funded jointly by the Meat and Livestock Australia, Australian Wool Innovations and Land and Water Australia and was on the board of LWA from 2005-2009.

Mackey is a member of the Cape York Peninsular Cultural and Scientific Committee advising the Queensland Government on areas of international conservation significance, lead author on a report to the NSW Government on the scientific basis for connectivity conservation in the Great Eastern Rangers and co-chair of the IUCN Council program and policy committee.

Bindoff lead the Climate Futures for Tasmania (CFT) project with 12 institutional partners. Climate Futures Tasmania project had 50 end user organisations and has resulted in policy changes on sea-level, water management, and communication tools on agriculture, water, climate extremes and ecological impacts. He is connected to international research on climate modelling through co-authorship of a chapter in the forth coming IPCC report.

Johnson has collaborative projects with the NERP Tropical Ecosystems Hub, chairs the Scientific Advisory Committee to the Save the Tasmanian Devil Program, leads an ARC project on the ecological consequences of devil decline, chairs the Australasian Marsupial and Monotreme Specialist Group for the IUCN Species Survival Commission, is a member of the Science Advisory Committee to the Australian Wildlife Conservancy and leads an ARC-Linkage funded study of the causes of small mammal decline across northern Australia and one on the effects of the dingo on Australian ecosystems.

Bowman was Principal Researcher of a CERF Significant Project with 3 institutional partners. He has served on the CERF Reference Group, AINSE Environment Committee and currently Kakadu National Park Research Advisory Committee. His research involves a close working relationship with Australian and State and Territory agencies including Health and Environment Departments in WA, NSW, Tasmania (ARC Bushfire Smoke Project), Wet Tropics Management Authority and DPIPWE Tasmania (ARC Rainforest Discovery Project), all nature conservation agencies (CERF *Callitris* project) and forestry agencies from WA, Victoria, Tasmania, NSW and Queensland (DAFF Climate Change project).

Davies has led several basin-wide projects for the MDBC and currently chairs the Sustainable Rivers Audit Group for the Murray Darling Basin Authority.

Lockwood has initiated and led several research projects addressing the socio-economics and governance of biodiversity and natural resource management – outcomes include enhanced design of incentive programs, socially-informed management plans and improved governance practice.

Moore has collaborated with all of Australia's protected area agencies and most state tourism organisations over the last decade through the 10 research projects with the Sustainable Tourism CRC. She is a governor with WWF Australia and a past member of their Scientific Advisory Committee

Tisdell has held senior external positions including Deputy CEO of the CRC for Catchment Hydrology, member of the Social Science network for UNESCO in Australia, and is currently a member of the Moreton Bay Scientific Advisory Board.

1.9 Communication, knowledge brokering, synthesis and analysis

Communication and knowledge brokering will be carried out through the *Communication and Knowledge Brokering* project with a staff of 4; the project leader and Hub director (Ted Lefroy), a full time communications manager based at the University of Tasmania (Suzie Gaynor) and two part time knowledge brokers. The project leader has responsibility for building and maintaining relationships with groups within the Australian Government, State Government agencies, regional NRM organisations, NGOs, local government, other groups and organisations involved in biodiversity planning plus Australian and international research groups undertaking similar work in biodiversity assessment and planning (particularly those in the UK, Europe and Canada). The communications manager will act as a knowledge broker between projects and themes within the Hub, and between the Hub and its research partners, and be responsible for developing the publication policies with the agreement of the Hub's partners and overseeing the Hub's publications and online resources.

The knowledge brokers Two regionally-based knowledge brokers will be appointed with a primary role of facilitating the exchange of knowledge between research teams and our partner organisations at regional scale. Appointments will be confirmed once the Hub's research plans have been approved, but we are in discussion with potential candidates who have long experience in the respective regions, have wide networks amongst environmental managers and planners, have worked in government, have good relations with the NGO and community conservation sectors and now operate independently. An important aspect of regional planning for biodiversity as it moves beyond research to become established practice will be processes for engaging the many different stakeholders from local government, regional organisations, community groups and industry. Establishing appropriate engagement processes for regional planning will be an important aspect of the social research in this Hub, and one that will be informed by the experience of the knowledge brokers through their roles of identifying the groups and organisations that need to be involved in consultation, those that are custodians of information, how they can be best engaged in the research process, and ultimately in regional biodiversity planning processes.

Breaking down barriers Studies of large interdisciplinary and transdisciplinary research groups (where unrelated disciplines come together with research users to solve problems) have identified several common barriers to effective operation. These are differences in institutional cultures and values, disciplinary language, the methods and rules of evidence accepted within different disciplines, the different reward structures and personal objectives of different teams members, and varying expectations of the research process and outcomes (Cash *et al*. 2003; Klein *et al.* 2008; Max-Neef 2005; Rogers 2006). An important internal role of the *Communications and Knowledge Brokering* team is to break down barriers between teams by recognising obstacles as they appear, diagnosing their cause and identifying remedies and preventative processes. This is especially the case in the area of biodiversity conservation and environmental management where biophysical and social processes are poorly understood, management decisions are commonly based on untested assumptions, assessments of value at all levels from species to ecosystems are highly subjective, and the planning process involves reconciling competing values and interests.

Similar obstacles can prevent effective communication with external audiences and an additional role of the knowledge brokers is to identify the Hub's different audiences, determine their preferred methods of communication, and prepare material designed to reach each audience most effectively. Our experience through the CERF program has been that scientists with prior management experience in state agencies are well suited to the role of knowledge broker due to their experience of the research process from different perspectives, and our recruitment is targeting people with this background and drawing on the research team's networks of experienced knowledge brokers in the field of biodiversity conservation.

Table 7. Framework for the Hub Science Communication Plan based on audience, purpose and communication method over the life of the Hub

Audience	Communication purpose and methods by project stage		
	Stage 1 Preliminary engagement, scoping, baseline data collection	Stage 2. Developing and testing scenarios	Stage 3 Interpreting social-ecological analysis
DSEWPaC			
Strategic Assessments			
Biodiversity Conservation			
Aquatic Ecosystems			
National Reserve System			
DAFF			
Land and Coasts			
ABARES			
Dept. Regional Australia			
State & Territory agencies			
DPIPWE			
Parks Victoria			
DECCW			
ACT			
Aust. Alps Liaison C'ttee			
Regional NRM orgs			
NRM North			
NECMA			
Southern Rivers			
Murray			
East Gippsland			
Local Government			
NGOs			
Other NERP Hubs			
Other research groups			

Audiences, engagement and forms of communication The first task of the Communications Manager will be to develop the Hub Science Communication Plan using the framework outlined in Table 7. The *Communication and Knowledge Brokering* project will also include the establishment and management of a database in consultation with the Environmental Information Resources Network (ERIN) within DSEWPaC to ensure that data format and metadata descriptions are compatibility with existing information networks and where appropriate can be made available to regional and other groups through existing portals. Each of the outputs of the Hub will be supported by a hierarchy of products designed to reach the many audiences for the Hubs research (Figure 1).

Australia's Biodiversity Conservation Strategy 2010-2020 (National Biodiversity Strategy Review Task Group 2009) identified 'Mainstreaming Biodiversity' as the second of its six national priorities. The aim of this priority is to 'demonstrate the importance of biodiversity to the sustainability of communities and the quality of our lives'. This Hub presents a unique opportunity to contribute to that aim by compiling the diverse range information collected by the Hub from primary and secondary sources in the process of conducting each regional case study into a highly accessible form. By synthesizing the knowledge acquired from datasets, local experience and other sources into a plain English narrative, we will produce a series of illustrated publications on '*The nature of..*' each case study region to portray its biodiversity, how it supports ecosystem services and contributes to social and cultural identify.

Analysis and synthesis *is a specific task of the Ecological Futures Theme described in section 2.2*

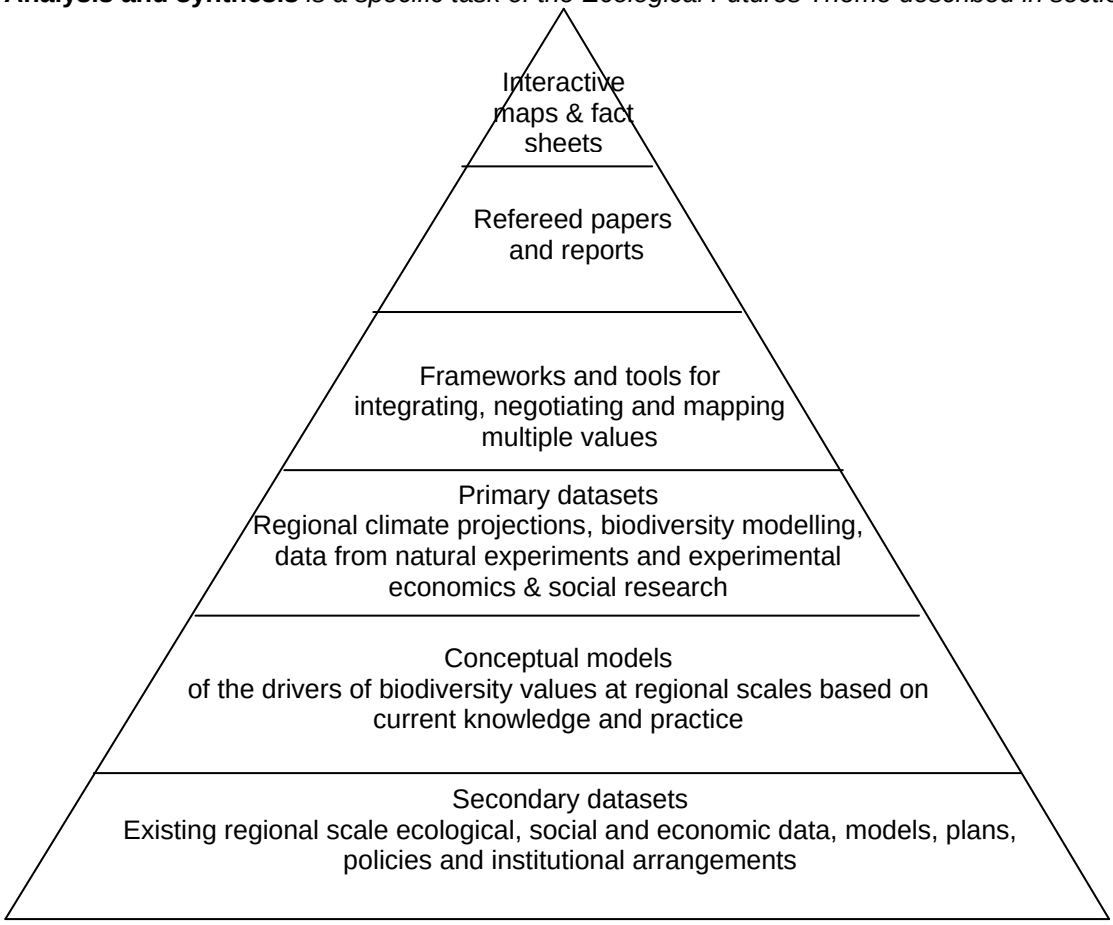

Figure 2. The hierarchy of products that will support the Hub's major outputs from 2013 and 2014, showing increasing integration and synthesis from bottom to top. A key output is the third level from the top, *Frameworks and tools for integrating, negotiating and mapping multiple values,* which represents proof-of-concept for integrated assessment and planning, supported by the levels below and validated and summarised by the levels above

1.10 Measuring success

To be developed in line with the forthcoming NERP Monitoring and Evaluation Strategy and Plan

2.0 Research Themes

2.1 Theme 1 – Communication

2.1.1 Theme Description

See section 1.9 - Communication, knowledge brokering, synthesis and analysis

2.1.2 Theme Activities

See section 1.9 - Communication, knowledge brokering, synthesis and analysis

Attachment A provides detailed information about each theme in the Hub over the life of the program. It describes expected outcomes, outputs (including services and products), performance indicators, timelines and links to end user requirements.

2.1.3 Theme Approach and Methods

See section 1.9 - Communication, knowledge brokering, synthesis and analysis

2.2 Theme 2 – Social and Economic Futures

2.2.1 Theme Description

	Project	Leader
Social & Economic Futures	2. Social & Institutional Futures	Michael Lockwood, University of Tasmania Sue Moore, Murdoch University
	3. Economic Futures	John Tisdell, University of Tasmania

2.2.3 Theme Approach and Methods

In Stage 1, the 'fitness for purpose' of the current nature conservation regime will be examined using ABS data, social surveys and an expert panel. Elements to be assessed include

i) planning and assessment processes and instruments (IBRA framework and associated CAR reserve prioritising and selection procedures; current and proposed nature conservation provisions of the EPBC Act; state threatened species, environmental assessment, land use planning and protected area legislation; and regional planning systems);
ii) institutions that make up the multi-level and polycentric system of nature governance in Australian (national, state/territory, regional, local – public, private, NGO, community-based); and
iii) instruments including covenants, management agreements, voluntary wildlife conservation programs and data on the efficacy of MBIs derived from the *Economic Futures* project.

Having identified limitations, gaps and deficiencies, the panel will then suggest potential reforms and innovations. In Stage 2, promising institutional designs, policy approaches and planning instruments will be explored in detail in regional scale case studies by assessing the influence these interventions have on the potential outcomes identified in ***Ecological Futures*** theme. The fitness of alternative policy regimes to meet the challenges of landscape-scale conservation will be assessed, as will the institutional structures that support them. Findings from analysing the socio-ecological systems models in the ***Ecological Futures*** theme will be compared with those from qualitative scenario planning to provide corroborative evidence. This will allow assessment of institutional designs, policy approaches and planning instruments on future system trajectories. Interviews with key informants from local, regional, state and national institutions will be used to test the credibility of the findings. In Stage 3, regional community surveys will be conducted to assess the likely acceptability and uptake of policy options amongst various landholder segments. In conjunction with socio-economic impact data from the *Economic Futures* project, this will enable us to identify acceptable and effective policy regime options.

The *Economic Futures* project in this theme will involve three main areas of research and application. The first is to collect on the effectiveness of different policy instruments and interventions, such as environmental water allocations, on structural unemployment and other social and economic indicators. These data will feed into the development of bio-economic models of spatially connected conservation areas, analysis of an environmental reparation fund, and design options for a national 'Biobanking' scheme. The second stage will involve regional-scale economic and social surveys of community values and attitudes towards regional conservation planning. The survey data will complement the social and economic indicator data collected in the first phase and provide a comprehensive view of bioregional management options and insights into effective and practical engagement processes. The final stage will be in two parts. First, the regional economic and social impacts of promising policy options identified in the *Social and Institutional Futures* project will be assessed using input-output models and social impact assessment. Second, calibrated bio-economic models will be developed and an assessment made of an environmental reparation fund and national 'Biobanking' scheme using experimental economics. The use of economic mechanisms for land management change have provided tangible outcomes and an established method from which to move on to management of more complex ecosystems that take into account functional connectivity and isolation. The bio-economic model will provide the frontiers from which to evaluate bio-banking and fund management options. The experiments will provide a means of evaluating the options under controlled conditions. The novel aspect to this research is that we will be exploring the application of market based instruments to securing more spatially connected conservation outcomes, funded through an environmental reparation fund in an Australian context. The survey, data collection, modelling and experimental design will be done in consultation with key industry stakeholders to ensure buy-in and final ownership of the results. The theme will directly contribute to the Hawke review recommendation to "...set up an Environment Reparation Fund and national 'Biobanking'"

2.3 Theme 3 – Ecological Futures

2.3.1 Theme Description

	Project	Leader
Ecological Futures	4. Bioregional Futures	Brendan Mackey, Australian National University
	5. Climate Futures	Nathan Bindoff, University of Tasmania
	6. Wildlife	Chris Johnson, University of Tasmania
	7. Vegetation & Fire	David Bowman, University of Tasmania
	8. Freshwater Systems	Peter Davies, University of Tasmania

2.3.2 Theme Activities

The ***Ecological Futures*** theme consists of 5 biophysically based projects that will make use of a wide range of existing environmental datasets from sources including the Atlas of Living Australia, BoM, ABS, the CERF program, State Agency partners, other agencies and long term primary datasets held by the research team to develop conceptual models of biodiversity status and trend in each region. These will operate in parallel for the first two and a half years within their own discipline areas, and then integrate their results in the last year to identify the key drivers including land use change, climate change, and demographic change and likely biodiversity response variables using a range of socially desired and legislated conservation outcomes as the end points. Social and economic research being conducted in parallel in the ***Social and Economic Futures*** theme will collect historic data on the effectiveness of different policy instruments, planning schemes and management interventions in this region along with their social and economic impacts to validate the social and economic assumptions in the regional models.

2.3.3 Theme Approach and Methods

This theme will also test some of the key biophysical assumptions that currently underpin large scale conservation efforts by designing natural experiments. The first stage would be to select communities and key species within a range of taxa that could serve as bio-indicators of larger scale biodiversity values based on their local significance, ecological function, amenability to study, availability of data, relevance to existing large scale private and public conservation projects across multiple tenures and their value as model organisms or communities in other regions and landscapes. For example, an appropriate focus of study might be river red gum communities and fish assemblages of the Murray River. A conceptual model will be built to represent the likely response to environmental and social change at regional scale. Natural experiments to test these assumptions can then be set up by identifying river reaches or tributaries with different histories of flow regime, flood plain management and timber harvesting. Species and community condition such as stand structure, recruitment and growth parameters will be measured along these gradients in a stratified study to indicate the likely responses to different management regimes. Regional scale climate surfaces will meanwhile be generated by the *Climate Futures* project at a scale of ~10 km ^{2} and the modelling outputs and the results of the natural experiments will then be used to test the assumptions in the ecological models. These models will then be used to produce plausible trajectories for these species and communities under different environmental conditions in response to different management interventions and policies levers.

Analysis and synthesis. A key role for this theme is to identify, and modify and adapt as necessary, integration frameworks suitable for dynamic analysis of multiple layers of spatial data in real time. These data will range from empirical data on species distribution and abundance, likely community response to management interventions, environmental variables, household and property level social and economic data, policy and management goals and public opinion. The integration framework will have a dual role as both a research tool to develop spatial indices of ecological, social and economic value, and a facilitation tool to enable discussion, interpretation and problem solving amongst stakeholders (see Figure 2). While an integration framework such as that shown can aid the resolution of multiple values, the utility of the output will depend on the process used to select input layers and assign weightings, as well as spatial resolution and data quality.

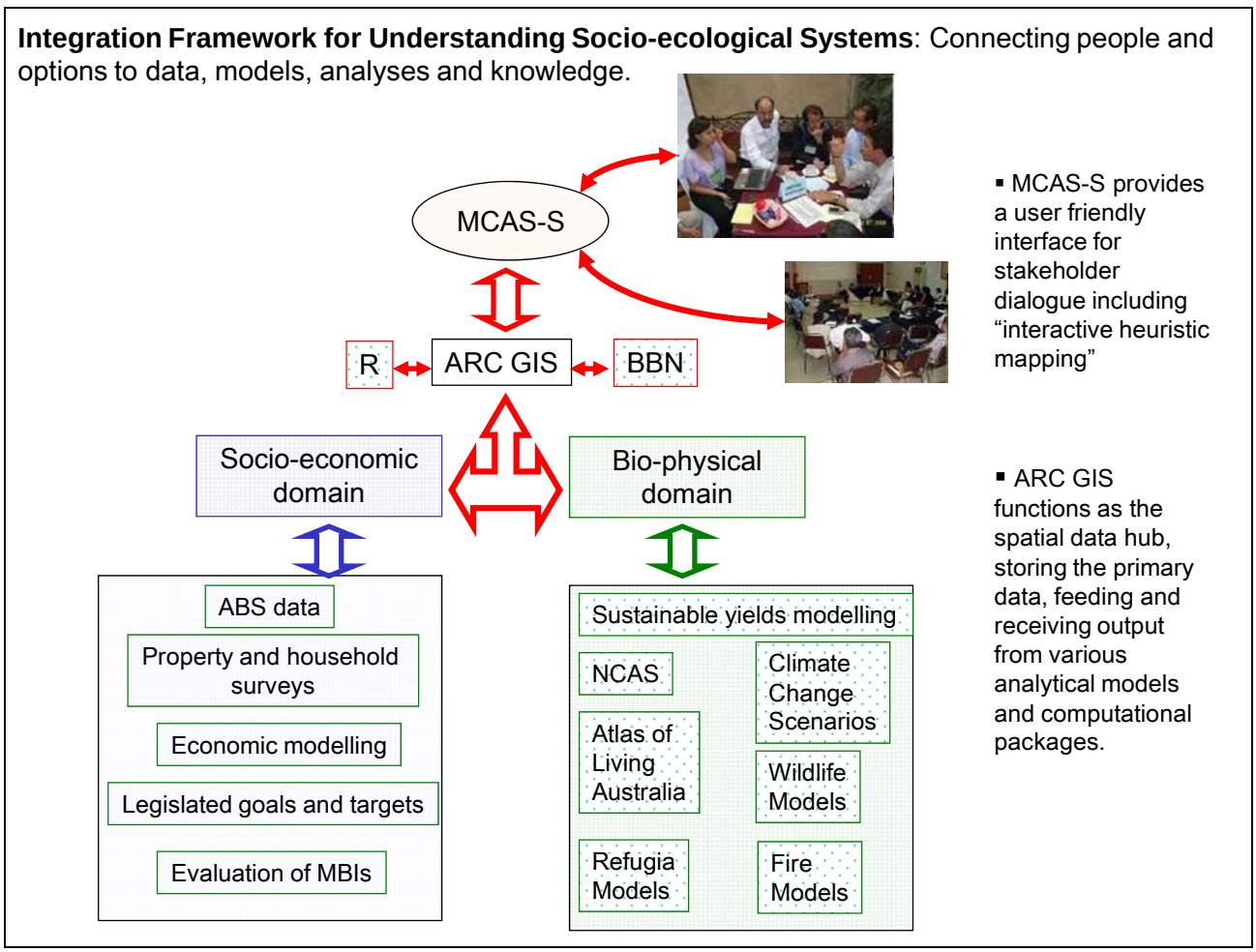

Figure 2 Example of the type of integration framework being considered for use by the Hub, in this case built around the MCAS-S (Multiple Criteria Analysis Shell) for spatial decision support developed by ABARES. The ***Social and Economic Futures*** theme will identify policy, planning and institutional measures to support biodiversity conservation at regional scale based on historical analysis of past response, scenarios of alternative arrangements, and structured engagement to discuss and analyse response to the scenarios.

3.0 Research Projects

3.1 Project Activities

Attachment B provides a summary of each project over its life including links to policies and programs, indicative budget and timelines. Below is more detailed information about each project including research questions, outcomes and outputs.

Table 8. Research projects in the Landscapes and Policy Hub

Theme	Project	Leader
Communication	1. Communication & Knowledge Broking	Ted Lefroy
Social and Economic Futures	2. Social & Institutional Futures	Michael Lockwood & Sue Moore
	3. Economic Futures	John Tisdell
Ecological Futures	4. Bioregional Futures	Brendan Mackey
	5. Climate Futures	Nathan Bindoff
	6. Wildlife	Chris Johnson
	7. Vegetation & Fire	David Bowman
	8. Freshwater Systems	Peter Davies

The research activities in projects 2 to 8 in the above table are described here under five headings; ***Research Questions, Input Data, Activities, Outputs*** and ***Audiences***. Outputs are described in a generic sense, with specific outputs for each project by year shown in Tables 2-5, pp. 5-7.

PROJECT 2 SOCIAL & INSTITUTIONAL FUTURES (MICHAEL LOCKWOOD AND SUE MOORE)

The proposed study areas for this project will be 1. The *Upper Murray Basin* (comprising Towong, Alpine, Indigo (southern part) and Tumbarumba LGAs, which includes (i) northern and western catchments of sub-bioregions AA1 Australian Alps and AA2 Victorian Alps; (ii) those parts SEH2 Highlands Northern Fall within Alpine and Indigo LGAs; (iii) those parts of SEH14 Bondo; and NSS1 Northern Inland Slopes Upper Slopes and within Tumbarumba LGA, and 2. The *Northern Midlands Bioregion* comprising parts of Northern Midlands, Southern Midlands and Meander Valley LGAs. This will allow comparison of a strict bioregional approach with a multi-LGA/CMA approach.

Social and Institutional Futures 2011-2012

Specification of the current institutional, social and economic conditions relevant to biodiversity conservation in the two study regions

Research Questions

What are the key institutional, social and economic drivers of biodiversity conservation in study regions?
What are the most appropriate indicators for describing or measuring these drivers?
What data are already available for these indicators?
What data gaps do we need to fill by primary data collection, and is this feasible?

Input data

Government legislation and policy
Land tenure, zoning, sub-bioregions
Resource sector, local government, regional NRM and conservation NGO documents (annual reports, plans and policy)
ABS Regional Profile data relevant to the social ecological systems model (see below) which may include: Agricultural Commodities, Agricultural Production, Assets, Building, Cattle, Cereal, Crops, Estimated Resident Population, Income, Industry Businesses, Irrigation, Occupation, Population Density, Population Age and Sex, Qualifications, Unemployment, Water Use
Primary surveys (attitudes, values and behaviours towards biodiversity; preferences for management approaches and outcomes)

Activities

In conjunction with projects 2, 3, 5 and 8, develop a social ecological systems model (2012-2035) for each study area (or parts thereof)
In conjunction with projects 2, 3, 5 and 8, review proposed study area boundaries as described above and adjust as necessary to encompass scales of key model variables
Collate and integrate descriptions and/or measurements of key institutional, social and economic indicators for the study areas (as determined by the a social ecological systems model) for an initial base period of 2009-2012
Undertake primary data collection where essential and feasible

Outputs

Spatial representation of key institutional, social and economic indicators for the study areas at as fine a scale as possible given the various scales of source data, for an initial base period of 2009-2012

Audience

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Social and Institutional Futures 2012-2013

Design of promising institutional, policy and planning reforms that address hypothesised biodiversity trajectories from Projects 2-6; and evaluation of potential uptake issues and barriers

Research Questions

What are the requirements for good and effective institutional, policy and planning regimes for system-scale biodiversity conservation?
Which institutional, policy and planning designs and methods show potential for meeting these requirements?
What are the potential uptake issues and barriers to reforming current regimes?

Inputs

Spatial representation of key institutional, social and economic indicators for the study areas
Analyses of promising institutional, policy and planning models from Australia and internationally
Academic literature on governance and planning design

Activities

Delphi (expert panel) process to identify requirements for good and effective biodiversity conservation institutional, policy and planning regimes

Workshops to develop promising regime designs

Workshops with biodiversity governance and planning institutions to identify potential uptake issues and barriers

Outputs

Promising and implementable institutional, policy and planning reform options for improving landscape scale biodiversity outcomes.

Audience

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Social and Institutional Futures 2013-2014

Evaluation of institutional, policy and planning reforms in terms of (i) likely efficacy of achieving desired conservation trajectories and (ii) institutional and social acceptability (see also Project 8). Projects 7 and 8 combined: Recommendations regarding sets of institutional, policy and planning reforms, including deployment of MBIs, likely to contribute to achieving societal preferences for biodiversity trajectories.

Research Questions

How responsive are the (i) institutional, policy and planning reform options; and (ii) MBIs; to the biodiversity conservation issues identified in Projects 1-6?

How acceptable are the promising and implementable institutional, policy, planning and MBI reform options to biodiversity conservation stakeholders?

Input Data

Data on biodiversity conservation values, issues and trajectories identified in Projects 1-6 for the two study areas

Activities

Scenario planning and/or Bayesian Belief Network modelling based on the social ecological systems models (2009-2035)

Stakeholder surveys

Outputs

Potentially useful, acceptable, and implementable institutional, policy, planning and MBI reform options for improving landscape scale biodiversity outcomes

Spatial representation of key institutional, social and economic indicators for the study areas at as fine a scale as possible given the various scales of source data, for the period of 2009-2035, showing the influence of policy, planning and MBI reform options

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Social and Institutional Futures 2014 (Third and Fourth Quarter)

Proof of concept for methods capable of assessing the likely effectiveness of alternative biodiversity conservation policies, institutional relationships, planning instruments and MBIs based on (i) an understanding of projected changes in ecosystem pattern and process and the conservation status of selected species and communities; and (ii) human wellbeing and the sustainability of regional communities. (Projects 2-8 combined)

Research Questions

What are the likely outcomes for (i) ecosystem pattern and process; (ii) the conservation status of selected species and communities; and (iii) human wellbeing and the sustainability of regional communities; from deploying the institutional, policy, planning and MBI reforms?

What are suitable indicators for enabling continuous learning and improvement?

Potential Input Data

Data for the study areas from Projects 1-8

Activities

Further scenario planning and/or Bayesian Belief Network modelling

Workshops with institutional stakeholders

Outputs

Potentially effective, acceptable, and implementable institutional, policy, planning and MBI reform options for improving landscape scale biodiversity outcomes

Spatial representation of key biophysical, institutional, social and economic indicators for the study areas at as fine a scale as possible given the various scales of source data, for the period of 2009-2035, showing the influence of policy, planning and MBI reform options

Indicators to support continuous regime learning and improvement

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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PROJECT 3 ECONOMIC FUTURES (JOHN TISDELL)

Economic Futures 2011-2012

Development of a conceptual landscape bio-economic model and associated experimental economics platform to evaluate policy options with a focus on MBIs

Research Questions

What need to be considered when developing landscape-scale market based mechanisms?

Are catchment/small scale bio-economic models and experimental platforms suitable for landscape scale management?

What modifications need to be done to existing models to inform policy at a landscape scale?

Activities

Review current experimental and bio-economic models for their applicability to landscape scale use
- experimental software for connectivity at a large landscape scale.
- agent based models at landscape scale management.

As needed, modify or develop new models and platforms to account for connectivity and alternative land tenures at a landscape scale.

Develop novel market base instruments to capture the objectives of biodiversity management at a landscape scale.

Outputs

Conceptual landscape bio-economic model and associated experimental economics platform to evaluate policy options with a focus on MBIs

Audiences

National state and local governments, resource sectors, regional NRM bodies, and conservation NGOs.

Economic Futures 2012-2013

Design economic instruments to promote landscape level biodiversity management. Calibrate the agent based models and experimental platforms to the case study regions (using data collected in program 7).

Research Questions

What economic instruments are suitable to promote landscape scale biodiversity in the study regions?

Is there sufficient private land tenure to apply MBI instruments?

Is there sufficient heterogeneity in private landholder land use to apply MBIs?

If not, what other economic instruments may be appropriate? (Pigovian taxes, group incentive payments etc.)

Which institutional, policy and planning designs and methods show potential for meeting these requirements?

What are the challenges and limitations in calibrating economic models at a landscape scale?

Input Data

Data at a regional and landholder scale on:

Land use

Land tenure

Gross margins (for agricultural land)

Rainfall and evaporation data

Biodiversity indices derived from projects 2-6 data

Activities

Calibration of conceptual models to case study region. This will require:

Identifying subregions where the application of economic instruments is suitable for promoting biodiversity activities predominately on private lands.

Linking land use data, land tenure data, physical landscape and weather characteristics with economic data on the returns to current and future land use.

Conduct ‘proof of concept’ simulations of economic instruments. This will require:

Modelling large scale auctions/tenders/group coordination activities.

Experimentation of alternative economic instruments, weather conditions and biodiversity metrics.

Outputs

‘Proof of concept’ results on the performance of alternative economic instruments in promoting biodiversity at a landscape scales.

Empirical economic analysis of different market mechanisms.

Audiences

National state and local governments, regional NRM bodies and conservation NGOs

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Economic Futures 2013-2014

Projects 7 and 8 combined: Recommendations regarding sets of institutional, policy and planning reforms, including deployment of MBIs, likely to contribute to achieving societal preferences for biodiversity trajectories. Projects 2-8 combined: Evaluation of institutional, policy and planning reforms in terms of (i) economic costs and benefits associated with achieving conservation trajectories and (ii) pilot testing MBI interventions in the study regions.

Research Questions

What do full landscape scale economic models tell us about the performance of economic instruments in promoting the conservation of biodiversity at a landscape scale?

How do key stakeholders and land managers react to alternative biodiversity policy options?

Activities

Full scale modelling at the whole of landscape scale using agent-based models

Experimental and demonstration sessions with key stakeholders in the field. This will involve holding workshops and field days in the regions with key stakeholders.

Outputs

Understanding of how economic instruments may perform at a landscape scale in the study regions.

A series of policy recommendations based on a formal and replicable quantitative data.

Audiences

National state and local governments, regional NRM bodies, conservation NGOs and key land managers in the study regions.

PROJECT 4 BIOREGIONAL FUTURES (BRENDAN MACKEY)

Bioregional Futures 2011-12

Spatial and temporal representations of landscape ecosystems and related biodiversity characteristics in the study regions,

Research Questions

At what scales can which landscape ecosystems characteristics be represented?

Which biodiversity metrics are most useful?

What data are already available and how can data gaps be filled within the constraints of the project?

Input Data and Models

Atlas of Living Resources spatial portal and GIS services (beta version now being tested)

IHACRES (catchment-scale rainfall-streamflow modelling methodology whose purpose is to characterise the dynamic relationship between rainfall and streamflow, using rainfall and temperature (or potential evaporation) data, and to predict streamflow); http://www.toolkit.net.au/IHACRES

NCAS (National Carbon Accounting System); http://www.climatechange.gov.au/government/initiatives/national-carbon-accounting.aspx

National land use and land tenure data; http://adl.brs.gov.au/mapserv/landuse/index.cfm?fa=app.loaddata&tab=loaddata

Activities

Representation of landscape ecosystem characteristics in terms of:

Stocks and flows of energy, water and nutrients;

Habitat resources and requirements of focal species;

Representation of biodiversity metrics in time and space (e.g. patterns of diversity, distribution and abundance of focal species and assemblages, Distribution and condition of vegetation communities; and

Patterns of tenure, land use and land management.

Outputs

Spatial representation of selected ecosystem characteristics and biodiversity metrics

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Bioregional Futures 2012-13

Identification of landscape area requirement special conservation management responses

Research Questions

Where are there important refugia areas?

Where are there important areas for maintaining and restoring critical landscape linkages?

What are the conservation management priorities given threats?

Input Data

Satellite-based remotely sensed data of vegetation productivity and land cover

Current native vegetation cover

Information on (a) vegetation condition and (b) threatening processes

Activities

Modelled and field tested techniques for identifying refugia (against drought, fire, climate change) for selected species, to be determined in collaboration with Projects 3, 4 and 5 and partners.

Mapped current connectivity gaps for focal species, determined in collaboration with Project 4.

The conservation status of landscapes, ecosystems and focal species and associated degrading and threatening processes identified for contrasting study regions

Outputs

Modelling and analysis of landscape-scaled conservation management issues.

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Bioregional Futures 2013-14

Potentially useful, acceptable, and implementable institutional, policy, planning and MBI reform options for improving landscape scale biodiversity outcomes

Research Questions

How responsive are the (i) institutional, policy and planning reform options; and (ii) MBIs; to the biodiversity conservation issues identified in Projects 1-6?

How acceptable are the promising and implementable institutional, policy, planning and MBI reform options to biodiversity conservation stakeholders?

Input Data

Data for the study areas representing the biodiversity conservation issues identified in Projects 1-6

Activities

Modelled potential impacts of climate change on fire regimes in Tasmania and the Greater Alps and consequences for vegetation, habitat resources and focal species including Evaluation of climate change impacts on (i) W (climatic water balance index) and (ii) Net Ecosystem Exchange (GPP, respiration);

Conservation management options identified for landscapes, ecosystems and focal species with respect to refugia, connectivity and degrading and threatening processes.

Comparative analysis of fire activity in mainland temperate forests to understand the climate, topographic vegetation and land management factors that cause mega fires and relate this knowledge to Tasmania to generate plausible fire risk scenarios

Comparative analysis of projected threats to persistence of vertebrates in the 2 case study regions under future spatial patterns of climate change and variability, likely changes in land use, exotic invasions etc.

The likely impacts of climate change on freshwater ecosystems in the 2 case study regions based on fine scale regional projections

Outputs Analysis of potential climate change impacts and conservation management options

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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Bioregional Futures 2014 (integrated analysis across Projects 2-8 combined)

Proof-of-concept for an approach to regional biodiversity planning based on projected changes in (i) ecosystem pattern and process and the conservation status of selected species and communities and (ii) human wellbeing and the sustainability of regional communities.

Research Questions

What are the likely outcomes for (i) ecosystem pattern and process; (ii) the conservation status of selected species and communities; and (iii) human wellbeing and the sustainability of regional communities; from deploying the institutional, policy, planning and MBI reforms?

What are suitable indicators for enabling continuous learning and improvement?

Input Data

Outputs from projects 2-8 for 2011-2013

Activities

Scenario planning and/or Bayesian Belief Network modelling

Workshops with institutional stakeholders

Outputs

Potentially effective, acceptable, and implementable institutional, policy, planning and MBI reform options for improving landscape scale biodiversity outcomes

Spatial representation of key biophysical, institutional, social and economic indicators for the study areas at as fine a scale as possible given the various scales of source data, for the period of 2009-2035, showing the influence of policy, planning and MBI reform options

Indicators to support continuous regime learning and improvement

Audiences

National state and local governments, resource sectors (agriculture, forestry, water, tourism), regional NRM bodies, conservation NGOs

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PROJECT 5 CLIMATE FUTURES (NATHAN BINDOFF)

Climate Futures 2011-12

Research Questions

What ecological indices can be best used with multi-model projections of future climate change in Tasmania?

What are the largest climate drivers (e.g. East Coast Lows, winds, temperatures, SAM, El Nino) of future ecological change in Tasmania?

Can a probability approach be used to estimate climate driven changes in ecosystems in Tasmania?

Input Data

From Climate Futures Tasmania CERF project, model output (17 different simulations), Software, and related tools for establishing analyses of Climate Futures for Tasmania outputs.

Activities

Working with project two, identify three key ecological indices can be used with climate projections (project 2 and 3).

Project the ecological indices from 1960 to 2100 for the Tasmanian region, using the Climate Futures for Tasmania simulations (project 2 and 3).

Assess the performance of the ecological indices for current climate (e.g. 1960 to 2010) over Tasmanian, taking into account terrain and spatial and temporal scales. The assessment would include comparison with the AWAP data. Assess the performance of the ecological indices for the 1960-1990 average climate (without consequences of climate changes: in effect a control simulation)

Prepare simulations for second chosen area (likely to be the Australian Alps, but explore options for covering whole of eastern Australia, or the whole of Australia)

Design simulations to include the requirements of LAP projects (Project 2,3,4,5 and 6 (if necessary)) and within resources, but including consideration of:

1. Control simulation in the absence of climate change (and to asses "natural variation", across an ensemble of simulations from GCM's controls
2. A2 emissions scenario, across ensemble of simulations from GCM's scenarios of climate changes
3. Consideration of downscaling models, preferring to choose more than one depending on resources (e.g. CCAM, UK met office downscaling package, or WHRF model.)
4. work with other groups within NERP and ARC Centre of Excellence in Climate Systems Science to collaborate on down scaling simulations.

Outputs

New multi-model estimates of future ecological projections for Tasmania as maps and times series.

Bias-adjusted or calibrated time series of current and future ecological projections for Tasmania (based on AWAP or similar observational data sets.

Initial simulations (based on design work) of the future and current climate for one GCM, and one downscaling model.

Audience 2011-2012:

The primary audience of the Climate Futures project is the other seven projects within LAP

Secondary audiences include associated projects, government, as well as NRM, conservation, water and policy managers

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Climate Futures 2012-1013

Research Questions

Focus on Australian Alps (or larger areas, resources permitting).

What ecological indices can be best used with multi-model projections of future climate change in the Australian Alps?

What are the largest climate drivers and processes for the future climate of the Australia Alps (e.g. East Coast Lows, winds, temperatures, SAM, El Nino) of future ecological change in the Australia Alps and or on Eastern Australia?

What does climate change mean for precipitation over the Australian Alps?

Inputs

LAP Climate Futures for Australia simulations (developed and implemented in previous year)

Reference ecological data sets and indices established for the reference period.

Software, and related tools for establishing the modelling and ecological responses.

Merging of climate model projections with repositories like Atlas of Living Australia.

Activities

Working with project two identify three key ecological indices can be used with climate projections in Australian Alps (and more broadly) (project 2 and 3).

Project the ecological indices, their means and extremes, from 1960 to 2100 for the Australian Alps, using the LaP Climate Futures for Australia simulations (project 2 and 3).

Assess the performance of the ecological indices for current climate (e.g. 1960 to 2010) over Australian Alps, taking into account terrain and scales. The assessment would include comparison with the AWAP data. Assess the performance of the ecological indices for the 1960-1990 average climate (without consequences of climate changes: in effect a control simulation)

Complete simulations for second chosen area as part of the LaP Climate Futures for Australia (using the agreed design from previous years work)

Outputs

New multi-model estimates of future ecological projections for Australian Alps as maps and times series.

Bias-adjusted or calibrated time series of current and future ecological projections for Australian Alps (based on AWAP or similar observational data sets.

Complete set of multi-model simulations of the future and current climate (based on design work and initial simulations of the previous year).

Audiences

The primary audience of the CF project is the other seven projects within LAP

Researchers at national and international conferences

Secondary audiences include associated projects, government, as well as NRM, conservation, water and policy managers on the mainland and as identified in the other projects.

Climate Futures 2013-2014

Research Questions

Focus on synthesis of climate projects for alpine areas of south eastern Australia, Tasmania and other Australia regions where appropriate.

1. What ecological indices can be best used with multi-model projections of future climate change in the Australian Alps.

2. What are the thresholds and tipping points in ecosystem responses to climate change projections.

3. How much has climate change already affected ecosystems, and what meteorological processes drive these thresholds.

Inputs

LAP Climate Futures for Australia simulations (developed and implemented in previous year)

Software, and related tools for establishing the modelling and ecological responses

Reference data (for reference period) sets in the extended sets of ecological indices, fire indices, rivers and related indices needed to establish calibrated projections of future indices.

Activities

Working with other projects identify transitions in ecosystems responses in projections of future climate in Australian Alps (and more broadly) (project 2 and 3).

Extend the ecological indices to fire and other applied indices from 1960 to 2100 for the Australian Alps and more generally, using the LAP Climate Futures for Australia simulations (project 2 and 3).

Assess the performance of the fire and other applied indices for the 1960-1990 average climate (without consequences of climate changes: in effect a control simulation)

Complete analyses of environmental indices for the Australian Alps as part of the LAP Climate Futures for Australia.

Outputs

new multi-model estimates of future ecological projections for Australian Alps as maps and times series.

Bias-adjusted or calibrated time series of current and future ecological projections for Australian Alps (based on AWAP or similar observational data sets.

Complete set of multi-model indices for the identified extensions of the future and current climate.

Publish the projected indices on repositories suitable storing and dissemination of these results.

Publish research papers of the consequences of climate change on environmental indices

Audience

The primary audience of the CF project is the other seven projects within LAP

Secondary audiences include associated projects, government, as well as NRM, conservation, water and policy managers on the mainland and as identified in the other projects.

Climate Futures 2014 (Quarter 3 and 4)

Research Questions

Focus on synthesis of climate projects for alpine areas of south eastern Australia, Tasmania and other Australia regions where appropriate. Questions include

What is the likely effectiveness of alternative conservation policies, institutional relationships and planning instruments based on an understanding of projected changes in ecosystem pattern and process, the conservation status of selected species and communities and human well being and the sustainability of regional communities?

Activities

Continue the provision of interpretation of Climate Futures of Australia simulation for the all projects.
Continue publication analysis and revision of research papers

Outputs

Research paper on critical thresholds in environmental indices for meteorological aspects of fire, species, and ecosystems.

Audience

The primary audience of the CF project is the other seven projects within LAP
Secondary audiences include associated projects, government, policy managers on the mainland and as identified in the other projects.

PROJECT 6 WILDLIFE (CHRIS JOHNSON)

The study area will initially be the whole of Tasmania. Distribution models will first be created, and patterns of concordance of habitat and climatic refugia examined, at this scale. Outputs will then be generated for particular regions, especially the Tasmanian midlands, for use in conservation planning at that scale. Subsequently, the approach will be extended to the Australian Alps. There will also be a comparison with the Wet Tropics bioregion, through collaboration with the NERP Tropical Ecosystems hub.

Wildlife 2011-2012

Research Questions

1. Can we predict fluctuations in the distribution and abundance of Tasmanian mammals at decadal and longer time scales?
2. Can we define and map key refugial areas, of high and stable environmental suitability, for Tasmanian mammal species? Do such areas function as genetic sources for surrounding sink populations?
3. For selected species of high and immediate conservation concern: what are the factors that determine distribution limits and the locations of stable refuges?

Input data

Primary data on species distributions the Tas DPIPWE Natural Values Atlas, plus:
Tas DPIPWE annual Statewide spotlight surveys
Location-specific records of occurrence and abundance from published research studies and unpublished fauna surveys
Weather and climate data: AWAP data; other outputs from LAP Project 3 [Climate Futures]
Vegetation and geological/soil mapping from other State and Commonwealth agencies

Activities

1. Select species for initial development of models and testing of models. These will be the Tasmanian bettong *Bettongia gaimardi* and the eastern quoll *Dasyurus viverrinus*. These are chosen because both are endemics with restricted distributions in Tasmania (predominantly in the east and midlands) and there are imminent threats to the status of both: the bettong is likely to be the species most sensitive to the impacts of the red fox; the quoll is currently in decline for reasons that are unclear (and will be investigated in part in this project], and is also likely to be highly susceptible to fox impact.
2. Compile distribution and habitat data for both species. Using standard distribution modelling tools (MaxEnt and others) with static environmental features plus variable weather as inputs, generate dynamic distribution models showing how suitability has varied across space for the last 50 years. Identify areas of stable high suitability, and important paths for maintenance of population connectivity for each species.

For the bettong, test for concordance of distribution of high stability with likely fox distribution. For the quoll, test weather variation as a cause of recent decline.
Project distributions forward over 50 years using down-scaled climate and weather data for Tasmania.
Compile existing genetic samples for the two species.
Recruit PhD student for genetics work.
Recruit Post-doc fellow for subsequent spatial ecology work.
Extend the modelling approach developed for the bettong and quoll to all other Tasmanian mammals.

Outputs

New distribution models (with map products) for the two test species, with areas prioritised according to their stability through time.
Prioritisation of areas for protection of bettong and quoll populations from the impact of invading red foxes.

First estimate of concordance of key spatial refuges across Tasmanian mammal species.

Audience

Conservation planners and wildlife managers in Tasmania (DPIPWE), through collaboration with DPIPWE science staff and formal reporting to DPIPWE.

The spatial ecology science community, through publication in the scientific literature.

Wildlife 2012-2013

Priorities for 2012-2-013 are to

Extend spatial modelling of species distributions, as developed in 2011-12, to other terrestrial vertebrates: remaining mammals, then birds, reptiles and frogs

Establish detailed goals and methods for genetics PhD, with collaborative links to DPIPWE

Wildlife 2013-2014

Priorities for 2013-2014 are to

Develop trophic network models, to include species interactions as determinants of distribution.

Apply systematic conservation planning tools to prioritise areas for conservation in Tasmania as a whole and the midlands in particular.

Extend data and analysis coverage to the Australian Alps.

Contribute to data integration and analysis with LAP Projects 2-6.

Wildlife 2014

Priorities for 2014, third and fourth quarters are to

Complete comparative analysis of patterns of concordance of habitat and climatic refugia with NERP Tropical Ecosystems Hub.

Final integration across Leap Projects 2-8.

PROJECT 7 VEGETATION AND FIRE (DAVID BOWMAN)

Vegetation and Fire 2011-2014

Research Questions

How does fire activity vary according to landscape, vegetation type, land tenure and management history, including grazing and burning, in two SE Australia settings (Tasmania and the Australian Alps)?

How can this fire history information be delivered to managers on the web for biodiversity conservation, infrastructure and emergency services planning?

Input Data

Use satellite data to measure fire activity

Consolidate existing GIS thematic layers

Validate satellite data using available fire data held by management agencies

Harmonize approach with current NASA collaborative project on giant fires and related field survey

The majority of the data will be in the form of satellite-derived products for the whole of Australia, and topographic GIS datasets obtained from state agencies for the respective study regions (Tasmania and Alps). The MODIS product is extremely useful in identifying fire hotspots on a daily basis from 2002 onwards, including fire intensity, and burnt area. LANDSAT products also provide a means of mapping large fires historically at a more broad temporal resolution, and can provide information on land-use change over time. Vegetation information will be collated from MODIS (providing broad-scale metrics of tree and herbaceous vegetation), the USGS Global Land Cover Categorization (GLCC), which provides globally standardised vegetation coverage information, and national and state-based vegetation mapping products, which while variable in their classification methods and coverage, provide genera- and species-level floristics and vegetation structure, which is useful for fuels assessment. Tenure and land management information will be obtained from state agencies. Dataset will be harmonised with current NASA grant studying giant fires across Australia.

Activity

Built GIS data bases for all data sets

Undertake statistical modelling and validation using field data

Built web delivery tool

Evaluate prototype web tool with end users

Two GIS databases, on for Tasmania, and one for the Australian Alps, will be created to store and manage the input data. These databases will be based on the Postgres/PostGIS platform, which allows connectivity with GIS and statistical software and the web, and import and processing of data in a common format. These databases will provide the backend for the web-based query tool, as well as the statistical analysis of the fire activity. We anticipate an extensive process of collating the data from the various sources and converting it to a standardized format, as well as manual fire identification from

LANDSAT imagery to increase the period over which we have fire data. Multi-model inference methods will be used to identify the set of drives that best predict landscape fire activity, based on the input data, including landscape type, vegetation type, tenure and management history. Models will be validated using field data across fire boundaries selected using environmental stratification techniques. Web delivery format will be modified following end user engagement and trailing of prototype.

Outputs

Database for analysis

Undertake preliminary analyses

Web based delivery tool for Tasmania

A web-based fire history tool for Tasmania, allowing users to view fire occurrence over Tasmania during the period of records, with other topographic and satellite imagery layers included. We anticipate this will be achieved using the Postgres/PostGIS database back end, and the Google Maps API for display. We will also produce GIS databases for Tasmania and the Australian Alps, including all input layers, fire history, and predicted fire activity (risk) models based on the fine scaled climate projections from Project 3, Climate Futures.

Audience

Close end user engagement throughout entire program with Australian government and state agencies

Scientists seeking information on historical fire activity in these two regions, and managers looking to assess fire risk across the landscape and in association with landscape characteristics are the prime audience for these outputs. End users will be engaged through the entire research cycle involving sourcing data, formatting data, structure and capacity of web delivery tool and validation of products with real field data.

PROJECT 8 FRESHWATER SYSTEMS (PETER DAVIES)

Freshwater Systems 2011-2012

Research Questions

What are the primary human drivers of river health in agricultural lowland and upland catchments, and their interactions?

What is the evidentiary basis for these drivers?

How do variations in these drivers (in space and time) under climate change influence the relative conservation value of river system components?

Input Data

Catchment and drainage features;

Infrastructure (dams, weirs etc.);

Ecological condition (macroinvertebrate, fish, algae, riparian vegetation);

Special values: threatened species and communities;

Land tenure and landuse.

Above data to be compiled as:

Spatial (GIS) data and layers for Tasmania and the Greater Alps regions (CFEV and Stein drainage layer and attributes, DPIPWE and X hydrological network layers; climate change projections for hydrological and temperature change; state and national listings);

Cause-effect ('gradient') evidence: published evidence and/or data sets across gradients of human impacts (hydrological change, fire history, landuse intensity, weir/barrier density etc) from both study regions.

Activity

Compile source (input) data on relationships between drivers (landuse, fire, flow regulation, temperature change, dams and barriers, diffuse pollution (nutrients and sediments)) and river ecological responses (algae, macroinvertebrates, fish, riparian vegetation). Include direct and indirect cause-affect relationships and all major interactions.

Data to be complied separately for both core regions (Tasmanian lowlands, Alps).

Conduct causal criteria analysis on evidence, compile and document.

Analyse driver-response relationships in multiple data sets using Bayesian Regression Tree analysis. Use models to check BBN model network structure and conditional probabilities.

Develop the integrated draft set of semi-quantitative Bayesian Belief Networks (developed from existing Landscape Logic BBN) within a qualitative model framework for both regions.

Develop a generic BBN or qualitative model based on the Tasmanian CFEV conservation value and prioritisation framework, using CFEV data and rule sets. Model to be applicable to both regions.

Develop the capacity to make this spatially explicit (link to a GIS platform, and conduct sequential iterative conservation value selections across the stream drainage network within a single catchment, and regionally).

Specific or Intermediate Outputs

Compilation and assessment of cause-effect evidence of human driver – river ecosystem responses, based on formal causal criteria;

Integrated semi-quantitative BBN model framework to assess responses to changes in human drivers under climate change (*BioResponse* model framework);

Bayesian Belief Network model for conservation value assessment and prioritisation (*Conservation Value* model framework);

Audiences

NRM managers

Jurisdictional catchment and water management planners.

Freshwater Systems 2012-2013

Research Questions

How do variations in human drivers of catchment change (in space and time) under climate change influence the relative conservation value of river system components, under specific scenarios?

What are the resulting risks to conservation value, and how do relative conservation values and priorities change (in space and time)?

Input Data

Models from Year 1;

Final cause-effect compilation from Year 1;

Spatial data as per Year 1;

Scenario information from Climate Futures and stakeholder organisations;

Activity

Test the integrated draft set of Bayesian Belief Network *BioResponse* and *Conservation Value* model frameworks against independent data sets.

Finalise and test the iterative conservation selection algorithm for the BBN-based *Conservation Value* model.

Link and fully integrate the *Bioresponse* and *Conservation Value* models using a spatially explicit GIS platform.

Select scenarios for climate change (and resulting hydrological and temperature changes); socio-economic responses to climate change and the resulting likely changes to human drivers of catchment change (irrigation and infrastructure development; land use change etc); within specific test catchments and regions (Tasmanian lowlands and Alps).

Run trial scenarios through the integrated model framework to evaluate implications for conservation value, risk and conservation management priority.

Outputs

Finalised cause-effect evidence compilation.

Spatial (GIS) model platform which integrates changes in human drivers at regional, catchment and sub-catchment scales with biological responses and conservation value, risk and priority.

Outputs of trial scenarios for selected catchments and at regional scale.

Audiences

NRM managers; jurisdictional catchment and water management planners.

Conservation planners.

Freshwater Systems 2013-14

Research Questions

What are realistic management options for catchment and water management authorities (given a range if policy environments) for reducing risks to conservation values and for achieving optimum conservation outcomes for aquatic ecosystems (rivers), at local, catchment and regional scales?

How do these options compare in terms of ecological condition and risk, relative conservation value and priority?

What are the key criteria for aquatic conservation refuges?

How can these be used to spatially locate optimum refuge locations (in space and time) in river networks?

Input Data

Compilation of management options for aquatic conservation (from NERP team and stakeholder organisation input) at range of scales;

Final scenarios (from Year 2);

Refugial characteristics (from NERP team scoping).

Activity

Identify range of potential management actions for aquatic bioconservation at sub-catchment, catchment and regional scales; including options for water management, landuse, land management, land tenure security change and bio-translocation.

Comparatively evaluate the effects of selected management options under the previously selected scenarios, for both the selected catchments and the regions, on the relative magnitude, extent and location of:

Ecological condition (for key components e.g. fish, vegetation);
Conservation value;
Conservation risk and priority.

Develop criteria for aquatic refugia (in line with team refugial criteria) and apply to spatial data for test catchments and regions.

Develop spatial prioritisation procedure to identify 'hotspots' for conservation value and risk;

Link spatial prioritisation with refugial locations at regional scale.

Outputs

Scoped sets of management options for climate change scenarios, rated by:

comprehensiveness of conservation outcomes and risk;
degree of alignment with socioeconomic responses to climate change;
intensiveness (as a surrogate for cost).

Identification of refugia at catchment to regional scales.

Audiences

NRM managers; jurisdictional catchment and water management planners

Conservation planners.

Freshwater Systems 2014

Research Questions

How do the sets of management actions required to achieve a measure of success in aquatic conservation align with results of socioeconomic responses to climate change?

What are the policy and planning implications of optimal sets of management actions required to achieve a measure of success in aquatic conservation?

What are the 'key messages' for aquatic conservation across a range of scenarios (and the two study regions)?

Input Data

Outputs of socioeconomic analysis conducted by NERP team (with workshop);

Outputs of modelling analysis of management options under scenarios from Year 3.

Activity

Link management options and conversation outcomes for each scenario with socioeconomic factors.

Describe policy implications for various successful combinations of management actions under range of climate change scenarios.

Develop simplified output and communication products – e.g. 'Scenario Factsheets'

Outputs

Full model suite, incorporating

Comprehensive analysis of management options under range of likely scenarios under climate change, for the two study regions.

Documentation of main outcomes for ecological condition, conservation value and risk, under a range of management options with climate change;

Identification of main implications for policy development and implementation.

Audiences

NRM managers

Jurisdictional catchment and water management planners.

Conservation planners.

Conservation and water management policy analysts.

4.0 Research Hub Administration

4.1 Leadership and Governance

Governance. The Hub is structured into eight disciplinary projects within three themes. The management of the Hub is overseen by a Management Committee comprising project leaders with representatives from collaborating organisations and knowledge brokers as necessary, chaired by the Hub Director. The

Management Committee meets monthly to oversee the exchange of information between research teams, partners and stakeholders; the financial management of the Hub; and the integration of component research to achieve delivery of outputs on time. Statements of roles and responsibilities for the Steering Committee, the director, the Management Committee, theme leaders and project leaders are available on request.

Administrative arrangements including contracting, project management, financial management and risk mitigation are the responsibility of the Director and administrative units within the University of Tasmania using the same institutional resources and processes that met the research and financial reporting milestones for the Landscape Logic CERF Hub.

Steering Committee The Steering Committee has been assembled to achieve three distinct roles; i) To ensure the alignment of the Hub's research to the policy needs and interests of DSEWPaC, ii) to connect the Hub's research questions, activities and outputs to relevant practical experience, research activity and policy initiatives outside the Department, and iii) to review the annual work plans and progress of the Hub and provide strategic advice on its general operation.

The Steering Committee met for the first time on 24 May 2011 and is scheduled to meet four times a year, two by teleconference and two face to face.

1. Chair, Barbara Norman, Foundation Professor of Urban and Regional Planning, University of Canberra
2. Geoff Richardson, Environment Research and Information Branch, DSEWPaC
3. Carolyn Cameron, Strategic Assessments Branch, DSEWPaC
4. Louise Gilfedder, Biodiversity Conservation Branch, DPIPWE
5. Pam Green, Chair Southern Rivers CMA
6. Stuart Cowell, Tasmanian Land Conservancy
7. Peter Jacobs, Chief Rangers Alps, Parks Victoria
8. Andrew Campbell, Charles Darwin University
9. Brendan Wintle, Deputy Director NERP Environmental Decisions Hub
10. Ted Lefroy, Director NERP Landscapes and Policy Hub, UTAS

Collaboration across the NERP program. An important task in for the Hub is identifying frameworks and approaches to integrate knowledge from different sources and disciplines in quantitative and qualitative form. This challenge will be shared by all Hubs in the program, and following discussions with Dr Nic Bax from the NERP Marine Biodiversity Hub, Dr Michael Douglas from the NERP Northern Australia Hub, Prof. Hugh Possingham from the NERP Environmental Decisions Hub and Dr Peter Doherty from the NERP Tropical Ecosystems Hub have agreed to establish relationships at three levels to exchange information on integration methods and other common challenges. Directors from other NERP Hubs will be invited to join our Steering Committee, researchers from other Hubs will be invited to attend cross-project meetings and annual science meetings to share their knowledge and experience of techniques in areas of common interest, and at the individual level, we will collaborate through jointly funded post doctoral fellowships, PhD scholarships and secondments. This approach was used successfully in the Landscape Logic Hub with a post doc shared with the AEDA Hub and a jointly funded PhD scholarship with the Environmental Economics Hub. These two shared positions allowed us to keep in touch with the thinking in other groups and facilitated the rapid spread of ideas and techniques. In one case, collaboration resulted in finding a resolution for a challenging issue in environmental management, setting quantitative vegetation condition targets within a practical management framework (Rumpff *et al.* 2011)

Leadership - balancing rigour and relevance. A major challenge for applied environmental research is that managers are looking for clear practical advice in a field that is characterised by huge knowledge gaps and uncertainty. Our philosophy in approaching the task of large scale planning for biodiversity is the importance of balancing rapid assessment methods with rigorous empirical investigation. While desk top approaches to the analysis of biodiversity can be extremely valuable in providing an overview of status and trend based on known major controlling variables, they offer no opportunity for surprise of the sort revealed by carefully targeted empirical science. While investigation into the evolutionary history of species, communities and landscapes and their response to past change provides no guarantee of responses to future change, it does equip us with an understanding of their trajectory, how they came to be where they are, which provides some measure of their adaptive capacity and the processes that ultimately underpin resilience. The techniques used in historical ecology can be very time consuming, but where they are carefully targeted at bio-indicators or model species with wide distributions it is possible to add the lessons of history to the challenge of planning. Having the available skills to marry historical understanding of ecological processes with the best available fine-scale climate forecasting and ecosystem modelling was a major consideration in bringing this group together. Taking a pre-emptive approach to biodiversity conservation requires the best available skills in looking back and looking forward so we can plot plausible trajectories for the species, processes and

human communities that biodiversity planning is designed to serve. Achieving this balance between rigour and relevance and between historical ecology and ecosystem modelling is central to the philosophy of this Hub.

4.2 Reporting requirements

Due date	Reporting Requirement
6 June 2011	• Provision of Draft Research Plan and 1st Annual Work Plan
7 July 2011	• Provision of final research plan and first Annual Work plan (first plan will cover up to 18 months and end December 2012).
1 November 2011	• Progress Report 1 and associated financial report (period covered: Start of project – 31 Sept 2011) • Audited financial report for 2010/11 financial year • Monitoring and Evaluation Plan • Science Communication Plan
2 April 2012	• Progress Report 2 and associated financial report (period covered: 1 Oct – 31 Dec 2011).
1 October 2012	• Progress Report 3 and associated financial report (period covered: 1 Jan – 30 June 2012) • Audited financial report for 2011/12 financial year • Annual work plan for 2013 • Updates (if required) to Hub Plans
1 April 2013	• Progress Report 4 and associated financial report (period covered: 1 July – 31 Dec 2012)
1 October 2013	• Progress Report 5 and associated financial report (period covered: 1 Jan – 30 June 2013) • Annual work plan for 2014 • Updates (if required) to Hub Plans
1 April 2014	• Progress Report 6 and associated financial report (period covered: 1 July – 31 December 2012)
1 October 2014	• Progress Report 7 and associated financial report (period covered: 1 Jan – 30 June 2014) • Audited financial report for 2012/13 financial year
1 April 2015	• Final Report and associated financial report
Within 60 business days of completion of the Activity	• Final audit report showing that no funds remain unspent is provided to and accepted by the Department

4.3 Risk Management

Identified risks	Proposed management strategy
Reputational risk	
1. Release of material in conflict with Hub partners' current policies or practice	All research results and products such as models, publications, and data sets will be developed in collaboration with users from DSEWPaC and collaborating state agencies and other organisations in accordance with a communications policy to be approved by the Steering Committee, with partners and collaborators notified of content prior to release.
2.Failing to engage with appropriate groups and organisations relevant to the two case study regions 3. Having engagement processes captured by special interest groups or otherwise failing to adequately represent key areas of knowledge and activity relevant to the project in the two case study areas	The project has been designed to occur in three stages (1. Preliminary engagement, scoping and baseline data collection, 2. Developing and testing scenarios, 3. Interpreting social-ecological analysis). The role of the regionally-based knowledge brokers in Stage 1 will be key to identifying those collaborators with whom the project team will then be collaborating with in Stages 2 and 3.
Delivery risk	
4. Inability to recruit post doctoral	All of the Hub project leaders manage active research

Identified risks	Proposed management strategy
fellows and PhD students	groups that attract high-level post graduate staff, and top-up scholarships will be used to attract the very best students.
5. Loss of key staff	Sufficient duplication of staffing will exist with several members in each team capable of delivering against the tasks in this work plan.
6. Work plan exceeds capacity to deliver	This work plan has been based on the capacity of the project team to deliver against the outputs.
7. Inter-dependencies between research activities	Project leaders, theme leaders and the Hub director will pay particular attention to managing interdependencies and establishing contingent arrangements in advance where outputs of one activity are inputs for another and are at risk of being delayed. For example, a major interdependency is the timely availability of fine scale climate projections for the Alps region. The projects that are dependent on this data have identified an alternative available source of regional climate projections for Australia, albeit at a courser scale, as a contingency. Similarly all project leaders have been asked to identify alternative sources where they are relying on primary datasets from other projects.
Social and Political Risk	
8. Sensitivities associated with listed species and communities in the two case study areas.	Social and economic assessments of the implications of different biodiversity conservation strategies will specifically focus on the impacts on private land owners of obligations under statutory planning and legislation. Management of this issue will be incorporated in the Communications Plan and the Hub Director and Communications Manager will be responsible for managing these sensitivities and bringing these issues to the attention of the research team.
Financial risk	
9. Funds not adequately accounted for	All contracts and sub-contracts are subject to external financial audit by the institutions concerned

Attachment A – Landscapes and Policy Hub Multi-Year Research Plan – Theme Descriptions (July 2011 - December 2014)

Attachment B – Landscapes and Policy Hub Multi-Year Research Plan Description – Project Descriptions (July 2011 - December 2014)

Landscapes and Policy Hub

Attachment A

Multi-year Research Plan Theme Descriptions (2011-2014)

Theme 1:

Communication

Theme leader: Ted Lefroy

Total budget: $3,310,688 (ex GST, includes partner cash and in-kind)

Total NERP funds: $1,239,413

Key expected outcomes

1. Short term outcome: The Hub Science Communication Plan provides adequate planning and support to foster engagement of end users from all levels of government, regional groups, community groups and NGOs.
2. Medium term outcome: The Theme supports constructive engagement of end users in the three stages of the research process (described in Table 7, p.14 Multi Year research Plan).

Key expected outputs

Senior Communications Manager employed July 1 2011. Hub Science Communication Plan submitted as Milestone 4 (1 November 2011). Two regionally-based knowledge brokers employed late 2011/early 2012.

Key risks

Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research questions (environment portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This theme is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Preparation of response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End users (name, title and section)

Carolyn Cameron and Margaret Considine (Strategic Assessment); Charlie Zammit (Biodiversity Conservation); Mark Taylor (National Reserve System); Judy West (Parks and Biodiversity Science); Paul Marsh (Aquatic Ecosystems and Health); Vicki Middleton (EPBC Taskforce); Damian McRae (Environmental Biosecurity)

Links and Dependencies to other hubs and projects

This Theme links all projects in the Hub to one another, to partners, stakeholders and other end users and to other Hubs. Links with other Hubs are through the Steering Committee and collaborative projects and co-funded appointments, particularly in the area of integrating spatial information and engagement process for incorporating local and regional knowledge and expertise.

Theme 2:

Social and Economic Futures

Theme Leader: Michael Lockwood

Total budget: $3,566,257 (ex GST , includes partners cash and in-kind)

Total NERP funds: $1,301,173

Key Expected outcomes

1. Approaches to examining the social and economic implications of managing areas of high natural value under a range of likely human and natural threats and opportunities that are systematic, empirically grounded and widely applicable.
2. Demonstration of how ecological data, social research and community engagement can be applied to biodiversity planning in two regional scale case studies.
3. Understanding of the effectiveness of incentive mechanisms aimed at encouraging biodiversity conservation on private land and designs for future mechanisms and planning instruments.

Key expected outputs

Evaluation of different scenarios of institutional, policy and planning reform in terms of (i) likely efficacy of achieving desired conservation trajectories (ii) institutional and social acceptability (iii) economic costs and benefits associated with achieving conservation trajectories and (iv) pilot testing MBI interventions in subsets of the two study regions. (see Outputs Table 4, p. 7 Multi Year Research Plan for details).

Key risks

1. Being able to develop effective processes for expert elicitation and stakeholder engagement.

2. Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research questions (environment portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

- ERIN Species Mapping Program

Key Events and Dates to Influence Policies

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Carolyn Cameron (Strategic Assessment); Charlie Zammit (Biodiversity Conservation); Mark Taylor (National Reserve System); Judy West (Parks and Biodiversity Science); Paul Marsh (Aquatic Ecosystems and Health); Vicki Middleton (EPBC Taskforce); Martin Riddle (Australian Antarctic Division).

Links and Dependencies to other hubs and projects

This Theme links all projects in the Hub to one another, to partners, stakeholders and other end users and to other Hubs. Links with other Hubs are through the Steering Committee plus

collaborative projects and co-funded appointments in the area of integrating spatial information and engagement process for incorporating local and regional knowledge and expertise.

Theme 3:

Ecological Futures

Theme Leader: Brendan Mackey

Total budget: $7,766,751 (ex GST , includes partners cash and in-kind)

Total NERP funds: $3,459,414

Key expected outcomes

1. Approaches to examining the social and economic implications of managing areas of high natural value under a range of likely human and natural threats and opportunities that are systematic, empirically grounded and widely applicable.
2. Demonstration of how ecological data, social research and community engagement can be applied to biodiversity planning in two regional scale case studies.
3. Understanding of the effectiveness of incentive mechanisms aimed at encouraging biodiversity conservation on private land and designs for future mechanisms and planning instruments.
4. Evaluation of the concepts of resilience and connectivity and their operational use in regional scale conservation planning and management

Key expected outputs

A systematic approach for identifying refugia likely to be effective against multiple threats for multiple species developed from the synthesis of Projects 2 to 6.
Systematic processes for identifying priority locations for protection, enhancement, connection, acquisition and remediation developed from the synthesis of Projects 2 to 6. (see Outputs Table 4, p. 7 Multi Year Research Plan for details).

Key risks

1. Developing a sufficiently rigorous, transparent and user friendly method for integrating multiple spatial values.

2. Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End users (name, title and section)

Carolyn Cameron (Strategic Assessment); Charlie Zammit (Biodiversity Conservation); Mark Taylor (National Reserve System); Judy West (Parks and Biodiversity Science); Paul Marsh (Aquatic Ecosystems and Health); Vicki Middleton (EPBC Taskforce)

Links and dependencies to other hubs and projects

A key role for this Theme is to develop integration methods that will enable dynamic analysis of multiple values in spatial form that are sufficiently transparent to encourage engagement of stakeholders, rigorous to be accepted by the research community and practical to be adopted by planners. As a common area across Hubs, it will be a focus for knowledge exchange and co-research.

Landscapes and Policy Hub

Attachment B

Multi-year Research Plan Project Descriptions (2011-2014)

Theme 1: Communication

Project 1

Communications and Knowledge Brokering

Project Leader: Ted Lefroy

Total budget: $3,310,688 (ex GST, includes partner cash and in-kind)

Total NERP funds: $1,239,413

Problem

The challenge for the Communications and Knowledge brokering theme and project is building participatory processes into the 3 stages of the research:

I. Preliminary engagement, scoping, baseline data collection

II. Developing and testing scenarios

III. Interpreting social-ecological analysis.

Key Expected Outcomes

1. Approaches to examining the social and economic implications of managing areas of high natural value under a range of likely human and natural threats and opportunities that are systematic, empirically grounded and widely applicable.
2. Demonstration of how ecological data, social research and community engagement can be applied to biodiversity planning in two regional scale case studies.
3. Understanding of the effectiveness of incentive mechanisms aimed at encouraging biodiversity conservation on private land and designs for future mechanisms and planning instruments.
4. Evaluation of the concepts of resilience and connectivity and their operational use in regional scale conservation planning and management

Key Expected Outputs

A Senior Communications Manager will be employed by July 1 2011. Additionally, a Hub Science Communication Plan will be submitted as Milestone 4 (1 November 2011) and two regionally-based knowledge brokers will be employed late 2011/early 2012.

Key Risks Assessment

Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research Questions Environment Portfolio

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

- ERIN Species Mapping Program

Key Events and Dates to influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users name title and section

Carolyn Cameron (Strategic Assessment); Charlie Zammit (Biodiversity Conservation); Mark Taylor (National Reserve System); Damian Mc Rae (Environmental Biosecurity); Kate Sandford Read-Head and Jeff Tranter (ERIN Landscapes Policy and Ecology)

Links and Dependencies to other hubs and projects

This Theme links all projects in the Hub to one another, to partners, stakeholders and other end users and to other Hubs. Links with other Hubs are through the Steering Committee and collaborative projects and co-funded appointments, particularly in the area of integrating spatial information and engagement process for incorporating local and regional knowledge and expertise.

Theme 2: Social and Economic Futures

Project 2

Social and Institutional Futures

Project Leader: Michael Lockwood and Sue Moore

Total budget: $2,044,718 (ex GST, includes partner cash and in-kind)

Total NERP funds: $723,586

Problem Statement

What are the key institutional, social and economic drivers of biodiversity conservation in study regions?
What are the most appropriate indicators for describing or measuring these drivers?
What data are already available for these indicators?
What data gaps do we need to fill through primary data collection, and is this feasible?

Key Expected Outcomes

Potentially effective, acceptable, and implementable institutional, policy, planning and MBI options for improving landscape scale biodiversity outcomes.

Key Expected Outputs

1. Spatial representation of key biophysical, institutional, social and economic indicators for the study areas at as fine a scale as possible given the various scales of source data, for the period of 2009-2035, showing the influence of policy, planning and MBI reform options.
2. Indicators to support continuous regime learning and improvement.

Key Risks Assessment

- Developing a sufficiently rigorous, transparent and user friendly method for integrating multiple spatial values

- Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research Questions Environment Portfolio

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science
- Aquatic Ecosystems and Health
- EPBC Taskforce
- ERIN Species Mapping Program

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Carolyn Cameron (Strategic Assessment); Charlie Zammit (Biodiversity Conservation); Kate Sandford Read-Head and Jeff Tranter (ERIN Landscapes Policy and Ecology)

Links and Dependencies to other hubs and projects

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs.

Project 3

Economic Futures

Proejct Leader: John Tisdell

Total budget: $1,521,539 (ex GST, includes partner cash and in-kind)

Total NERP funds: $577,587

Problem Statement

What economic instruments are suitable to promote landscape scale biodiversity in the study regions?
Is there sufficient private land tenure to apply MBI instruments?
Is there sufficient heterogeneity in private landholder land use to apply MBIs?
If not, what other economic instruments may be appropriate? (Pigovian taxes, group incentive payments etc.)
Which institutional, policy and planning designs and methods show potential for meeting these requirements?
What are the challenges and limitations in calibrating economic models at a landscape scale?

Key Expected Outcomes

A better understanding of the effectiveness of alternative economic instruments in achieving societal preferences for biodiversity under a range of plausible scenarios of environmental and social change.

Key Expected Outputs

1. 'Proof-of-concept' results for the performance of alternative economic instruments in promoting biodiversity at a landscape scales from experimental economics.
2. Empirical economic analysis of the past effectiveness of different market mechanisms designed to promote biodiversity conservation.

Key Risk Assessments

Developing a sufficiently rigorous, transparent and user friendly method for integrating economic and ecological values and representing them spatially. Managing the expectations and constructive engagement of numerous potential stakeholder groups at the appropriate times and incorporating their knowledge and experience in regional assessment and planning of biodiversity.

Research Questions Environment Portfolio

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats. v
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Charlie Zammit (Biodiversity Conservation), Hilary Schoefield (Planning, Tourism and National Landscapes)

Links and Dependencies to other hubs and projects

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs.

Project 4

Bioregional Futures

Project Leader: Brendan Mackey

Total budget: $1,627,539 (ex GST, includes partner cash and in-kind)

Total NERP funds: $683,587

Problem Statement

The major challenge for the Bioregional Futures project is to generate spatial and temporal representations of ecosystem processes at landscape and regional scale that can be shown to relate to biodiversity characteristics in the two study regions.

Key Expected Outcomes

1. Empirically grounded approaches to the regional assessment of biodiversity in the face of changing threats and opportunities.
2. Better understanding of how data, proxies, surrogates, models and integration tools can be applied to biodiversity planning at regional scale.
3. Information and tools that contribute to National Environmental Accounts and SoE reporting
4. Evaluation of the concepts of resilience and connectivity and their operational use in conservation planning and management.

Key Expected Outputs

Modelled and field tested techniques for identifying refugia (against drought, fire and climate change) for selected species, communities and MNES, determined in collaboration with the Climate Futures, Wildlife, Vegetation and Fire and Freshwater Systems projects and partner organisations.

Key Risks Assessment

Adopting or developing a sufficiently rigorous, transparent and user friendly method of dynamic analysis of multiple values in spatial form for both research (analysis of multiple benefits and interactions) and stakeholder engagement.

Research Questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

- ERIN Species Mapping Program

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Carolyn Cameron (Strategic Assessment) ; Kate Sandford Read-Head and Jeff Tranter (ERIN Landscapes Policy and Ecology)

Links and Dependencies to other hubs and programs

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs

Project 5

Climate Futures

Project Leader: Nathan Bindoff

Total budget: $1,941,095 (ex GST, includes partner cash and in-kind)

Total NERP funds: $853,669

Problem Statement

What ecological indices can be best used with multi-model projections of future climate change?
What are the largest climate drivers and processes for future ecological change in the 2 study regions (e.g. East Coast Lows, winds, temperatures, SAM, El Nino) ?
What does climate change mean for precipitation over the 2 study regions?

Key Expected Outcomes

1. Future trajectories for biodiversity in regional plans informed by the best available fine scale climate projections.
2. Better understanding of how climate change is likely to influence environmental indices.
3. Thresholds and tipping points in ecosystem responses to climate change projections.
4. How much has climate change already affected ecosystems, and what meteorological processes drive these thresholds.

Key Expected Outputs

New multi-model estimates of future ecological projections for the 2 study regions as maps and times series. Bias-adjusted or calibrated time series of current and future ecological projections for the study regions. Multi-model indices for extensions of the future and current climate. Publications on the projected indices and the consequences of climate change on environmental indices.

Key Risks Assessment

Completing the fine scaled climate projections in time for the other biophysical projects (2, 4, 5 and 6) to incorporate this data into their modelling and analysis. Fall back is to use currently available but coarser regional climate projections as a stop gap in the initial syntheses until the fine scaled climate projections are available.

Research Questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science
- Aquatic Ecosystems and Health
- EPBC Taskforce
- ERIN Species Mapping Program

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Damian McRae (Environmental Biosecurity); Carolyn Cameron (Strategic Assessment); Kate Sandford Read-Head and Jeff Tranter (ERIN Landscapes Policy and Ecology)

Links and Dependencies to other hubs and programs

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs.

Project 6

Wildlife

Project Leader: Chris Johnson

Total budget: $1,338,289 (ex GST, includes partner cash and in-kind)

Total NERP funds: $577,587

Problem Statement

How can we make best use of available data and models on the distribution and habitat suitability of mammals, birds, reptiles and amphibians to identify likely climatic refugia for multiple species and communities under scenarios of environmental change?

Key Expected Outcomes

1. Improved ability to represent likely distributions of multiple spp. under scenarios of environmental change based on
2. Refined distribution models that include the effects of weather-induced local scale variability.
3. Fine-scale mapping of stable refugia based on historical weather variability.
4. Projection of locations of refugia under future climate and weather scenarios.

Key Expected Outputs

New distribution models (with map products) for selected mammals, birds, reptiles and amphibians with areas prioritised according to their stability through time.
Prioritisation of areas for protection of multiple spp. First estimate of concordance of key spatial refuges across the 2 study areas.

Key Risks Assessment

Having fine scaled climate projections competed for the Australian Alps Study region in time for this and other biophysical projects (2, 5 and 6) to incorporate into modelling and analysis. Fall back is to use currently available but coarser regional climate projections as a stop gap in the initial syntheses until the fine scaled climate projections are available.

Research Questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

- ERIN Species Mapping Program

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Mark Taylor (National Reserve System); Judy West (Parks and Biodiversity Science); Charlie Zammit (Biodiversity Conservation); Damian McRae (Environmental Biosecurity)

Links and Dependencies to other hubs and programs

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs.

Project 7

Vegetation and Fire

Project Leader: David Bowman

Total budget: $1,521,539 (ex GST, includes partner cash and in-kind)

Total NERP funds: $577,587

Problem Statement

1. How does fire activity vary according to landscape, vegetation type, land tenure and management history, including grazing and burning, in Tasmania and the Australian Alps?
2. How can this fire history information be delivered to managers on the web for biodiversity conservation, infrastructure and emergency services planning?

Key Expected Outcomes

Improved understanding of the climatic, topographic, vegetation and land management factors that cause mega fires in the 2 study areas, generating plausible fire risk scenarios. Improved understanding of the likely interactions between climate, land management change, fire, water yield, carbon sequestration and biodiversity from analysis of historic data and application of fine scaled climate projections to the 2 study regions.

Key Expected Outputs

1. Modelled potential impacts of climate change on fire regimes in Tasmania and the Australian Alps and consequences for vegetation, habitat resources and focal species
2. Comparative analysis of fire activity in mainland temperate forests to understand the climate, topographic vegetation and land management factors that cause mega fires and relate this knowledge to Tasmania and the Alps to generate plausible fire risk scenarios.

Key Risks Assessment

Having fine scaled climate projections competed for the Australian Alps study region in time for this and other biophysical projects (2, 4 and 6) to incorporate into modelling and analysis. Fall back is to use currently available but coarser regional climate projections as a stop gap in the initial syntheses until the fine scaled climate projections are available.

Research Questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Judy West (Parks and Biodiversity Science); Mark Taylor (National Reserve System)

Links and Dependencies to other hubs and programs

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs.

Project 8

Freshwater Systems

Project Leader: Peter Davies

Total budget: $1,338,289 (ex GST, includes partner cash and in-kind)

Total NERP funds: $766,984

Problem Statement

1. What are realistic management options for catchment and water management authorities for reducing risks to conservation values and for achieving optimum conservation outcomes for aquatic ecosystems at local, catchment and regional scales?
2. How do these options compare in terms of ecological condition and risk, relative conservation value and priority?
3. What are the key criteria for aquatic conservation refuges?
4. How can these be used to spatially locate optimum refuge locations (in space and time) in river networks?

Key Expected Outcomes

Better understanding of the options available to water and catchment managers to conserve the biodiversity of aquatic ecosystems based on natural experiments and modelling studies of the relationships between land management and aquatic ecosystem condition.

Key Expected Outputs

Preliminary relationships established between past interventions, ecosystems process and the distribution and abundance of selected species based on modelling recent historical changes to water and land management in the Tasmanian Midlands and Australian Alps case study areas.

Key Risks Assessment

Having fine scaled climate projections competed for the Australian Alps study region in time for this and other biophysical projects (2, 4 and 5) to incorporate into modelling and analysis. Fall back is to use currently available but coarser regional climate projections as a stop gap in the initial syntheses until the fine scaled climate projections are available.

Research Questions (Environment Portfolio)

Q 1. Understanding the major drivers for maintaining biodiversity.
Q 2. Understanding ecosystem function and monitoring ecosystem health
Q 3. Maintaining/building resilience for future changing threats.
Q 4. Sustainable use of biodiversity and ecosystems.
Q 5. Biodiversity markets.

Policies and Programs

This project is relevant to the following department policies and programs:

- Strategic Assessment

- Biodiversity Conservation

- National Reserve System

- Parks and Biodiversity Science

- Aquatic Ecosystems and Health

- EPBC Taskforce

Key Events and Dates to Influence Policies and Programs

Launch of new 'high growth zone' strategic assessments project; Launch of National Wildlife Corridors Plan; Launch of next Caring for Our Country Business Plan; Launch of MDB Plan; Response to 'landscape and regional scale biodiversity planning' aspect of Hawke Review of EPBC Act.

End Users (name, title and section)

Ben Docker (Environmental Water Policy); Paul Marsh (Aquatic Ecosystems and Health), Damian McRae (Environmental Biosecurity)

Links and Dependencies to other hubs and programs

This project shares a task in common with other projects in other Hubs, namely to identify user friendly approaches to integrating spatial information and incorporating local and regional knowledge and expertise. This is expected to be an area for collaborative projects and co-funded appointments with other Hubs